Esthetic effect of orthodontic appliances on a smiling face with and without a missing maxillary first premolar

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Introduction: In this study, we evaluated the effects of orthodontic appliances and an extracted maxillary first premolar on the esthetic evaluation of a smiling face according to the perceptions of orthodontists and laypeople.

Methods: Standardized oblique photographs of a young woman with a pleasing smile were taken. The photos were edited by using digital imaging software to produce 10 combinations of presence or absence of orthodontic appliances with either esthetic or metal brackets, rubber bands of different colors, and presence or absence of the maxillary first premolar. Two groups of 50 observers each, 1 of laypeople and the other of orthodontists, evaluated the images and assigned esthetic scores to the smiles according to a visual analog scale.

Results: The presence of orthodontic appliances and metal brackets, regardless of rubber band color, had no negative effect on the esthetic evaluation of the smile by either group. Appliances with esthetic brackets were significantly less pleasing for laypeople, whereas for orthodontists they did not affect the esthetic evaluation of the smile. The extraction space had a significantly negative effect on the evaluation of the smile, and only orthodontists thought that the appliance minimized its effect.

Conclusions: The type of bracket used with the orthodontic appliances and a maxillary first premolar extraction space produced different esthetic perceptions in laypeople and orthodontists. (Am J Orthod Dentofacial Orthop 2009;135:S55-60)

The appearance of a smile has direct implications on facial esthetics and attractiveness and, consequently, on a person’s social interactions. Several studies identified factors that cause a smile to be perceived as beautiful, despite the subjectivity of the concept of beauty. Studies to evaluate esthetics must deal with inherent difficulties, but there is consensus that the position and the curvature of the upper lip, the maxillary anterior incisal curve parallel to the lower lip, the relationship between maxillary anterior teeth and lower lip, and the number of teeth displayed affect the esthetics of a smile. The latter factor is relevant for orthodontic practice because extractions are routinely prescribed during orthodontic treatment; this temporarily decreases the number of teeth displayed in a smile. Extraction spaces can be visible and, thus, affect the attractiveness of a smile. Therefore, orthodontists, who are also concerned with improving the esthetics of a smile, might temporarily worsen esthetics when extractions are prescribed because the space will cause a negative effect for several months.

Patients often seek orthodontic treatment for esthetic reasons; they can be disconcerted by the suggestion to extract teeth to correct the malocclusion and even resist treatment. The interaction between the space created by extractions and the fixed metal or esthetic appliance might mitigate esthetic problems. However, no studies have investigated this possible interaction, and a review of the literature yielded no studies about the impact of orthodontic appliances on smile esthetics. Moreover, large investments are made by dental material manufacturers to develop and sell orthodontic appliances that are increasingly less visible, but evidence of the attractiveness of these appliances is not available in the literature.

The purpose of this study was to evaluate the effect of fixed orthodontic appliances on a smiling face with and without a missing maxillary first premolar.
in the perception of orthodontists and laypersons. The specific objectives were to analyze the esthetic effects of metal and esthetic brackets, various colors of elastomeric ligatures, and a maxillary first premolar extraction space on a smiling face.

**MATERIAL AND METHODS**

This study was approved by the Ethics and Research Committee of the School of Medicine of the Universidade de Brasília, Brasília, Brazil. Volunteers who agreed to participate in the study and to be photographed or to participate in the evaluation panel signed informed consent forms.

A female volunteer with an attractive smile was photographed in the lateral oblique view with an SLR camera (EOS D-60 digital, Canon, Oita, Japan) with a 100-mm macro lens. Fixed metal (Morelli, São Paulo, Brazil) and polycarbonate esthetic orthodontic brackets (Spirit, Ormco, Glendora, Calif) were temporarily bonded on the dental surfaces of the maxillary arch without acid etching. For the simulated bonding of the appliances, Transbond XT (3M Unitek, Monrovia, Calif) adhesive and resin were used. An 0.018-in archwire was used as a reference for positioning of brackets.

Photos of the volunteer’s face were taken in 5 situations: without an orthodontic appliance; with fixed metal orthodontic brackets and simple ties of gray, red, or green elastomeric ligatures; and with fixed esthetic orthodontic brackets with simple ties of clear elastomeric ligatures.

The photo of the smiling face without the orthodontic appliance was selected as the matrix photo. The matrix smile was digitally altered by using Photo-Paint software (version 12.0, Corel Corporation, Ottawa, Ontario, Canada). The images of teeth and orthodontic appliances of the other photos were transferred to the matrix image to maintain the same relationship between lips and teeth in the smile and the same position of the head in all images. Five images were obtained for evaluation: the matrix photo (Fig, A and B) and the 4 manipulated images with appliances and elastomeric ligatures of different colors (Fig, C to F).

The images were manipulated to simulate the extraction of the maxillary first premolar (Figs, G-K).
The image of the extraction space was copied from a photograph of another female volunteer who had the maxillary first premolar extracted for orthodontic reasons. Therefore, 10 images were obtained of the same smiling face with all possible combinations of presence or absence of orthodontic appliance and extraction space, type of appliance, and color of elastomeric ligatures. All raters were shown the full-face photographs in which the only differences from the matrix photograph were the smiles. These differences are shown in the Figure.

Photo-quality color prints measuring $15 \times 21$ cm were produced and randomly grouped in an album. Fifty orthodontists and 50 laypeople—senior law ($n = 20$), business administration ($n = 15$), and accounting ($n = 15$) students—rated the photos. The dental specialists were randomly selected from the list of members of the Regional Council of Dentistry, and the students were from 2 universities in Brasília, Brazil.

Each rater received the smile album and a rating sheet with a 100-mm visual analog scale, as described in previous studies. The straight lines on the left side indicated “very unattractive” and, on the right side, “very attractive.” The raters were told not to compare smiles in the album. The rating sheet was filled out in the presence of at least 1 author.

The scores were measured by an author (P.M.B.) using a digital caliper (MGF 505646, Mitutoyo, Tokyo, Japan) that was positioned on the left-most point of each line of the visual analog scale and opened to the mark made by the rater. All values in millimeters were recorded as scores.

**Statistical analysis**

SAS software (version 8.1, SAS, Cary, NC) was used for statistical analysis of the data. One outlier case in the group of orthodontists was excluded from analysis. Descriptive statistics were reported as means and standard deviations. Student $t$ tests were used to assess the hypothesis of no difference between sexes in both groups. Repeated-measures analysis of variance (ANOVA) was used for the statistical analysis of each type of change. The hypothesis that there was no difference between the various digitally manipulated smiles for each group of raters was tested, and, when adequate, Newman-Keuls multiple comparisons were conducted as post-hoc analyses. The level of significance, adjusted with the Bonferroni correction, was established at 1%.

Measurement error was calculated by using the formula $(\sqrt{\sum d^2/n})$, where $d$ was the difference between 2 measurements made by the same observer within a 2-week interval, and $n$ was the size of the sample. Fifteen percent of the answers were randomly selected for this evaluation. Error was $0.211$ mm.

## RESULTS

The numbers of men and women in each group of raters were different, but there were no significant differences in the scores between the sexes (laypeople: 23 men, 27 women, $P = 0.23$; orthodontists: 33 men, 16 women, $P = 0.39$).

There was a significant difference in the esthetic perception of smiles between laypeople ($F_{9,490} = 37.67; P < 0.0001$) and orthodontists ($F_{9,480} = 57.01; P < 0.0001$). Means, standard deviations, and the results of the Newman-Keuls tests are shown in Tables I and II.

The presence of metal appliances, regardless of the color of the elastomeric ligatures, did not have a negative effect on the esthetics of the smile in the perceptions of laypeople and orthodontists. The esthetic appliance did not affect esthetics for orthodontists, but there was a significantly negative effect for laypeople.

The extraction space had a significant effect on the smile for the 2 groups, but the appliance significantly mitigated this effect for the orthodontists.

## DISCUSSION

A person’s social interaction when smiling involves head movements. This dynamic process shows people...
at different angles. Some angles, such as a frontal view, can mask the absence of premolars. However, an oblique view directly exposes the premolar extraction spaces, and, in this view, the missing tooth might have its greatest impact. The photographs taken at an oblique angle in this study did not provide a full view of the smile but offered a view similar to that at some moments of interpersonal daily interactions.14,15 Several studies about esthetic perceptions of smiles used a limited dental view, but their results might not correspond to the way people evaluate smiles in everyday life.4,11,13 Smiles are usually evaluated as an integral part of facial esthetics and not as an isolated feature. This explains why laypeople tend to assign greater impact to negative features of a smile when shown limited dental views than when they see a full facial view of the smile.16 Therefore, this study used full smiling faces near actual size rather than close-up views to investigate the effect of orthodontic appliances and extraction spaces in the context of the face. For the same reasons, we did not use partial views because they might not represent reality and could highlight only certain features.

Most adults seek orthodontic treatment for esthetic reasons.17-19 However, orthodontists do not seem prepared to discuss with patients what should probably be the first piece of information to be provided: the impact of the appliance on the adult’s facial esthetics. Apparently, there are no studies about the effect of appliances on facial esthetics in the literature. However, adults often spend an important part of their lives with an appliance in their mouths, and they need to know the role of appliances in esthetics.

Our results suggest that an orthodontic appliance with metal brackets and gray, red, or green elastomeric ligatures does not have a negative effect on the attractiveness of a smiling face of a young woman. The perception of the esthetic effect of an orthodontic appliance is affected by cultural and social factors.7,20 Therefore, our findings might show that, in countries in which orthodontic treatments are frequent, citizens have incorporated these appliances into their beauty rituals; orthodontic appliances are like any other personal ornament or a sign of a positive attribute, such as social status19 or oral health.21

At the same time, the perceptions of laypeople and orthodontists of the esthetic appliance were different, and similar differences have already been described for other smile factors.13,22-24 Laypeople perceived a smile with an esthetic appliance as significantly less attractive than a smile with a metal appliance or with no appliance, whereas orthodontists classified it as no different from the other smiles. There could be more than 1 explanation for these findings.

Laypeople might perceive the esthetic appliance as less attractive because it does not have a defined contour as does the fixed metal appliance, and it lacks contrast with the teeth.25 Dental plaque and food debris also do not have well-defined contours and often are of a color similar to that of teeth.26 Therefore, laypeople might associate an esthetic appliance with teeth that are not well cleaned.

Alternatively, this difference could be explained because orthodontists are exposed to information and market influences that differ from those received by laypeople.27 In addition to the information associated with their academic backgrounds, orthodontists are exposed to intense advertising of brackets by dental material companies. Esthetic brackets are frequently advertised in scientific journals and at orthodontic conferences, and such exposure could affect their perceptions.

Although esthetic appliances might seem to be an adequate choice for those whose image is important, such as TV anchors and politicians, our results suggest that this choice is not supported by esthetic factors. Although our findings do not rule out the use of esthetic appliances, they show evidence of lack of information about their advantages and disadvantages. Future studies to investigate other variables might justify this clinical option.

### Table II. Means, standard deviations, and results of the Newman-Keuls test of ratings in the group of laypeople

<table>
<thead>
<tr>
<th>Smiling face</th>
<th>Mean</th>
<th>SD</th>
<th>Newman-Keuls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal brackets + green ligatures</td>
<td>59.51</td>
<td>22.40</td>
<td>A</td>
</tr>
<tr>
<td>Matrix photo (no brackets)</td>
<td>55.69</td>
<td>20.89</td>
<td>A</td>
</tr>
<tr>
<td>Metal brackets + red ligatures</td>
<td>55.09</td>
<td>21.68</td>
<td>A</td>
</tr>
<tr>
<td>Metal brackets + gray ligatures</td>
<td>54.72</td>
<td>20.71</td>
<td>A</td>
</tr>
<tr>
<td>Esthetic brackets</td>
<td>45.72</td>
<td>18.42</td>
<td>B</td>
</tr>
<tr>
<td>Esthetic brackets + extraction</td>
<td>28.37</td>
<td>19.22</td>
<td>C</td>
</tr>
<tr>
<td>Metal brackets + gray ligatures + extraction</td>
<td>25.97</td>
<td>16.65</td>
<td>C</td>
</tr>
<tr>
<td>Metal brackets + green ligatures + extraction</td>
<td>23.95</td>
<td>16.51</td>
<td>C</td>
</tr>
<tr>
<td>Metal brackets + red ligatures + extraction</td>
<td>23.88</td>
<td>16.35</td>
<td>C</td>
</tr>
<tr>
<td>No brackets + extraction</td>
<td>18.37</td>
<td>13.97</td>
<td>C</td>
</tr>
</tbody>
</table>

*Smiling faces with the same letter did not differ significantly.
A difference between the perceptions of orthodontists and laypersons was also found in the ratings of smiling faces with a missing premolar. Laypeople did not find differences between smiling faces with a missing premolar with or without appliances, whereas orthodontists perceived the appliances as a mitigating factor of the negative impact of extraction. Orthodontists can perceive the extraction space in a patient under treatment as the transient condition of a person with good oral health, because most perceptions of beauty in general are associated with apparent health.\(^{21}\)

Laypersons, conversely, associate missing anterior teeth with a lower self-image, because teeth are usually extracted because of caries or periodontal disease, and missing posterior teeth are likely to have a similar impact on self-image.\(^{20}\) Differently from orthodontists, they do not realize that the extraction was prescribed by a dentist; for them, a missing tooth might indicate disease and consequently elicit a negative perception of the smile. To mitigate this perception, artificial teeth should be attached to the orthodontic arches of patients who have premolar extractions and be gradually drilled as the space closes.

There is a tenuous line between treatment of the patient’s esthetic complaints and overtreatment to achieve the aims established by the orthodontists. During orthodontic planning, the orthodontist must understand the patient’s perception of the esthetic requisites of a smile and of treatment. This will ensure that the orthodontist informs the patient about advantages and disadvantages of each condition, and will facilitate the decision about the type of treatment or the appliance. Such decisions should be made together; do not keep patients from choosing esthetic appliances even when aware of the lack of scientific evidence of their esthetic superiority.

The different perceptions of laypeople and orthodontists of the esthetic effects of orthodontic appliances warrant further investigation. Studies are underway to evaluate the esthetics of various brands of brackets and the behavioral factors that affect laypersons’ perceptions of fixed appliances. The results of this and future studies can help orthodontists to integrate their patients’ esthetic needs and perceptions into orthodontic planning and might serve as guidelines for future investments by orthodontic material companies.

**CONCLUSIONS**

1. Metal orthodontic appliances did not have a negative effect on the esthetic perception of a young woman’s smiling face for laypeople and orthodontists.

2. The esthetic appliance was significantly less attractive to the laypeople but did not affect facial esthetics for the orthodontists.

3. The presence of an extraction space had a significant negative effect on esthetics for both laypeople and orthodontists. For orthodontists, an orthodontic appliance mitigated the negative impact of extraction.

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**REFERENCES**


