Canine substitution for missing maxillary lateral incisors: The influence of canine morphology, size, and shade on perceptions of smile attractiveness

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Introduction: This study was conducted to determine whether variations in the morphology, size, or shade of maxillary canines would influence perceptions of smile attractiveness in patients with canines substituted for missing maxillary lateral incisors. Methods: A smiling photograph of a hypodontia patient who had orthodontic space closure with maxillary canines replacing the lateral incisors was digitally modified to create a bilaterally symmetrical image. Four groups of images were created, digitally altering canine gingival height, crown tip height, canine width, and canine shade. Three groups of judges (40 orthodontists, 40 dentists, and 40 laypeople) ranked the images for smile attractiveness, also scoring the most and the least attractive of each of the 4 groups, and the most and least attractive of all images. Results: Canine gingival height was the most attractive 0.5 mm below the gingival margin of the maxillary central incisor and progressively less attractive with increasing gingival height. Increasing canine width, increased canine tip height, and pointed canines were perceived to be unattractive. Brighter than normal shades of canines were preferred to darker shades. Narrow canine crowns were most frequently ranked as the most attractive overall, 1.5 mm narrower was preferred by the orthodontists and dentists, and 3.0 mm narrower was preferred by the laypeople. All 3 groups ranked the darkest image, 20 times darker than the original, most frequently as the least attractive image overall. There was good general agreement between orthodontists, dentists, and laypeople for all 4 parameters of smile attractiveness, although laypeople demonstrated greater intragroup variations. Conclusions: The morphology, size, and shade of the maxillary canine in patients having orthodontic space closure and lateral incisor substitution can have a marked effect on perceived smile attractiveness. (Am J Orthod Dentofacial Orthop 2010;138:705.e1-705.e9)
in occlusal function and prevalence of temporomandibular dysfunction.8 However, this treatment approach requires careful consideration of the differences in the morphology between the lateral incisor and the canine, and whether the patient is ultimately suitable for space closure and the result will be acceptable and esthetic.

The lateral incisor has incisiform morphology: ie, a smaller, flat-faced tooth compared with the caniniform and conical shaped canine. The canine has a broader neck and, because the tooth is thicker and contains more dentin, is often darker. The gingival margin of the canine is usually higher than that of the lateral incisor, and canines tend to have a prominent tip. If these differences are not compensated for, the esthetic outcome will be compromised.9-11

Several techniques can be used to mask the differences between the 2 tooth types. The canine bracket can be inverted to increase palatal root torque, which might reduce the eminence of the canine. The bracket can be positioned more gingivally to extrude the canine and its gingival margin; the canine tip can then be reduced.12 Since the canine is wider than the lateral incisor, its width can be reduced mesiodistally with interdental enamel reduction. Finally, because the canine is often naturally darker than the adjacent lateral incisor, the tooth can be bleached after orthodontic treatment.

Previously, authors have investigated perceived smile attractiveness in hypodontia patients (Table 1).2,13-16 However, the influence of the morphology of the maxillary canine on the perceived attractiveness of the smile has not been investigated.

The principal aims of this study were to (1) quantitatively score smile attractiveness in a hypodontia patient, managed with space closure and maxillary canines substituted for the missing lateral incisors, with incremental alteration of the following parameters of the maxillary canine: crown width, crown height and tip morphology, gingival margin height, and shade; and (2) compare the perceptions of smile attractiveness between orthodontists, dentists, and laypeople.

MATERIAL AND METHODS

One hundred twenty observers were recruited as participants for the study. They were orthodontists, dentists, and laypeople.

Each group had 40 observers. The orthodontists comprised final year and higher orthodontic trainees, specialist practitioners, and hospital consultants and included 12 men and 28 women (18 white and 22 nonwhite; mean age, 33.9 ± 7.8 years; range, 26-65 years). The dentists were all qualified practitioners and included 16 men and 24 women (26 white and 14 nonwhite; mean age, 34.3 ± 11.2 years; range, 23-57 years). The lay group comprised people from various nonclinical backgrounds and included 11 men and 29 women (33 white and 7 nonwhite; mean age, 36.6 ± 11.7 years; range, 20-63 years). Each observer was asked to rank a series of images in the order of attractiveness of the smiling mouth, displaying the maxillary second premolar to second premolar. The original photograph was of a smiling mouth showing only the maxillary dentition of a hypodontia patient who had been treated by space closure and canine substitution.

A photograph of a patient’s smile was selected that exhibited good dental alignment, having had maxillary canines substituted for missing lateral incisors. The photograph showed the maxillary teeth, lips, and surrounding skin, but the nose and chin were cropped out to reduce the confounding variables. A bilaterally symmetrical image was digitally created (Photoshop CS2 software, Adobe Systems, San Jose, Calif). The photograph was then digitally altered to create 31 images divided into 4 groups. In each group of images, 1 variable was incrementally altered: the variables were canine width (6 images), canine crown height and tip morphology (9 images), canine gingival margin height (6 images), and canine shade (10 images). A duplicate of 1 image was included in each group of images to assess intraexaminer reliability (Fig 1).

The images were printed on color photographic paper in size 6 × 4 in, and each image had a unique identifier number on the reverse side of the image. The images were laid out on a table in their 4 groups in random order.

All observers in the study were given the same verbal instructions by the same examiner (E.B.). The observers were asked to study 1 group of photos at a time and then to rank them for attractiveness, from most to least attractive.

Once they had ranked the 4 groups of images and were happy with their decisions, the 4 most attractive images they selected were grouped together, and the 4 least attractive images were grouped together separately. They were then asked to pick the most attractive image from the 4 attractive images and the least attractive image from the 4 least attractive images.

Statistical analysis

The data were analyzed by using descriptive, mixed logistic regression analysis. Data analysis was performed with a statistical package (version 9, Stata, StataCorp, College Station, Tex).
Preference scores per image were computed overall and for each observer and professional group. Average ranks for each parameter were investigated along with differences in ranks given by each group.

Mixed logistic regressions were used to assess what influenced the choice for the most and the least attractive images. The independent variables were sex, age, ethnicity, amount of alteration, and professional status (group) of the observer.

**RESULTS**

Each of the 4 groups of images was analyzed individually. The data were analyzed for image preference related to the person, the observer group, and the overall total.

In the overall data of canine width alterations (Table II), the image that was favored by most observers was image 5; 50% of the observers found it the most attractive, followed by images 1 and 6. The least attractive image was image 4, 71.67% of the observers finding it the least attractive.

There were no significant differences in participant preferences (most or least attractive) related to age, sex, or ethnicity.

In the data for group-specific differences, there were significant differences in the preferences for attractiveness of the photographs comparing the orthodontists and the laypeople, and the dentists and the laypeople (there were no significant differences between the orthodontists and dentists).

By using multivariate logistic regression, both the orthodontist and the dentists were statistically significantly more likely to pick image 5 as attractive (ranked 1 or 2). Orthodontists and dentists were 12.5 and 7.7 \( (P < 0.001) \) times more likely, respectively, to pick image 5 as attractive; 92.5% of the orthodontists, 85% of the dentists, and 58% of the laypeople ranked image 5 as 1 or 2.

The least attractive image was number 4. It was almost unanimously ranked as the least attractive image by all groups; 72% of all observers found image 4 the least attractive. Both orthodontists and dentists were more likely than laypeople to rank this image least attractive.

### Table I. Previous studies of the management of patients with hypodontia of the maxillary lateral incisor and smile attractiveness

<table>
<thead>
<tr>
<th>Topic</th>
<th>Authors</th>
<th>Sample</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influence of various dimensions of maxillary lateral incisors to smile attractiveness</td>
<td>Bukhary et al.</td>
<td>41 hypodontia and 46 nonhypodontia patients, 30 dentists</td>
<td>Digitally altered width and height of maxillary laterals: 67% then 72% lateral to central ratio preferred. Images of maxillary laterals 1.5 mm shorter than the centrals were perceived as attractive; significantly shorter or longer teeth were unattractive.</td>
</tr>
<tr>
<td>Bilateral aplasia of maxillary lateral incisors and orthodontic space closure</td>
<td>Zimmer and Seifi-Shirvandeh</td>
<td>25 patients (15 female, 10 male), bilateral maxillary lateral incisor aplasia treated by PPM (for space closure)</td>
<td>Class III elastics are an essential part of PPM that have minor dental and skeletal effects. Orthodontic space closure for bilateral maxillary lateral incisor aplasia by PPM is a valid alternative to prosthetic replacements.</td>
</tr>
<tr>
<td>Missing maxillary lateral incisors; esthetic impact, comparing dental specialists’ and laypeople’s opinions</td>
<td>Armbruster et al.</td>
<td>140 dentists, 43 orthodontists, 29 dental specialists, 40 laypeople</td>
<td>Laypeople ranked canine substitution highest. Orthodontists preferred no teeth missing &gt;canine substitution &gt;bridges &gt;implants. Restorative dentists would restore the missing tooth, but they did not necessarily rank the restored option image as attractive.</td>
</tr>
<tr>
<td>Lateral incisor agenesis</td>
<td>Robertson and Mohlin</td>
<td>50 patients; 30 had space closure, 20 had space opening and restorative replacement</td>
<td>Space closure patients were more satisfied with treatment outcome than space opening patients. No difference in TMD symptoms. Space opening: poorer periodontal condition, greater plaque accumulation, and gingivitis.</td>
</tr>
</tbody>
</table>

PPM, Push-and-pull mechanics; TMD, temporomandibular dysfunction.
attractive; 95% of the orthodontists and 85% of the dentists ranked it least attractive, but only 35% of the laypeople agreed with this. No observer chose it as the most attractive. It was never chosen in second place, either by the dentists or the orthodontists and only by 5% of the laypeople.

All 3 groups were in general agreement about which images were attractive and unattractive, in terms of:

- **A**: Canine width images
- **B**: Canine crown height and tip morphology images
- **C**: Canine gingival height images
- **D**: Canine shade images
of width of the canine. However, the spread of the data and therefore the variations in opinions of the laypeople were greater than those of the orthodontists and dentists.

In the overall data of canine tip alterations (Table III), the image that was favored by most observers was image 1; 35.8% of them found it the most attractive, followed by images 3, 4, and 2. The least attractive image was image 9; 57.5% of the observers found it the least attractive image.

There were no significant differences in observer preferences related to age, sex, or ethnicity.

In the multivariate logistic regression, the orthodontists and dentists were more likely than laypeople to find image 1 attractive and rank it either as 1 or 2. The odds of this were 7.14 times greater for orthodontists than laypeople ($P = 0.000$) and 4 times greater for dentists than laypeople ($P = 0.01$).

Age ($P = 0.97$), sex ($P = 0.20$), and ethnicity ($P = 0.99$) had no significant effect on attractiveness rank. Both orthodontists and dentists were more likely than laypeople to rank image 1 as most attractive. Orthodontists were 3.71 times more likely than laypeople ($P = 0.02$) and dentists were 1.85 times more likely than laypeople ($P = 0.26$) to prefer image 1.

The image found least attractive more often was image 9; 57.5% of all observers found image 9 the most unattractive. It was chosen by 82.5% of the orthodontists, 51.2% of the dentists, and 40% of the laypeople. No orthodontist or layperson observer chose it as the most attractive.

Orthodontists were significantly more likely than dentists ($P = 0.003$) and laypeople ($P = 0.0000$) to pick image 9 as the least attractive.

In the overall data of canine shade (Table IV), the image that was favored by most observers was image 3 (10 times brighter); 23.33% found it to be the most attractive, followed by image 2 (5 times brighter), image 4 (15 times brighter), and image 1 (original image). The least attractive image was image 10 (20 times darker), the darkest image; 78.33% of the observers found it the least attractive image. No participant scored image 10 as the most attractive.

There were no significant differences in observer preferences related to age, sex, or ethnicity.

When we analyzed the data for group-specific differences with multivariate logistic regression analysis, the orthodontists and the dentists were more likely than the laypeople to pick image 3 as the most attractive (1.74 and 1.4 times, respectively); however, this was not significant.

Image 3 (10 times brighter) was preferred and ranked number 1 by both the orthodontists and the laypeople, whereas image 2 (5 times brighter) was ranked first by the dentists. Both the orthodontists and the dentists favored the more natural shades, compared with the laypeople, who ranked the brighter shades (15 and 20 times brighter) more attractive than the natural shades.

There was overall agreement between the 3 groups that image 10 was the least attractive. In all 3 groups, the 3 darkest shades were the least attractive, and the relationship between darker shades and reduced attractiveness correlated.

Image 10 was ranked least attractive by 87.5% of the orthodontists, 80% of the dentists, and 67.5% of the laypeople. Although all groups agreed about the least attractive image, the orthodontists ($P = 0.013$) were statistically more likely than the laypeople to pick image 10. The difference between orthodontists and laypeople was significant, whereas that between dentists and laypeople was not.

Age ($P = 0.15$) and sex ($P = 0.89$) had no significant effect on the preference ranks, but ethnicity did ($P = 0.03$).

In the overall data for canine gingival height (Table V), the image that was favored by most of the observers was image 1; 30% found it the most attractive, followed by images 3, 2, and 4. Image 6 was ranked as the least attractive image by 78.3% of the observers.

There were no significant differences in observer preferences related to age, ethnicity, or sex.

Table II. Overall and group-specific ranks for variations in canine width for each group

<table>
<thead>
<tr>
<th>Image</th>
<th>Alteration</th>
<th>Mean score</th>
<th>SD</th>
<th>Orthodontists</th>
<th>Dentists</th>
<th>Laypeople</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Rank</td>
<td>Mean</td>
</tr>
<tr>
<td>1 (D.D.)</td>
<td>Original image</td>
<td>2.46</td>
<td>1.20</td>
<td>2.08</td>
<td>0.86</td>
<td>2</td>
</tr>
<tr>
<td>2 (V.E.)</td>
<td>1.5 mm wider</td>
<td>4.12</td>
<td>1.20</td>
<td>4.23</td>
<td>0.95</td>
<td>4</td>
</tr>
<tr>
<td>3 (L.B.)</td>
<td>1.5 mm wider (copy of image 2)</td>
<td>3.98</td>
<td>1.30</td>
<td>4.35</td>
<td>0.86</td>
<td>5</td>
</tr>
<tr>
<td>4 (M.D.)</td>
<td>3.0 mm wider</td>
<td>5.47</td>
<td>1.00</td>
<td>5.93</td>
<td>0.35</td>
<td>6</td>
</tr>
<tr>
<td>5 (R.S.)</td>
<td>1.5 mm narrower</td>
<td>1.94</td>
<td>1.31</td>
<td>1.48</td>
<td>0.64</td>
<td>1</td>
</tr>
<tr>
<td>6 (Y.D.)</td>
<td>3.0 mm narrower</td>
<td>3.04</td>
<td>1.45</td>
<td>2.95</td>
<td>1.06</td>
<td>3</td>
</tr>
</tbody>
</table>
When we analyzed the data for group-specific differences, there was an indication of a difference in the preferences for attractiveness of the set of photographs comparing the groups ($P = 0.07$).

Dentists were more likely than orthodontists to give the best ranks (1 and 2) to image 1 ($P = 0.03$), and both dentists and laypeople were slightly more inclined than orthodontists to give the highest rank to image 1; these differences were not statistically significant. Orthodontists preferred image 3.

All groups ranked image 6 as least attractive. Ethnicity ($P = 0.06$) had an effect on the worst rank. Age ($P = 0.12$) and sex ($P = 0.23$) had no significant effect.

In the multivariate logistic regression, the orthodontists and dentists were more likely than laypeople to give the worst rank to image 6. Orthodontists were statistically significantly more likely than the laypeople to find image 6 unattractive ($P = 0.000$).

The observers were also asked to pick the image that they found the overall least attractive from the 4 images chosen as least attractive in the previous section. **Figure 2** demonstrates the frequency of the images ranked least attractive.

The image chosen as the overall least attractive image was the darkest shade of the canine (SB, 20 times darker); this was chosen by all 3 groups. This was followed by image MD (canine, 3.0 mm wider), the widest canine image; then image AZ (canine tip increased by 1.5 mm and pointed), the longest crown tip.

Image SB was also chosen most frequently as the least attractive by the laypeople, followed in order of frequency by images MD and ZJ.

Agreement within the groups varied. The greatest intragroup agreement was found in the orthodontists, with 5 images chosen as least attractive. This was followed by the dentists with 8 images chosen as the least attractive. Ten images were chosen by the laypeople as least attractive, demonstrating the lowest intragroup agreement.

The participants were also asked to pick the image that they found the most attractive overall from the 4 images chosen as most attractive in the previous section. **Figure 3** demonstrates the frequency of the images ranked most attractive.

The image chosen most frequently by the orthodontists as most attractive was image RS (1.5 mm narrower), with images CC (original image) and DD.

### Table III. Overall and group-specific ranks for variations in canine height and tip morphology for each group

<table>
<thead>
<tr>
<th>Image</th>
<th>Altered canine tip</th>
<th>Mean score</th>
<th>SD</th>
<th>Orthodontists</th>
<th>Dentists</th>
<th>Laypeople</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
</tr>
<tr>
<td>1 (J.K.)</td>
<td>Original image</td>
<td>2.76</td>
<td>1.98</td>
<td>1.88</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>2 (X.O.)</td>
<td>Increased 0.5 mm</td>
<td>3.66</td>
<td>2.3</td>
<td>2.45</td>
<td>1.38</td>
<td>2</td>
</tr>
<tr>
<td>3 (B.A.)</td>
<td>Increased 0.5 mm (copy of image 2)</td>
<td>3.28</td>
<td>1.84</td>
<td>3.18</td>
<td>1.28</td>
<td>3</td>
</tr>
<tr>
<td>4 (G.G.)</td>
<td>Reduced 0.5 mm</td>
<td>3.55</td>
<td>2.03</td>
<td>3.28</td>
<td>1.34</td>
<td>4</td>
</tr>
<tr>
<td>5 (H.L.)</td>
<td>Increased 1.0 mm</td>
<td>4.73</td>
<td>1.98</td>
<td>5.30</td>
<td>1.11</td>
<td>5</td>
</tr>
<tr>
<td>6 (E.A.)</td>
<td>Reduced 0.5 mm and pointed</td>
<td>6.69</td>
<td>1.65</td>
<td>7.20</td>
<td>1.04</td>
<td>7</td>
</tr>
<tr>
<td>7 (S.A.)</td>
<td>Increased 1.5 mm</td>
<td>5.72</td>
<td>1.75</td>
<td>5.48</td>
<td>1.36</td>
<td>6</td>
</tr>
<tr>
<td>8 (L.C.)</td>
<td>Increased 0.5 mm and pointed</td>
<td>6.88</td>
<td>1.81</td>
<td>7.48</td>
<td>0.99</td>
<td>8</td>
</tr>
<tr>
<td>9 (A.Z.)</td>
<td>Increased 1.0 mm and pointed</td>
<td>7.73</td>
<td>2.07</td>
<td>8.78</td>
<td>0.53</td>
<td>9</td>
</tr>
</tbody>
</table>

### Table IV. Overall and group-specific ranks for variations in canine shade for each group

<table>
<thead>
<tr>
<th>Image</th>
<th>Alteration</th>
<th>Mean score</th>
<th>SD</th>
<th>Orthodontists</th>
<th>Dentists</th>
<th>Laypeople</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
</tr>
<tr>
<td>1 (C.C.)</td>
<td>Original</td>
<td>3.77</td>
<td>1.83</td>
<td>3.60</td>
<td>1.46</td>
<td>4</td>
</tr>
<tr>
<td>2 (E.B.)</td>
<td>5 times brighter</td>
<td>3.53</td>
<td>2.32</td>
<td>2.95</td>
<td>2.16</td>
<td>2</td>
</tr>
<tr>
<td>3 (H.H.)</td>
<td>10 times brighter</td>
<td>3.17</td>
<td>2.12</td>
<td>2.73</td>
<td>1.71</td>
<td>1</td>
</tr>
<tr>
<td>4 (G.H.)</td>
<td>15 times brighter</td>
<td>3.72</td>
<td>2.28</td>
<td>3.20</td>
<td>1.57</td>
<td>3</td>
</tr>
<tr>
<td>5 (F.C.)</td>
<td>20 times brighter</td>
<td>4.75</td>
<td>2.40</td>
<td>4.95</td>
<td>2.17</td>
<td>6</td>
</tr>
<tr>
<td>6 (D.E.)</td>
<td>5 times darker</td>
<td>5.06</td>
<td>1.88</td>
<td>4.68</td>
<td>1.75</td>
<td>7</td>
</tr>
<tr>
<td>7 (J.L.)</td>
<td>10 times darker</td>
<td>6.33</td>
<td>1.97</td>
<td>6.98</td>
<td>1.48</td>
<td>5</td>
</tr>
<tr>
<td>8 (K.B.)</td>
<td>10 times darker</td>
<td>7.06</td>
<td>1.83</td>
<td>7.38</td>
<td>0.98</td>
<td>8</td>
</tr>
<tr>
<td>9 (B.B.)</td>
<td>15 times darker</td>
<td>8.18</td>
<td>1.92</td>
<td>8.80</td>
<td>0.85</td>
<td>9</td>
</tr>
<tr>
<td>10 (S.B.)</td>
<td>20 times darker</td>
<td>9.44</td>
<td>1.44</td>
<td>9.75</td>
<td>0.74</td>
<td>10</td>
</tr>
</tbody>
</table>
The image most frequently chosen by the dentists as the most attractive overall image was image RS (narrower by 1.5 mm), followed by image CC (original image), the same as those chosen by the orthodontist group. Images KA (gingival margin 0.5 mm higher), DD (original image), and BA (0.5 mm increased crown tip height) were equally selected as the most attractive by the dentist group.

Different images were chosen as the most attractive by the laypeople. Image YD (3.0 mm narrower, the narrowest image from the group) was chosen most frequently as the most attractive. The second most commonly selected was image HI (1 mm increased crown tip height), followed by image FC (20 times brighter).

There was less agreement between groups and within groups when selecting the most attractive image compared with the least attractive image, as shown in Figure 3. The most attractive image overall was unanimously image RS by both the dentists (29%) and the orthodontists (25%). This differed from the laypeople (14%), who picked image YD as the most attractive, although there was little agreement on which image was the most attractive. There were 13 different images chosen as the most attractive by the orthodontist group, 17 different images chosen by the laypeople, and 16 different images by the dentists.

The reliability of the rank was tested for each set of photographs by placing a duplicate image in the set. The reliability was set at 1 or less, which meant that the observer placed the duplicate images side by side (eg, duplicate images were ranked 3 and 4). The results demonstrated good agreement for all tests (canine width: difference, 0.14, $P = 0.38$, agreement level, good; canine shade: difference, 0.67, $P = 0.00$, agreement level, statistically poor but clinically acceptable [<1]; canine gingival height: difference, 0.06, $P = 0.72$, agreement level, good; canine tip height: difference, 0.27, $P = 0.27$, agreement level, good). The levels of agreement for all parameters were clinically good; however, for shade, there was statistically relatively poor agreement ($P = 0.00$), although the images were ranked 7 and 8 by the observers (ie, next to each other).

**DISCUSSION**

From the results of this study, there were general preferences related to the morphology of the canine in the position of the lateral incisor. Orthodontists preferred narrow rather than wide teeth, natural shades, gingival margins just below the adjacent central incisor, and rounded tips. These opinions were shared by dentists, although they tended to favor a less narrow or average size tooth, finding the images of the narrowest teeth unattractive. They also preferred teeth 1 shade darker than did the orthodontists. Laypeople shared the same overall preference trends, but they preferred narrower (3.0 mm narrower) and slighter brighter canines than did the orthodontists and the dentists; they demonstrated a greater range of opinions and less overall agreement within the group.

When we analyzed the data of each specific morphologic feature, starting with canine width, there was an overall preference and general trend for narrower canines in the position of the lateral incisor. The photographs ranked most attractive were with the canines slightly narrower than the original image, followed by the original image. All 3 groups chose narrow canines most frequently as the most attractive overall, with 3.0-mm narrower canines chosen by laypeople and 1.5-mm narrower chosen by orthodontists and dentists. This supports previous research by Bukhary et al in which a 67% ratio of lateral incisor width to central incisor width was perceived as the most attractive by orthodontists and dentists, although laypeople preferred a lower ratio. Wider teeth were found to be less attractive. Increasing the width of the canine had an inversely proportional relationship to perceived attractiveness.

In terms of gingival margin height, the image ranked most attractive had the gingival margin of the tooth in the lateral incisor position as 0.5 mm below the level of the adjacent central incisor. When the gingival margin was
only slightly lower than this, it was also ranked high; conversely, images with high gingival levels were perceived as unattractive. The degree and magnitude of the height of the gingival margin had an inverse relationship on perceived attractiveness. The group-specific data varied. Orthodontists preferred canine gingival margin height at 1 mm below the level of the central incisor, whereas both the laypeople and dentists preferred it 0.5 mm below. It appears from the data that small gingival height discrepancies have a minimal effect on attractiveness, but gingival height increases greater than 1.0 mm were perceived as relatively unattractive; this was verified by all 3 groups.

The shade of the tooth in the lateral incisor position had a significant impact on the perceived attractiveness of the smile. Generally, brighter shades were found more attractive than darker shades by all groups. The images showing canines slightly brighter than the original image were ranked as most attractive, followed by the original shades. Orthodontists preferred brighter than original teeth, dentists preferred slightly darker shades compared with the orthodontists, and laypeople found slightly brighter shades attractive. Darker than original shades were perceived as unattractive by all 3 groups, and the darkest shade of all the images was most frequently ranked as the most unattractive (image SB, 20 times darker than original).

Related to crown height and tip morphology alterations, all 3 groups agreed. They found increased crown tip heights greater than 1.5 mm unattractive, and, when the tip of the canine was pointed, this was also perceived as unattractive. The image with the canine tip height 1.0 mm

![Fig 2](image2.png)

**Fig 2.** Frequency of the images chosen as least attractive by orthodontists, dentists, and laypeople.

![Fig 3](image3.png)

**Fig 3.** Frequency of the images chosen as most attractive by orthodontists, dentists, and laypeople.
increased and pointed was ranked the least attractive in this section. Orthodontists and dentists disliked the pointed tips and ranked them most unattractive. The laypeople also disliked canines with pointed tips, but they ranked the 1.5 mm increased crown height with a rounded tip as the least attractive image.

For crown height, group-specific preferences were found in the data. The original image was preferred by dentists, slightly shorter canines were preferred by orthodontists, and a slightly increased canine crown height was preferred by laypeople.

CONCLUSIONS

In hypodontia patients with missing maxillary lateral incisors, having undergone space closure with canine substitution, the following conclusions were made.

1. The morphology of the maxillary canine is noticed by orthodontists, dentists, and laypeople, and this might have a detrimental effect on perceived smile attractiveness.
2. Dark canines were ranked least attractive by all groups.
3. Wide canines were perceived as unattractive.
4. Narrower canines were found most attractive overall most frequently by all 3 groups.
5. Canine gingival height greater than 0.5 mm above the gingival margin level of the adjacent central incisor was perceived as unattractive.
6. Natural shades were preferred by dentists and lighter brighter shades by orthodontists, whereas brighter shades were preferred by laypeople; all groups found brighter canines more attractive than darker canines, and there was a correlation between darker canines and unattractive smiles.
7. Orthodontists and dentists disliked a greater than 1.0 mm increase in canine tip height and pointed tips, and scored them unattractive; laypeople liked a 1.0-mm increase in canine tip height, but greater than 1.5 mm and pointed tips were perceived as unattractive.
8. Pointed canine tips were found highly unattractive by all groups.

Orthodontists, dentists, and laypeople noticed the morphology of the canine in orthodontic camouflage cases. The feature with the most detrimental effect on smile attractiveness was a canine with a dark shade; all 3 groups agreed. Small changes in any feature—i.e., gingival margin variations ± 0.5 mm, width changes ± 0.5 mm, and tip height changes ± 0.5 mm—were generally acceptable and tolerated. However, the farther any parameter varied from the average, the more unattractive the perceived appearance of the smile. The exception to this was reduction of the width of the canine; 1.5-mm reductions were scored highly by orthodontists and dentists, and 3.0-mm reductions were scored highly by laypeople.

REFERENCES