Original Article

Does the presence of maxillary midline diastema influence the perception of dentofacial esthetics in video analysis?

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ABSTRACT

Objective: To evaluate the influence of a midline diastema on dentofacial esthetic perceptions of orthodontists, restorative dental specialists or prosthodontists, and laypersons in a frontal facial evaluation performed by means of video.

Materials and Methods: Two individuals aged between 20 and 25 years, one of each gender, with presence of a midline diastema were selected. An acrylic resin mockup was made of the maxillary anterior region, simulating ideal conditions of smile esthetics. Four standardized frontal view videos of the complete face were filmed of each individual in the following situations: with the ideal smile (unchanged mockup) and with the presence of midline diastemas of 0.5, 1.0, and 1.5 mm created by the mockup. In all videos, the patient said a certain sentence and, at the end, simulated a posed smile. Dentofacial esthetic perceptions of all four videos of each individual were evaluated by 51 orthodontists, 51 restorative dental specialists or prosthodontists, and 51 laypersons by means of visual analog scales. Data were evaluated using analysis of variance and Tukey post hoc test, with the level of significance set at 5%.

Results: The most attractive videos for all groups of examiners were those without diastema and with a diastema of 0.5 mm, for both the woman and the man. For a diastema of 1 mm or 1.5 mm, the dentofacial characteristics were considered unesthetic.

Conclusions: Diastemas equal to or greater than 1 mm negatively influence dentofacial esthetics in a frontal facial evaluation performed by means of video. (*Angle Orthod.* 2021;91:54–60.)

KEY WORDS: Midline diastema; Dentofacial esthetics; Video recording

INTRODUCTION

The esthetic appearance of the teeth is very important for psychological well-being and social interaction because it affects the way people perceive themselves and how they are perceived by society. Therefore, self-perception and esthetic concerns are considered the main reasons for which people seek orthodontic treatment.[1]

The presence of a midline diastema is one of the important features that may affect smile esthetics. The esthetic perception of diastemas is a topic not only widely discussed in the literature but also one that is a controversial subject in contemporary society.[2] The following is the key question posed by this debate: Does the presence of maxillary midline diastema influence the perception of dentofacial esthetics.[2] In other words, what is the threshold for orthodontists and laypersons when evaluating midline diastemas?

According to the literature, midline diastemas of up to 1 to 1.5 mm were not noticed by orthodontists,[3,4] whereas diastemas of up to 1.5 to 2 mm may not be detected by laypersons.[3,4] In recent research[5–8] evaluating the influence of dentogingival characteristics on facial attractiveness, it was found that the maxillary midline diastema had a significant negative influence on the perception of dentofacial esthetics.

The articles[3–5,7–10] found in which the influence of diastemas on the perception of smile esthetics was studied were conducted by means of digital simulations in photographs and, in most instances, using close-up smile images. Although manipulated photographs were the method most often used for evaluating the

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influence of different variables on smile esthetics, the use of video represents a more natural and faithful methodology because it enables one to view the true dynamics of dentofacial movement during speaking and smiling.[11–13] Therefore, the aim of this study was to evaluate the influence of midline diastemas on the dentofacial esthetic perceptions of orthodontists, restorative dental specialists or prosthodontists (RDSP), and laypersons in evaluations made by means of video analysis.

MATERIALS AND METHODS

This study was approved by the Research Ethics Committee of the Dental School of the Federal University of Bahia, Brazil, protocol 3.034.558. All volunteers received and signed the "Terms of Free and Informed Consent."

We used a pilot study conducted using a sample calculation made with data from 15 orthodontists, 15 RDSP, and 15 laypersons. Based on an alpha with a level of significance of .05 and a sample effect of 0.80, the calculation was made with the aim of attaining a power of 80%. The results showed that 51 individuals were required in each group of examiners.

Two individuals with harmonious facial characteristics and a midline diastema of 1.5 mm were selected, one male and one female, aged between 20 and 25 years. Impressions were taken for the purpose of fabricating mockups made of Bis-acrylic resin (Protemp 4, Bis-Acryl, 3M ESPE, Irvine, Calif), with the objective of simulating some characteristics of an attractive smile, such as adequate width/height proportions in the esthetic zone, convexity of the smile arc, a 1.5-mm step between the central and lateral incisors, gingival exposure of less than 1 mm, and progressive increases in the size of the incisal embrasures from the incisors to the canines.[2,13–15]

Subsequently, four standardized videos were made from the full-face frontal view of each individual in the following situations: with the ideal smile (unchanged mockup) and with the presence of midline diastemas of 0.5, 1.0, and 1.5 mm created by wearing the mockup in decreasing amounts of 0.5 mm, according to the method described in a previous study.[13] An interproximal space calibrator (Coraldent, São Paulo, Brazil) was used to check measurements (Figures 1 through 3).

The full-face frontal videos were obtained with the individuals in a standing position, with the Frankfort horizontal plane and bipupillary line parallel to the ground and with the midline sagittal plane in the direction of the operator. The same operator performed filming with an iPhone 8 (Apple Inc, Cupertino, Calif) in filming mode; the camera was fixed on a camera tripod. The individual-camera distance was 1 m under the same lighting conditions and with a resolution of 1080 pixels in high definition (HD).

To make the video, individuals were instructed to repeat a certain sentence that favored different levels of exposure of the maxillary anterior teeth.[12,13] The sentence in Brazilian Portuguese was as follows: "Tia Ema torcia pelo antigo time da Tchecoslováquia." The videos began with the individuals in the resting facial position and concluded in the position of a posed smile.[13] The duration of each film was 8 seconds.

The videos were edited using the Lightworks x64 program (Editshare LLC, Boston, Mass), with the aim of cutting excess at the beginning and end of the video and standardizing the brightness and contrast. In addition, all of the videos were altered to black and white to guarantee maximum standardization and to minimize the influence of the artificial effects of the mockups. After editing, the upper limit of the full-face video was established above the hair, and the lower limit was established below the chin (Figures 2 and 3).[13]

Subsequently, the videos were transferred to a 360° HP Pavilion tablet (Hewlett-Packard Company, Palo Alto, Calif) and evaluated by 51 orthodontists (22 male and 29 female, with mean ages of 36.14 years and 32.39 years, respectively), 51 RDSP (25 male and 26 female, with mean ages of 36.31 years and 32.21 years, respectively), and 51 laypersons (23 male and 28 female, with mean ages of 35.80 years and 33.33 years, respectively), all of whom had completed college education and had no dental background.[14–17] The order of appearance of the videos was determined randomly using Random Software (random.org).[13] To guarantee calibration and magnification of the videos, the width of the maxillary right central incisor, previously measured on the wax model, was used. This measurement was recorded and transferred to the tablet screen to maintain a magnification ratio of 1:1.[13–15]

Prior to showing the videos, the examiners were instructed by the researcher to evaluate the dentofacial esthetics of the individual in each film. Additionally, they were advised that they would be allowed to watch each video only once.

The examiners positioned themselves comfortably 1–1.5 m from the tablet, with the bipupillary line parallel to the screen. The examiners were given 5 seconds after the film was shown to evaluate it, and then the researcher automatically switched to the next video.[13]

The level of attractiveness determined for each video was recorded on a form with visual analog scales (VAS), one for each video.[18,19] On the printed rulers, the examiners were instructed to mark a point corresponding to the level of esthetic attractiveness portrayed in

Figure 1. Mock set-up: (A) initial occlusion; (B) after installation of mockup simulating ideal maxillary anterior dentition; (C) 0.5-mm diastema; (D) 1-mm diastema; and (E) 1.5-mm diastema.

each video. The visual analog scale was 10 cm long and on its extreme left had the words "very unattractive" and on the extreme right the words "very attractive." The distance between the mark made by the examiner and the leftmost point was measured with an electronic digital caliper (Orthopli Corporation, Philadelphia, Pa) and served as the measurement, in millimeters, of the score for each video.

In order to evaluate the reliability of the method, 20 examiners from each group were randomly selected and requested to evaluate the videos once more, 1 month after the initial evaluation. The difference this time was that two of the videos were identical.[13–17,20,21] The intraclass test was used to compare the scores of these two videos to determine the intraevaluator agreement. The concordance index was high, showing

Figure 2. Photos retrieved from the woman's videos: (A) without diastema and with (B) 0.5-mm; (C) 1-mm; and (D) 1.5-mm diastemas.

Figure 3. Photos retrieved from the man's videos: (A) without diastema and with (B) 0.5-mm; (C) 1-mm; and (D) 1.5-mm diastema.

a coefficient greater than or equal to 0.71 for all groups of examiners: 0.81 for the orthodontists, 0.73 for the RDSP, and 0.71 for the laypersons.

The data from each questionnaire were analyzed statistically using SPSS 16.0 (Statistical Package for Social Sciences; SPSS Inc, Chicago, Ill). The normality of the data distribution of the sample was verified with the Shapiro-Wilk test. To make comparisons among the videos with the different diastemas and to compare among the perceptions of the different groups, analysis of variance and Tukey post hoc test were used. For all analyses, a level of significance of 5% was considered.

RESULTS

For the woman evaluated, the most attractive videos to the orthodontists, RDSP, and laypersons were the one without a diastema and the one with a diastema of 0.5 mm, without a statistically significant difference between them. On the other hand, the video that received the lowest score for the orthodontists was the one with a diastema of 1.5 mm, while for the RDSP and layperson groups it was the videos with diastemas of 1.0 and 1.5 mm. When the three groups of examiners were compared, a statistically significant difference was found only for the video with a diastema of 0.5 mm, with the orthodontists assigning lower scores than were assigned for the other groups (Table 1).

Following the same tendency, for evaluations of the videos of the man, the most attractive videos were the one without a diastema and the one with a 0.5-mm diastema; the most unattractive were those with diastemas of 1.0 mm and 1.5 mm by all groups of examiners. In the comparison among the three groups of examiners, no statistically significant differences were found in responses to any of the videos evaluated (Table 2).

DISCUSSION

Many studies[3–11,13–24] have been conducted with the aim of determining ideal esthetic characteristics of the smile. Among these, special emphasis was given to the maxillary central incisors.[3–10,13–15,17,20,21] Although diverse clinical situations may influence these teeth, the presence of a midline diastema is a crucial

Table 1. Means and Standard Deviations (SDs) for Dentofacial Attractiveness of the Woman's Video

	Orthodontists (O)			Restorative Dental Specialists/ Prosthodontists (RDSP)			Laypersons (L)			O × RDSP × L
Diastema	Mean	SD	Result[a]	Mean	SD	Result[a]	Mean	SD	Result[a]	Result[b]
0	57.69	15.45	A	62.3	14.48	A	60.04	18.51	A	$P = .21$
0.5	48.38	16.41	A,B	61.78	15.69	A	60.36	17.36	A	O < (RDSP = L), $P < .01$[b]
1	40.82	17	B	44.83	17.48	B	45.77	21.29	B	$P = .37$
1.5	32.17	18.95	C	37.21	17.46	B	38.13	23.58	B	$P = .27$

[a] Variables with the same letter did not differ statistically ($P > .05$).
[b] Significant difference exists between groups of examiners ($P < .05$).

Table 2. Means and Standard Deviations (SDs) for Dentofacial Attractiveness of the Man's Video

	Orthodontists (O)			Restorative Dental Specialists/ Prosthodontists (RDSP)			Laypersons (L)			O × RDSP × L
Diastema	Mean	SD	Result[a]	Mean	SD	Result[a]	Mean	SD	Result[a]	Result[b]
0	52.02	17.47	A	55.71	18.06	A	56.08	19.21	A	$P = .30$
0.5	51.33	19.02	A	53.23	19.33	A	52.51	16.37	A	$P = .97$
1	37.25	18.15	B	41.31	17.77	B	41.51	19.88	B	$P = .59$
1.5	36.2	17.95	B	38.89	16.27	B	36.71	19.98	B	$P = .73$

[a] Variables with the same letter did not differ statistically ($P > .05$).
[b] Significant difference between groups of examiners ($P < .05$).

characteristic. The research[3–6,8–10,22] that studied the influence of these spaces on smile esthetics used digitally manipulated photographs.

Although this was the most commonly used method to evaluate smile esthetic perceptions, this type of analysis is two-dimensional and static. One previous study[13] evaluated the influence of the presence of asymmetry at the incisal edges of the maxillary central incisors on dentofacial esthetic perception. The use of video makes it possible to have a more complete and dynamic view of the face and smile, thereby more faithfully portraying exposure of the incisors during speech, simultaneously enabling the patient to be observed in a routine conversation.[23,25] Following this trend, instead of photographs, the current study used a method similar to that of a previous study,[13] using videos to evaluate the influence of a midline diastema on the perception of dentofacial esthetics, demonstrating the unprecedented nature of this study.

Another aspect of this study that showcased a contemporary method was the use of mockups.[13] Differently from creating diastemas by means of photo digital manipulation,[3–6,8–10,22] the mockups were manipulated, making a more realistic evaluation possible by means of having the subjects wearing the acrylic resin. Differently from a previous study,[13] color videos were not used because the mockup appearance could be considered as somehow artificial and could, therefore, have been a source of bias during the evaluation. That was why the videos were edited in black and white before being evaluated by the examiners.

Among orthodontists, RDSP, and laypersons, there was a tolerance of 0.5-mm diastema (ie, this diastema was not noticed by the examiners). In contrast, the videos with diastemas of 1.0 mm and 1.5 mm were considered unattractive, showing that a diastema of 1 mm or greater was evaluated negatively. These results were in agreement with those of some studies[5,8] that found that even a midline deviation of 1.0 mm negatively affected smile attractiveness. In contrast, the results were not in agreement with those of other studies[3,4] that found a different threshold for midline diastemas (ie, in other studies, midline diastemas of up to 1.5 to 2 mm were not perceptible by laypersons).

Following the same trend, the results of this study were not in agreement with the findings of some research[26,27] that portrayed the presence of a midline diastema as a sign of beauty and that concluded that, given the appearance of these diastemas in models who appeared in women's magazines, they were acceptable. Once again, the current study showed that, in a dentofacial esthetic evaluation, videos with diastemas of 1 mm or more were negatively evaluated.

An interesting aspect of this topic is that there seems to be a consensus in the scientific literature with associating the midline diastema with an unattractive characteristic of the smile. However, the threshold for the diastema width is still controversial. Selections regarding the type of photography used, groups of evaluators, and cultural preferences seem to exert influence on the threshold differences. In addition to this discussion, this study used a new methodology for assessing the influence of midline diastemas on smile esthetic perceptions.

This study has great clinical application to both orthodontists and RDSP, with the aim of using this article to guide patients with regard to the negative esthetic influence of these diastemas. It may also serve to guide dental esthetic treatment planning, since these diastemas could be closed by means of orthodontic treatment and/or cosmetic restoration. However, although those treatment strategies are well documented in the literature, from an esthetic standpoint an interesting question can be asked: Is it necessary to close a slight diastema? If orthodontists, RDSP, and laypersons cannot recognize a 0.5-mm midline diastema as unattractive, why should dental specialists need to treat it? In other words, the treatment of a 0.5-mm midline diastema might reflect an exaggerated concern by dental specialists rather than an esthetic need unless it is part of the patient's chief complaint.[4,14–17]

Many studies[3–5,7–10,22] have approached the esthetic perception of midline diastemas using the image of one single individual. In this study, the design approached

the dentofacial esthetic evaluation of two individuals, a man and a woman, which provided a broader view about the influence of this variable in dentofacial esthetics.[15,16,18,20]

The examiners consisted of orthodontists, RDSP, and laypersons. The first group was selected because previous studies[4,18,19] showed that they were the most sensitive group in detecting deviations from ideal. The RDSP group was included because both of the specialists within this group work directly with esthetic restorations in the esthetic zone. The layperson group was chosen because they represent the target public for dental treatment. Differently from some studies[3–7,10,13,15–17,21] that showed that orthodontists were more critical, attributing lower esthetic scores overall, in this study in almost all situations there were no statistical differences in the scores among the three groups. Only for the woman's video with a diastema of 0.5 mm were the orthodontists shown to be more rigid, attributing lower scores to her appearance.

It is important to point out that since videos of two individuals were used, a man and a woman, and because the opinions of specific groups of examiners were collected, the results should be analyzed carefully. Therefore, as affirmed by Kokich et al.,[4] since the results and conclusions were based on mean values it is difficult to generalize this information to all patients because of the subjectivity of evaluation of dentofacial esthetics. Therefore, these results must be discussed with patients who will undergo esthetic dental treatments, particularly those related to midline diastemas, and individualized esthetic treatment planning should be considered. Further studies using this methodology[13] could yield more information with regard to the influence of midline diastemas and other characteristics on dentofacial and/or smile esthetics perception.

CONCLUSIONS

- The results showed that the presence of a maxillary midline diastema highly influenced the perception of dentofacial esthetics in video analysis. The most attractive videos were those involving a patient without a diastema and with a 0.5-mm midline diastema, as evaluated by orthodontists, RDSP, and laypersons, whereas videos with a 1-mm diastema or greater were evaluated as unattractive.
- In general, there was no significant difference in perception among the three groups of examiners. Only relative to the woman's video with a diastema of 0.5 mm did the orthodontists attribute lower scores than were attributed to the other groups.

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