Original Article

Effects of Buccal Corridors on Smile Esthetics in Japanese

Hideki Ioi[a]; Shunsuke Nakata[b]; Amy L. Counts[c]

ABSTRACT

Objective: To test the hypothesis that the amount of buccal corridor has no influence on smile evaluations of Japanese orthodontists and dental students.

Materials and Methods: One photograph of a smiling female, displaying first molar to first molar, was constructed. Buccal corridors were modified digitally in 5% increments, from 0% to 25% buccal corridor compared with the inner commissural width. Using a visual analog scale (VAS), 32 Japanese orthodontists and 55 Japanese dental students rated the attractiveness of six smiles with altered buccal corridors. The Wilcoxon rank-sum test was conducted to compare the distributions of the median scores between the male and female raters for each of the rater groups. Differences in the median esthetic scores were analyzed using the Kruskal-Wallis test. We used 15% VAS difference to determine the clinical significance of the esthetic scores.

Results: There was no significant difference in judging the effects of buccal corridors on the smile attractiveness between the male and female raters for both the orthodontists and dental students. There were significant differences in the median esthetic scores for both the orthodontists and dental students. The median esthetic score decreased to become clinically significant from 10% to 25% buccal corridor for both the orthodontists and dental students.

Conclusions: The hypothesis was rejected. Both the orthodontists and dental students preferred broader smiles to medium or narrow smiles. (*Angle Orthod.* 2009;79:628–633.)

KEY WORDS: Buccal corridor; Smile esthetics; Attractiveness; Visual analog scale; Japanese

INTRODUCTION

The mouth and teeth are considered fundamental in facial esthetics.[1,2] The attractiveness of smiles has been evaluated in modern orthodontics. Three aspects of smile esthetics have recently received great attention: the amount of gingival display, the presence of the smile arc, and buccal corridor spaces. A smile demonstrating minimal gingival display has been considered to be more esthetic than a smile with excessive gingival display.[3–5] The smile arc is defined as the relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in the posed smile.[6] The smile arc is considered ideal when the maxillary incisal edge curvature is parallel to the curvature of the lower lip.[3,6,7]

Another important smile aspect is the presence or absence of buccal corridors. Frush and Fisher[8] defined the buccal corridor as the spaces between the facial surfaces of the posterior teeth and the corners of the lips when the patient is smiling. They considered that the presence of the buccal corridor was important to attempt to fabricate a more natural-looking denture. They believed that a very broad denture gave the patient an unnatural denture appearance. At the present time, however, because more people are living longer and preserving their natural teeth, the perception of pleasing smile esthetics might be changing. In fact, when laypersons were shown full-face color photographs with five alterations in the buccal corridors, they preferred faces with minimal buccal corridor spaces.[9] Specifically, laypersons significantly preferred broader smiles to narrow smiles. To date, there has been no report evaluating the effects of buccal corridors on smile esthetics in the Japanese population.

The purpose of this study was to test the hypothesis

[a] Lecturer, Department of Orthodontics, School of Dentistry, Kyushu University, Fukuoka, Japan.

[b] Associate Professor, Department of Orthodontics, School of Dentistry, Kyushu University, Fukuoka, Japan.

[c] Professor, Department of Orthodontics, Jacksonville University, School of Dentistry, Jacksonville, Florida.

Corresponding author: Dr. Hideki Ioi, Department of Orthodontics, Kyushu University, 3-1-1 Maidashi, Higashi-ku, Fukuoka, Fukuoka 812-8582, Japan
(e-mail: ioi@dent.kyushu-u.ac.jp)

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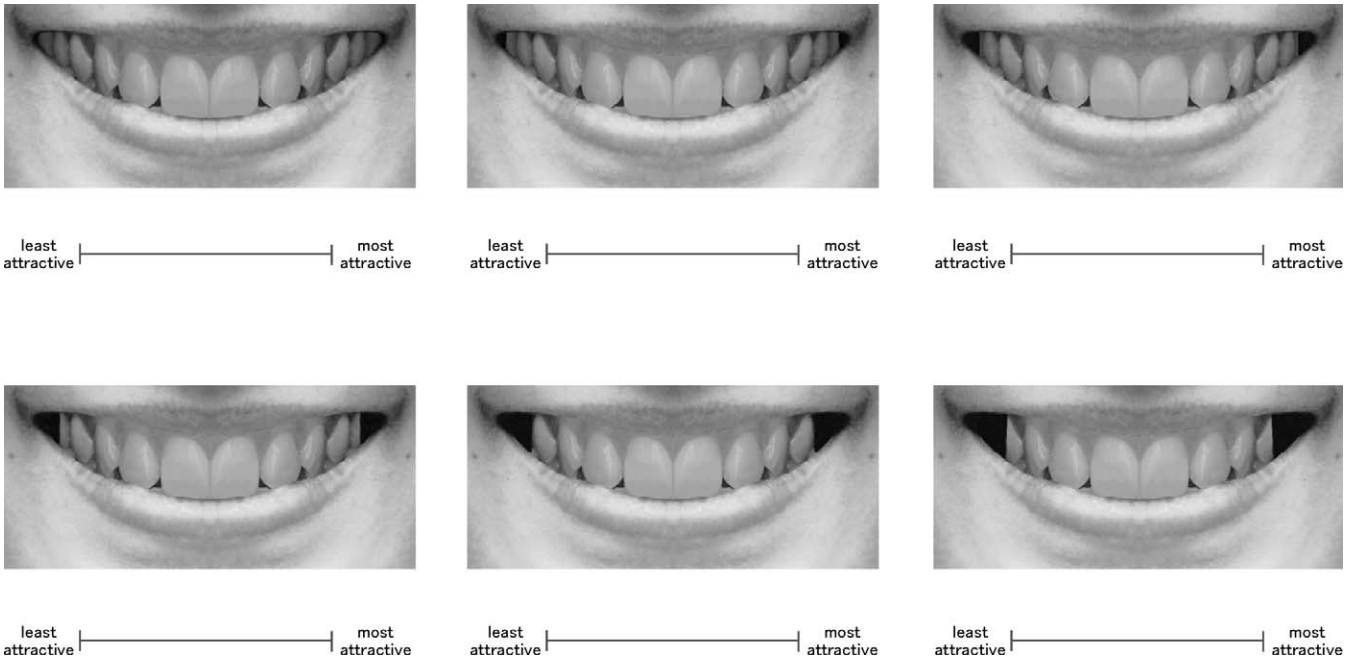

Figure 1. Series of six images illustrating the range of buccal corridors created: extra broad (0% buccal corridor), broad (5% buccal corridor), medium-broad (10% buccal corridor), medium (15% buccal corridor), medium-narrow (20% buccal corridor), and narrow (25% buccal corridor).

that the amount of the buccal corridor has no influence on smile evaluations of Japanese orthodontists and dental students.

MATERIAL AND METHODS

This study was performed in accordance with the guidelines of the Helsinki Declaration (1996).

Sample Size

A sample size calculation was undertaken using nQuery Adviser (version 6.01, Statistical Solutions, Cork, Ireland). According to our pilot study, the effect size was estimated at .914. On the basis of a significance level of alpha .050, the sample size was calculated to achieve 90% power. The sample size calculation showed that five subjects were necessary for each group.

Construction of a Series of Images

One frontal intraoral photograph of a female with ideally aligned teeth and one extraoral photograph of a female who displayed esthetic smiling lips were obtained from different persons. These ideally aligned teeth and the lips were combined to form a standard composite smile with all teeth displayed to the first molar. The lower lip coincided with the curvature of the incisal edges of the maxillary incisors and canines. These images were modified using Adobe Photoshop CS2 (San Jose, CA) to create bilaterally symmetrical teeth and lips. The amount of buccal corridor was calculated as the difference between the visible maxillary dentition width and the inner commissural width divided by the inner commissural width. The ratio was reported as a percentage. As the width of the dental arch increased, the buccal corridor would decrease, and it would result in broad smiles. Six different sizes of buccal corridor were created: extrabroad (0% buccal corridor), broad (5% buccal corridor), medium-broad (10% buccal corridor), medium (15% buccal corridor), medium-narrow (20% buccal corridor), and narrow (25% buccal corridor). Six images were arranged in the order of the amount of buccal corridor spaces and were displayed on A-4 size paper (Figure 1).

Raters

The profile raters were 32 Japanese orthodontists (15 men, 17 women; aged 32.8 $\pm$ 7.6 years) and 55 Japanese dental students in the fifth year of dental school (31 men, 24 women; aged 23.9 $\pm$ 2.5 years) from Kyushu University in Fukuoka, Japan. The subjective esthetic value of each smile was rated using a visual analog scale. This rating scale was designed for minimal constraints and the most freedom to express a personal response style. The VAS was 50 mm long, and raters used their own esthetic values to rank each smile from *least attractive* to *most attractive.* An esthetic score was obtained by multiplying the distance between the least attractive (zero) and the hash mark

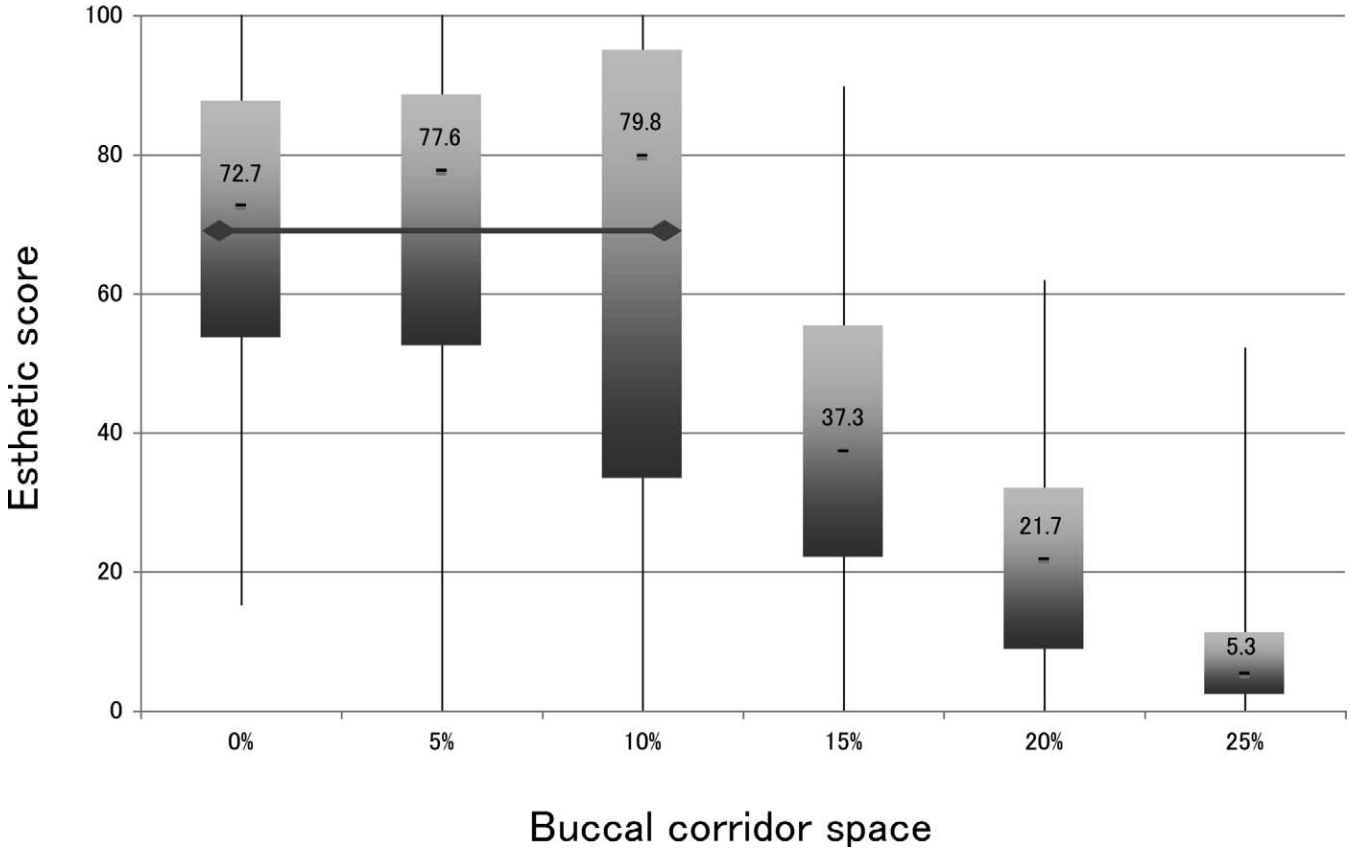

Figure 2. The median values and ranges of the esthetic scores for each buccal corridor space rated by the orthodontists. The bar indicates smiles for which there was no significant difference clinically. A 15% difference in VAS score was used to determine the clinical significance of the esthetic scores.

by two. Namely, the esthetic score was distributed from 0 to 100, with 0 being the minimum and 100 the maximum esthetic value.

Reliability

Ten randomly selected raters from each of the orthodontist group and dental student group were asked to evaluate six images twice to determine reliability. Paired-sample tests showed that there was no method error in rating the attractiveness for both groups.

Statistical Analysis of the Data

To compare the distributions of the median scores between the male and female raters for each of the rater groups, the nonparametric Wilcoxon rank-sum test was conducted. Differences in the median esthetic scores were analyzed using the Kruskal-Wallis test. The minimum level of statistical significance was set at $P < .05$.

The VAS has been used for pain research and generally, a minimum clinically significant difference ranges from 9% to 13% of the VAS scale.[10–12] Parekh et al[13] applied 15% VAS difference as a clinically significant difference to evaluate attractiveness. We also used 15% VAS difference to determine the clinical significance of the esthetic scores.

RESULTS

There was no significant difference in judging the effects of buccal corridors on the smile attractiveness between the male and female raters for both the orthodontist group and dental student group. Therefore, the pooled data for both the male and female raters were used for the following analysis. The median values and ranges of the esthetic scores to each buccal corridor space for the orthodontists and dental students are shown in Figures 2 and 3, respectively. The Kruskal-Wallis test showed that there were significant differences in the median esthetic scores for both the orthodontists and dental students ($P < .0001$).

For the orthodontists, the median esthetic score increased gradually from 0% to 10% buccal corridor and then decreased to become clinically significant (15% VAS difference) from 10% to 25% buccal corridor. For

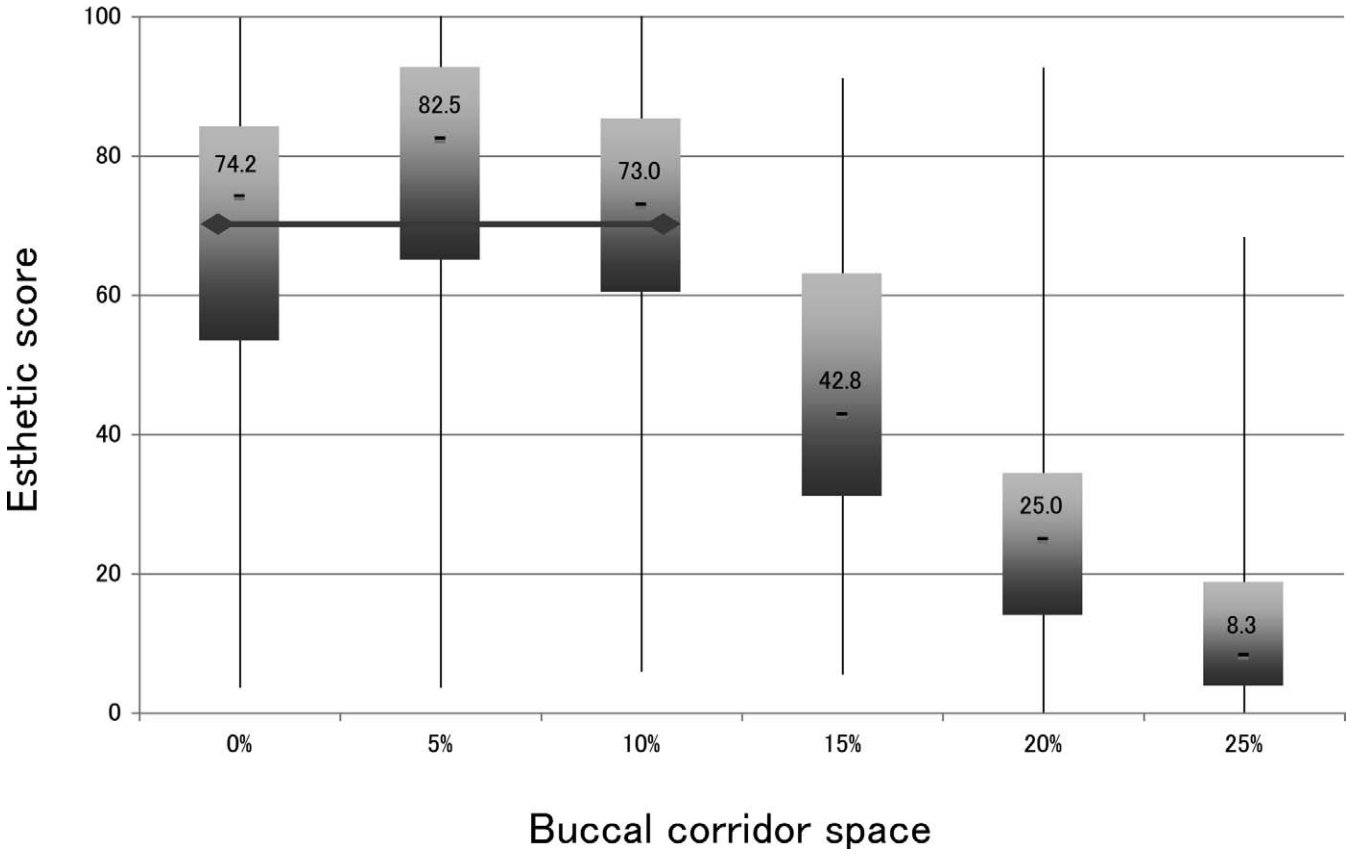

Figure 3. The median values and ranges of the esthetic scores for each buccal corridor space rated by the dental students. The bar indicates smiles for which there was no significant difference clinically. A 15% difference in VAS score was used to determine the clinical significance of the esthetic scores.

the dental students, the median esthetic score increased gradually from 0% to 5% buccal corridor and then decreased from 5% to 25% buccal corridor. In particular, it decreased to become clinically significant from 10% to 25% buccal corridor.

DISCUSSION

In a scientific study, it is important that the power is high enough. The sample size calculation revealed that a sample of five subjects for each group was sufficient to achieve 90% power. Since 32 Japanese orthodontists and 55 Japanese dental students were analyzed in this study, the power was sufficiently high to reveal reliable results.

The VAS is one of the most common tools used to assess pain intensity and has been shown to be a valid, reliable, and reproducible method of measuring subjective pain.[14] As many investigators[13,15–18] have used the VAS method to judge attractiveness, use of the VAS method in scoring esthetics should also provide simple, rapid, and reproducible results. The only drawback or shortcoming of this study was not showing the raters the images randomly. That could introduce an order effect.

To date, there has not been ample evidence to support what is esthetically attractive in the smiles of the Japanese population. This study focused on the effects of buccal corridors on smile attractiveness when judged by Japanese orthodontists and dental students.

No significant difference was shown in the esthetic scores between the male and female raters for both the orthodontists and dental students. Moore et al[9] found no significant difference in judging smile esthetics between male and female subjects or between male and female judges. Martin et al[16] and Gracco et al[19] also reported that rater gender and age were not significant in rating of buccal corridor preferences.

In this study, the orthodontists and dental students have similar tendencies in rating the preferences of buccal corridor spaces. Parekh et al[20] stated that laypersons and orthodontists have similar preferences when the acceptability of buccal corridors and smile arcs are considered. Krishnan et al[15] also indicated

that there was no perception difference between dental specialists and laypersons on overall smile evaluation. If the assumption is made that unpleasant smiles are those with esthetic scores ranging from 0 to 50 and that pleasant smiles are those with scores of 51 to 100, both the orthodontists and dental students considered smiles with buccal corridors of less than 10% to be pleasant and smiles with buccal corridors of more than 15% to be unpleasant. Overall, both the orthodontists and dental students preferred broader smiles to medium or narrow smiles. Hulsey,[3] Ritter et al,[17] and Roden-Johnson et al[18] reported that buccal corridor space was not a critical issue for evaluating smile esthetics. However, Parekh et al[13] reported that both laypersons and orthodontists preferred smiles in which the smile arc is parallel to the lower lip and buccal corridors were minimal. Moore et al[9] reported that a broader smile was judged by laypersons to be more attractive than a narrow smile. Martin et al[16] also indicated that orthodontists and laypeople rated smiles with small buccal corridors as significantly more attractive than those with large buccal corridors. Across the country, people appear to prefer less buccal corridor spaces. However, it should be taken into account that there is a substantial variation regarding the preferences of buccal corridor spaces. There is an argument that the impression of smile attractiveness is different when we evaluate it from full-face or mouth view. Moore et al[9] stated that the size of buccal corridors influences smile attractiveness when the entire face is taken in context. Our study showed that the effects of buccal corridors on smile esthetics could be evaluated from mouth view.

Both the orthodontists and dental students judged excessive buccal corridors of more than 15% as less attractive, and the median values of the esthetic scores of 10% to 15% buccal corridor for the orthodontists and dental students sharply decreased from 79.8 to 37.3 and from 73.0 to 42.8, respectively. It is interesting to reveal that this 5% difference of 10% to 15% buccal corridor caused a clinically significant change (15% VAS difference) in the preference of smile esthetics. Although the precise cause of this difference is unclear, the raters might consider a 15% buccal corridor as one of the narrow smiles, which were less attractive. Clinicians should keep in mind that a small change in buccal corridor spaces might significantly influence the perception of smile esthetics. We propose this range as a threshold between more and less attractive smiles when evaluating buccal corridors.

The raters selected for this study were orthodontists and dental students. We considered each of the two groups to be an expert and nonexpert group, respectively. Although the opinion of the dental students may not precisely represent lay opinion, we categorized them as the nonexperts. This was because the dental students who participated in this study received no prior education regarding the evaluation of smile esthetics. We also regarded the dental students as young adults who were potential candidates for orthodontic treatment. Although the orthodontists and dental students had similar tendencies in rating the preferences of buccal corridor spaces, the dental students tended to prefer a slightly broader smile compared with the orthodontists. These results suggest that it is important to consider the perceptions of nonorthodontists or young adults in determining orthodontic treatment goals. Additional research including lay people as raters appears to be warranted. If the orthodontist's perception of esthetics is not congruent with the patient's perception, the result might not be acceptable to the patient. However, it does not mean every patient should be treated to broad smiles with broad arches. The original arch form of each patient should be respected in preventing posttreatment relapse. Therefore, it is very important during diagnosing and treatment planning to examine not only the dental arch width or form but also the alveolar bone width or form.

CONCLUSIONS

- The hypothesis that the amount of buccal corridor has no influence on smile evaluations of Japanese orthodontists and dental students was rejected.
- No significant difference was shown for judging the effects of buccal corridors on the smile attractiveness between the male and female raters for both the orthodontists and dental students.
- Both the orthodontists and dental students preferred broader smiles to medium or narrow smiles.

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