Evaluation of the Effect of Buccal Corridor Size on Smile Attractiveness

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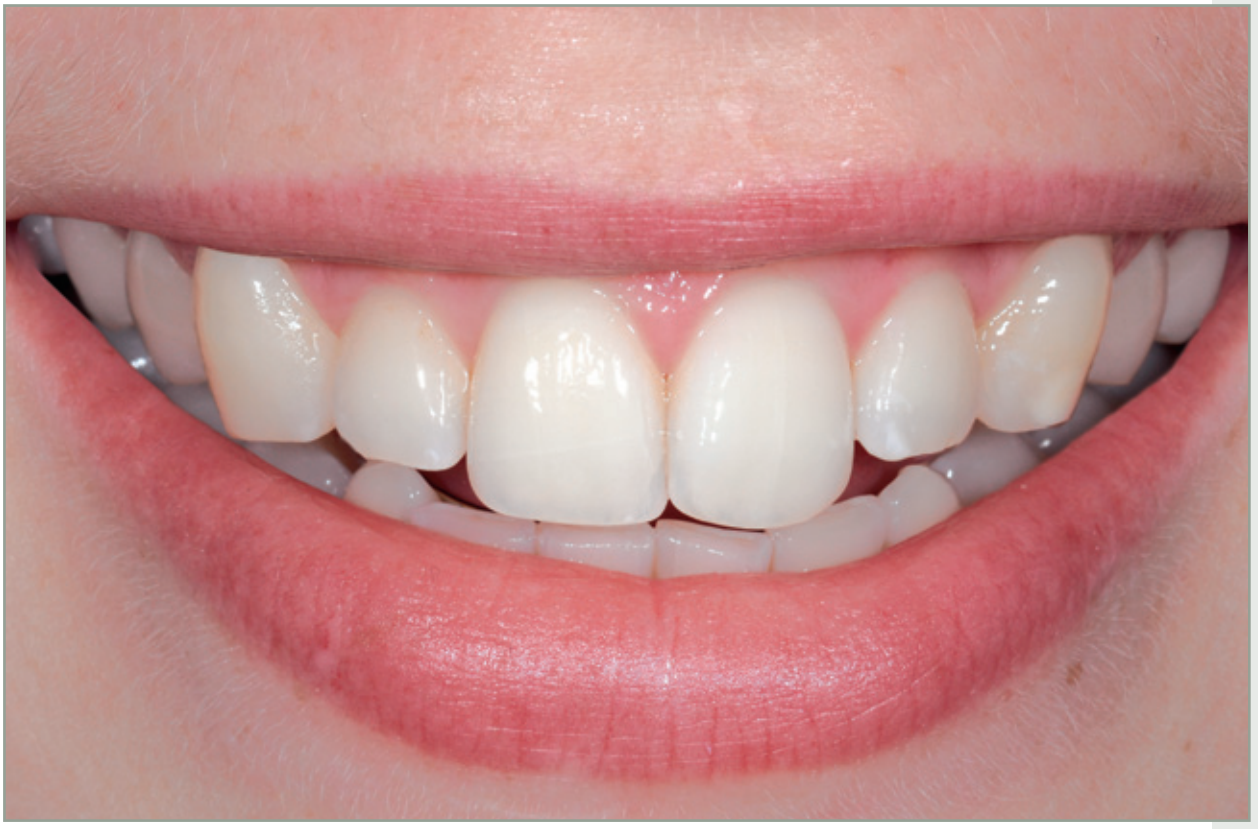

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Abstract

Introduction: An attractive smile helps people feel more self-confident and look younger. One of the more controversial aspects of smile attractiveness pertains to buccal corridor size. There is no previous study by those with artistic knowledge that has assessed the esthetic considerations of buccal corridor size. The purpose of this study was to observe whether the size of buccal corridors has an impact on smile attractiveness evaluated by lay people, dental students, and art students.

Materials and Methods: Colored post-treatment photographs with posed smiles of two subjects (one male, one female) were selected. The maxillary posterior dentitions were digitally altered to produce different buccal corridor sizes: narrow (28% buccal corridor), medium-narrow (22% buccal corridor), medium (15% buccal corridor), medium-broad (10% buccal corridor), and broad (2% buccal corridor). The 5 images of each subject were paired into 11 possible combinations and presented to three groups: art students, dental students, and lay people, who compared the two images in each pair for smile attractiveness. The statistical tests used were Wilcoxon signed rank test and Mann-Whitney test.

Results: Minimal and excessive buccal corridors were the least attractive when judged by three groups. All groups preferred smaller buccal corridors for the male subject and larger buccal corridors for the female subject. No significant judging differences were found between male and female judges from among art and dental students.

Conclusions: Minimal or excessive buccal corridors should be included in the problem list during orthodontic diagnosis and treatment planning.

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Introduction

Physical attractiveness plays an important role in how we view ourselves and how we are viewed by others.[1-3] Dentofacial attractiveness is a major determinant of overall attractiveness.[4-6] Within the face, the mouth and eyes appear to be very important;[7] therefore, the mouth and teeth are considered to be fundamental in facial esthetics.[5,8] However, esthetic perception varies from person to person, and between different social environments.[9] For the same reasons, there can be differences of opinion regarding beauty between lay persons and professionals.[10]

Smile, defined as a facial expression characterized by the upward turning of the corners of the mouth, is often an indicator of pleasure and amusement.[11] We trust smiling people more than nonsmiling ones.[12] An attractive smile helps people to feel more self-confident and to look younger. It can also express and communicate pleasant emotions.[13] An attractive smile is the result of the right interaction of different components,[14-16] and a good occlusion does not necessarily mean an attractive smile.[13] Smile attractiveness includes a number of important components including: smile arc, gingival marginal levels, and tooth color.

One of the more controversial aspects of smile attractiveness pertains to buccal corridor size, defined as the distance between the maxillary posterior teeth (especially the premolars) and the inside of the cheek,[17] which, during smiling, appear as dark areas.[13] As light passes posteriorly, it is reduced, and thus gives the teeth a darker shade and a smaller appearance.[18-20] The narrow maxillary arch[21,22-24] and extraction in the upper dentition[25] were thought to be the cause of the buccal corridor. Others suggested that the anterior-posterior position of the maxilla and the rotation of the maxillary molars could be factors influencing the buccal corridor.[13,26-29]

In 1958, Frush and Fisher defined buccal corridors in dentures and believed that absence of buccal corridors gave the patient an unnatural "denture" appearance. They stated that the size and shape of the buccal corridors were unimportant, as long as the buccal corridors were noticed.[30] Also, Roden-Johnson et al stated that buccal corridor spaces did not have an effect on the smile rating of orthodontists, general dentists, and lay people.[20] But studies found that lay people, dentists, and orthodontists preferred smiles in which their buccal corridors were minimal.[31-34]

To our knowledge, there is no previous study that has assessed buccal corridors and their association with smile esthetics by persons working in artistic environments. Therefore, the purpose of this study was to observe whether the size of buccal corridors has an impact on smile attractiveness, as evaluated by lay people, dental students, and art students.

Material and methods

Case selection

In this cross-sectional study, two patients (one woman, one man) were chosen by two observers (one orthodontist, one dental student) from among 100

patients who had completed comprehensive orthodontic treatment within the previous 24 months. Selected cases displayed the following:

- beautiful smile: both observers agreed on smile attractiveness
- completed permanent dentition (third molars were not considered)
- no active periodontal disease and no periodontal treatment except for routine scaling and polishing
- normal upper-lip length (the normal distance from subnasal to upper lip inferior is 19–22 mm), that is equal to one third of lower facial height (subnasal to soft tissue menton)[35]
- no craniofacial anomalies or other pathologies
- normal facial index: 88.5 in male and 86.2 in female (the proportional relationship of facial height (n–gn) to its width (zy–zy)).[17]

The subjects had colored post-treatment photographs with posed smiles. Posed smiles were used because they are the most repeatable smiles.[36]

Image processing and setting

Two smile criteria were considered: smile fullness and buccal corridor. Buccal corridor ratio (the distance between the maxillary posterior teeth (especially the premolars) and the inside of the cheek)[17] was measured as the difference between the visible maxillary dentition width and the inner commissure width divided by the inner commissure.

Because the original images were made with slight variations in patient-to-film distances, exact linear measurements of buccal corridor widths and smile fullness widths were not possible. Instead, these were calculated as percentages of the commissure width. The sum of the two ratios for a given image would equal 100%. To produce the varying sizes of buccal corridors, each photograph was first digitally scanned (Nikon Coolscan 4000, Melvilee, NY, USA). The resulting images were imported into Adobe® Photoshop® version 7.0 (Adobe Systems Inc., San Jose, CA, USA) and projected on a monitor, with two images of the same magnification. To preserve a realistic appearance, it was decided to leave the intercanine width unaltered. In both images, this width was, on average, nearly 72% of the inner commissure width.

Five altered images were produced for each of two subjects to produce a range of smile fullness that caused different buccal corridor ratios: narrow (28% buccal corridor), medium-narrow (22% buccal corridor), medium (15% buccal corridor), medium-broad (10% buccal corridor), and broad (2% buccal corridor). These five values were chosen according to Moore et al's study.[31] These ranges of smile fullness were produced by copying and pasting posterior teeth (premolars) of the same subject. Some artistic editing was needed to maintain a realistic look. The only difference between the altered images of the same object was the amount of buccal corridor (Fig 1).

Next, each altered image was paired with another altered image of the same subject. There were 10 possible combinations of pairings for each subject. This series of paired images of the same subject would be displayed to the raters. The images were paired be-

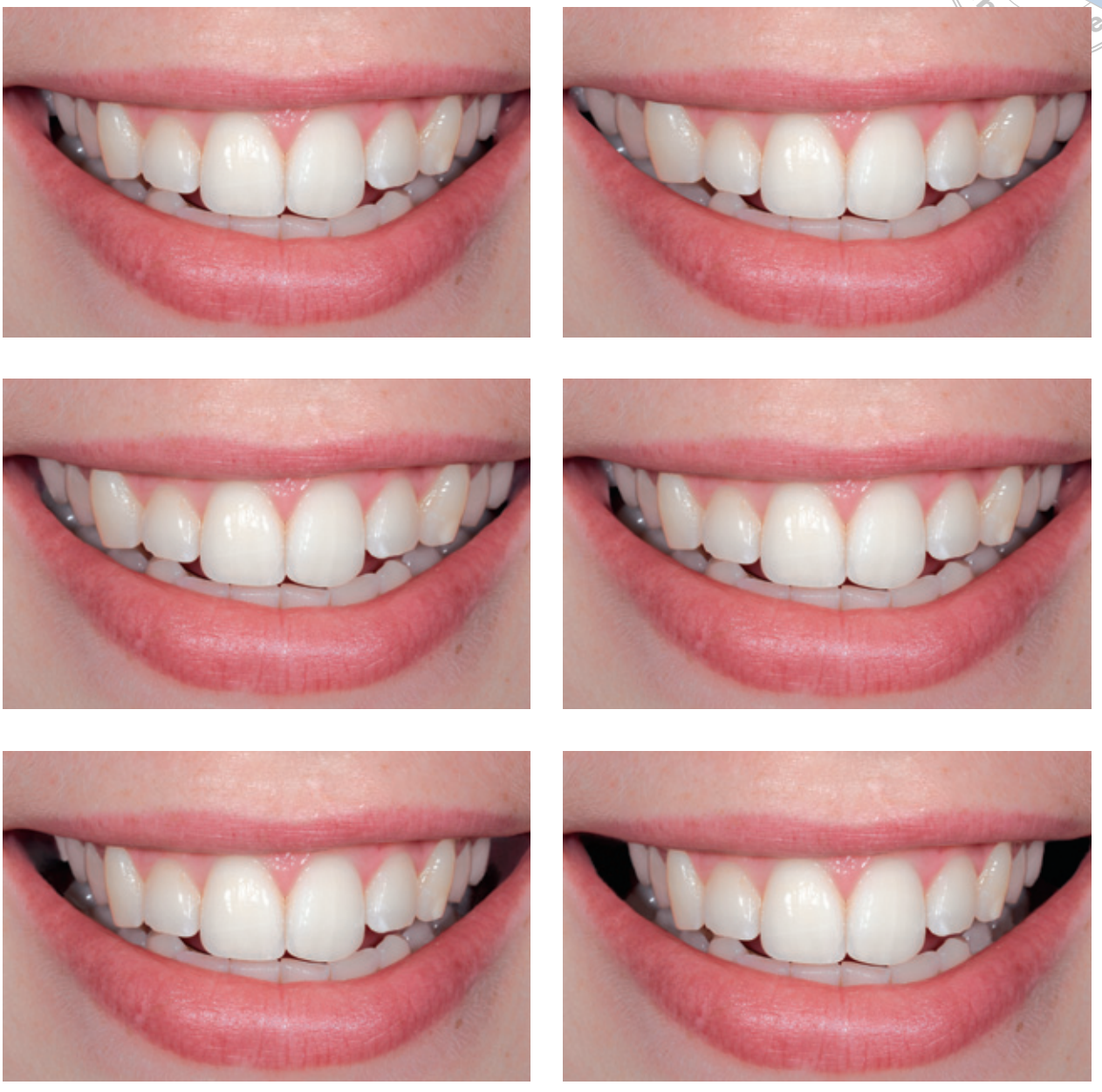

Fig 1 Original, broad, medium-broad, medium, medium-narrow, and narrow smile fullness, respectively.

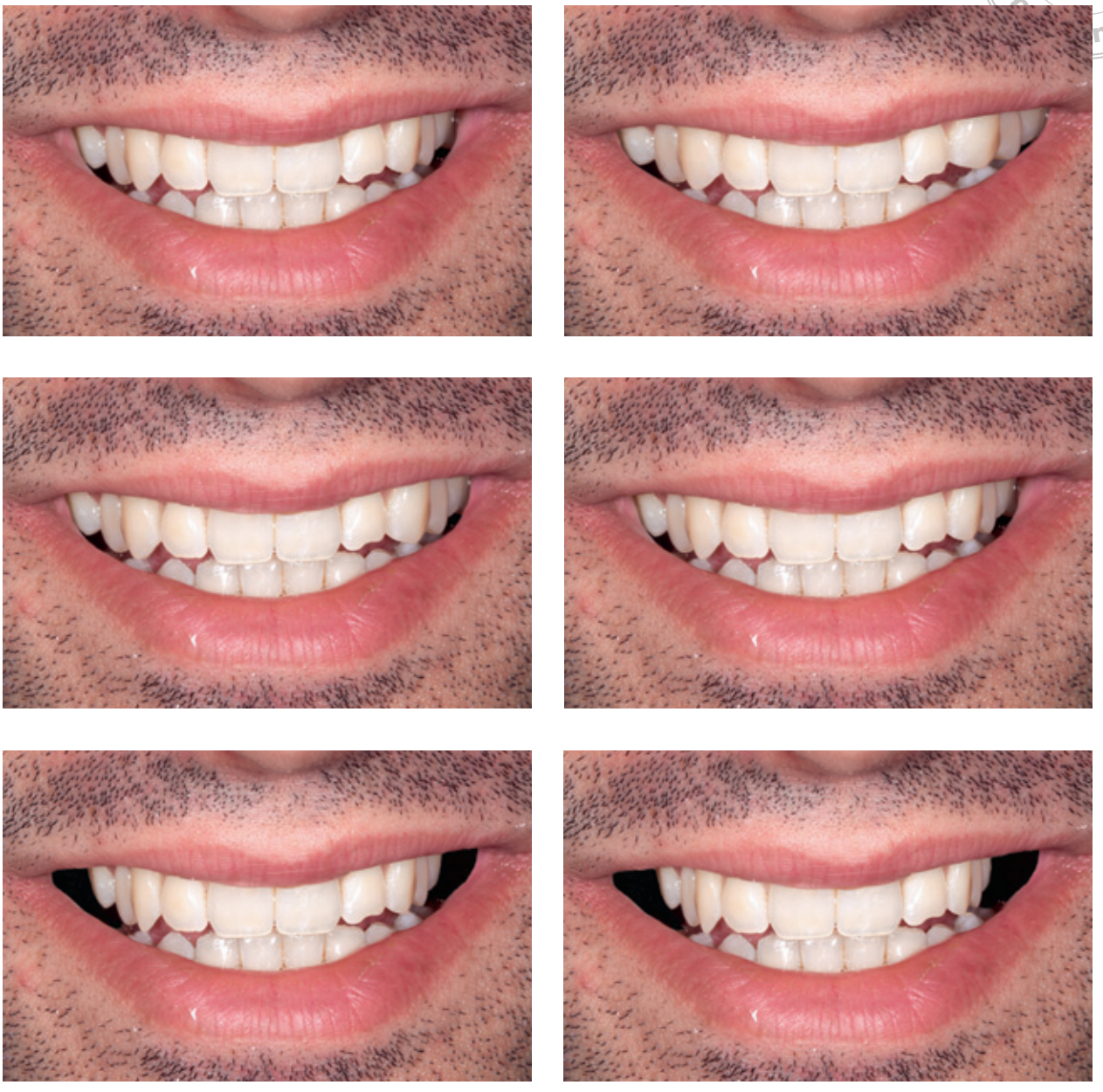

Fig 2 An example of the actual layout shown to the raters.

cause the raters can easily compare them. One randomly identical pairing for each subject was selected and displayed between images for evaluation of reliability of responses (11 pairings for each subject). The pairings were sorted randomly for sequence and left–right positioning (image A and image B). The pairings were then placed into a PowerPoint (Microsoft® Office 2003) slideshow to display to the raters panel. Figure 2 shows an example of the actual layout shown to the evaluators.

Approval for the study was obtained from the ethics committee of Shiraz University of Medical Sciences. As the eyes of the cases were not shown in the images, obtaining an informed consent was not necessary.

Rating and evaluation of images by raters

A total of 118 (48 men, 70 women) raters comprising three groups, aged 18–25, were selected as described below.

- Art students: 34 (15 men, 19 women) students who were trained in portrait drawing were selected randomly from institutions in Shiraz, Iran, until the sample size was large enough.
- Dental students: 52 (16 men, 36 women) students from the final year of dental school, who were taught smile analysis, were selected. At the end of one of their classes, the authors requested all attendant students to remain seated and to rate the images.
- Lay people: 32 (17 men, 15 women) people were selected randomly from patients in the waiting-rooms of different departments in the Shiraz Dental School.

In three groups, five warm-up slides, starting at 10 seconds per slide and gradually decreasing to 5 seconds per slide, were included at the beginning of the slide show. These five slides were not included in the data analysis. Each of the remaining 22 image pairings were shown for 5 seconds each. A 5-second blank slide was placed between each main slide so that participants had enough time to determine their scores. The slides were displayed on a laptop screen (Toshiba Satellite, A105-S 4074, made in Japan with a 13-in bright screen) for the art students and the lay people. These two groups were divided into subgroups consisting of 3 to 4 people, and the slides were shown to them in separate sessions. The slides were displayed to dental students, using a video projector (Notevision PG-C30XU, Sharp, Conshohocken, PA, USA), on a white screen, and all of them participated in the study at the same time.

All raters were instructed to choose the smile they preferred from each pairing and mark their opinion as:

- image A is much better than image B
- image A is better than image B
- image A and image B are the same
- image B is better than image A
- image B is much better than image A.

A point system based on response to each pairings was used to establish a score for each size of buccal corridor. For example, if “Image A is much better than image B” was chosen by a judge, 2 points were added to image A’s overall score, and 2 points were deducted from the overall score for image B. If “Image A is better than image B” was chosen, 1 point was added to its overall score and

1 point was deducted from the overall score for image B. If "same" was chosen, no points were added nor deducted.[31] The mean scores were computed for each combination of images and raters. Descriptive and statistical tests were performed with these mean values. The information from the identical pairings was isolated and analysed separately.

To compare the distributions of mean scores between the two photographs in pairings, the Wilcoxon signed rank test was used. To compare the distributions of mean scores between male and female judges, and between male and female subjects, the Mann-Whitney test was conducted. In all tests, $P < 0.05$ was used as the level of statistical significance.

Results

Regarding the male subject, art students rated 10% buccal corridor the most attractive and 28% buccal corridor the least attractive, but dental students rated 15% buccal corridor the best and 28% buccal corridor the least attractive. Art and dental students rated 22% buccal corridor the best and 2% buccal corridor the least attractive in female subjects. Lay people rated 10% buccal corridor the best in male subjects and 15% in female subjects. They rated 28% buccal corridor the least attractive in both genders.

The data provided no significant differences ($P > 0.05$) between male and female judges or between male and female subjects for each of the images using the Mann-Whitney test. Data showed that dental students could detect differences between degrees of smile fullness better than art students, and art students better than lay people. There were no significant differences between male and female judges and subjects in all three groups ($P > 0.05$).

Regarding identical pairings, measure of agreement (Kappa) was statistically acceptable.

Discussion

The present study, which addressed one of the numerous factors determining smile esthetics, showed that, generally, dental students, art students, and lay people do not prefer smiles with minimal and excessive buccal corridors for both male and female subjects. For male subjects, they prefer small to medium buccal corridors, and for female subject they prefer medium to large buccal corridors. It seems that larger buccal corridors are considered to be a female characteristic. In a study by Moore et al[31], there was no significant difference between male- and female-evaluated subjects' scores, and this is not in agreement with the results of from this study. This may be attributed to the cultural and racial differences with regard to smile esthetics. In the Moore et al study, lay people preferred faces with minimal buccal corridors significantly more than narrow smiles.[31] Similarly, in the present study, lay people preferred smaller buccal corridors than did dental and art students. However, it must be borne in mind that they used full-face photographs, which added various complex characteristics of the face and might cause bias in evaluation of smiles.

Dunn et al[37] offered the opinion that showing a great number of teeth while smiling is more attractive than showing fewer teeth. Although, to some extent, this is comparable to our results, in their study, 16 subjects were evaluated, and this large number of subjects, with great variety of tooth and lip shape and arrangement, could cause different results.

Parekh et al[32] found that both lay people and orthodontists preferred smiles in which the buccal corridor was minimal. This is not in agreement with the present results, which indicated that dental students preferred greater buccal corridors. This may be attributed to the fact that the opinion of a graduate orthodontist differs from a dental student who may have been taught only a little about smile analysis.

Gracco et al[38] demonstrated no differences based on the age or gender of the raters or between lay persons and orthodontists. However, in their study only three different buccal corridors were evaluated, and the greater range of smile fullness in the present study might better resolve natural individual variations.

Martin et al[34] demonstrated that raters' gender did not influence the impact of buccal corridor on smile attractiveness. In our study, there was no significant difference between female and male raters from art and dental students for any images. This may be attributed to the fact that trained individuals (dental and art students of both genders) had a more comparable range of opinion compared with lay people.

Roden-Johnson et al[20] and Hulsey[39] found that variations of buccal corridor sizes did not have an effect on smile esthetics. This might be due to the fact that their definition of buccal corridor size was based on intercanine width. Also, a greater number of subjects, and the use of only 20 raters in Hulsey's study, might account for different results.

The present study showed that dental students preferred smiles with larger buccal corridors, as compared with lay people and art students. This is the first study that considered art students' opinions in the survey.

In the present study, lay people were not as discriminating as art students, and art students were not as discriminating as dental students regarding buccal corridor sizes. As dental students are trained to focus on smiles, they might be expected to detect smaller differences in the size of buccal corridor than lay people. Art students whose major training was in drawing portraits detected the differences between buccal corridors better than lay people, as they pay attention to smile structures in drawing portraits. Therefore, in evaluation of smiles, artistic concepts are also important. These findings are in agreement with Kokich et al[40], who demonstrated different perceptions of dental esthetics between general dentists, orthodontists, and lay people, and also showed that orthodontists are more perceptive than the other groups.

As excessive and minimum buccal corridors were perceived to be less attractive than average buccal corridors, orthodontists should include these in the problem list during orthodontic diagnosis and treatment planning.

In art and dental student groups, there was no difference between male and female judges. The results indicate

that the gender of the judge does not affect the perception of buccal corridor size in these groups. The lack of a gender difference is in agreement with other studies evaluating smile esthetics, for example, Brisman,[33] Dunn et al,[37] Gracco et al,[38] and Martin et al,[34] which all indicated that male and female judges had similar opinions. However, it is not in agreement with Perrett et al[41] and Moore et al,[31] who described how females are more sensitive to changes in factors of attractiveness. This might be attributed to cultural and study design differences in different studies.

Conclusions

- Minimal or excessive buccal corridors should be included in the problem list during orthodontic diagnosis and treatment planning.
- Dental students are more discriminating about buccal corridor changes than art students, and art students are more discriminating than lay people.
- No significant differences are found between male and female judges from art and dental students in judging smile attractiveness with varying levels of smile fullness.
- Lay people and art and dental students prefer smaller buccal corridors for male subjects and larger buccal corridors for female subjects.

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