Effects of buccal corridors on smile esthetics in Japanese and Korean orthodontists and orthodontic patients

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Introduction: The purpose of this study was to evaluate the influence of the size of buccal corridors on the assessment of attractive smile esthetics by Japanese and Korean orthodontists and orthodontic patients. Methods: Buccal corridors were modified digitally from 0% to 25% compared with the inner intercommissural width. Using a visual analog scale, 41 Japanese and 25 Korean orthodontists, and 96 Japanese and 72 Korean orthodontic patients (15-29 years old) rated the attractiveness of 6 smiles with altered buccal corridors. The influence of the size of the buccal corridor on smile esthetics was assessed. Results: Although there was no significant sex difference in judging the effects of buccal corridors for the Korean and Japanese orthodontists, significant sex differences were shown for the Japanese orthodontic patients. There were significant differences in the 6 levels of median esthetic scores for all groups: 0%, 5%, and 10% buccal corridors in the smiles tended to be preferred to the other smiles, to become clinically significant for all groups. The median esthetic score decreased to become clinically significant from 10% to 15% buccal corridors for all groups. Conclusions: Japanese and Korean orthodontists and orthodontic patients prefer narrow or medium buccal corridors to broad buccal corridors. (Am J Orthod Dentofacial Orthop 2012;142:459-65)

The smile plays an important role in facial expression. It influences a person’s perceived attractiveness and is the cornerstone of social interaction. People mainly focus on another person’s eyes and mouth during interpersonal interactions.1 Goldstein2 stated that the smile ranks second only to the eyes as the most important feature in facial attractiveness. On the other hand, Havens et al3 reported that tooth alignment is a more important factor than the eyes for evaluating facial esthetics. Therefore, contemporary orthodontists must consider esthetic smiles by managing the dentition and soft tissues. In clinical orthodontics, patient-driven esthetic diagnosis and treatment planning have become important. Thus, smile analysis has become an essential element of diagnosis and treatment planning.

Buccal corridors are the spaces between the facial surfaces of the maxillary teeth and the inner commissures. There seems to be a difference of opinion among investigators about the esthetic value of buccal corridors. Several researchers4-9 have reported that buccal corridor minimization is a critical smile feature, whereas others concluded that buccal corridors have little impact on smile esthetics.10-13 The preference of the amount of buccal corridors might be influenced by the regional differences of raters, who have a variety of cultural and ethnic backgrounds. A few researchers have stated that demographic, cultural, and ethnic backgrounds affect a layperson’s perceptions of esthetic and smile characteristics.14-16 However, little is known about how cultural and ethnic differences influence esthetic perceptions.

Koreans and Japanese stem from the same racial group and have similar cultural backgrounds. Moreover, at the present time, young adults experience greater exposure to mass media through television, movies, the
Internet, and travel. The perception of a pleasing facial profile might differ between the 2 countries or be converging on a more internationally pleasing one. In light of these facts, in this study, we aimed to evaluate the influence of the size of buccal corridors on smile esthetics as assessed by Japanese and Korean orthodontists as well as orthodontic patients.

It is important to evaluate the perceptions of dentofacial esthetics by laypeople or orthodontic patients when an orthodontic treatment plan is determined. In general, orthodontists tend to be more critical of dental esthetics than do laypeople when a dental disharmony is small. On the other hand, Phillips et al reported that trainee orthodontists gave higher scores when rating overall dentofacial attractiveness than did dental undergraduates and laypeople. In our previous studies investigating attractive anteroposterior lip positions in Japanese subjects, both the orthodontists and the orthodontic patients showed similar tendencies in their preferences. As of yet, no report has compared the preferences for buccal corridors between orthodontists and orthodontic patients for Japanese and Korean people.

The overall purpose of this study was to identify the threshold where the size of the buccal corridors begins to diminish dentofacial esthetics in the smiles as assessed by Japanese and Korean orthodontists and orthodontic patients. The hypotheses were that (1) the amounts of buccal corridor affect the assessments of smile esthetics, (2) there are no significant differences in the assessment of smile esthetics between Japanese and Korean people, (3) there are no significant differences in the assessment of smile esthetics between orthodontists and orthodontic patients, and (4) a distinct threshold would exist when the effects of the buccal corridors on the smile are evaluated.

**MATERIAL AND METHODS**

This study was performed in accordance with the guidelines of the Helsinki Declaration revised in Seoul (2008). The research protocol was approved by the institutional review board for clinical research of Kyushu University, Fukuoka, Japan.

A sample size calculation was undertaken by using nQuery Adviser (version 6.01; Statistical Solutions, Cork, Ireland). According to our pilot study, the effect size was estimated at 0.95. On the basis of a significance level of alpha 0.05, the sample size was calculated to achieve 80% power. The sample size calculation showed that 21 subjects for each group were necessary.

One frontal intraoral photograph of a woman with ideally aligned teeth and 1 extraoral photograph of a woman displaying esthetically smiling lips were obtained from different persons. These ideally aligned teeth and lips were combined to form a standard composite smile with all teeth shown to the first molars. The lower lip coincided with the curvature of the incisal edges of the maxillary incisors and canines so that the smile arc was consonant. These images were modified (CS4; Adobe Photoshop, San Jose, Calif) to create bilaterally symmetrical teeth and lips. The amount of buccal corridor was calculated as the difference between the inner intercommissural width and the visible maxillary dentition width divided by the inner intercommissural width. The ratio was reported as a percentage. As the visible maxillary dentition width increases, the buccal corridor decreases, and it would result in narrow buccal corridors. Six sizes of buccal corridors were created: narrow (0%), medium-narrow (5%), medium (10%), medium-broad (15%), broad (20%), and extrabroad (25%). Six images were arranged in the order of the amount of buccal corridor spaces and displayed on size A-4 paper (Fig 1).

The smile raters were 41 Japanese orthodontists (18 men, 23 women; ages, 31.5 ± 7.2 years); 96 Japanese orthodontic patients (36 males, 60 females; age range, 15-29 years; SD, 21.5 ± 3.8 years) from Kyushu University Hospital in Fukuoka, Japan; 25 Korean orthodontists (12 men, 13 women; ages, 27.9 ± 2.3 years); and 72 Korean orthodontic patients (33 males, 39 females; age range, 15-29 years; SD, 22.2 ± 3.2 years) from Pusan National University Dental Hospital in Pusan, Korea. The determination of the subjective esthetic value of each smile was accomplished by using a visual analog scale. This rating scale was designed for minimal constraints and the most freedom to express a personal response style. The visual analog scale was 50 mm long, and the 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 (0) and the hash mark by 2. The esthetic scores were distributed from 0 to 100, with 0 the minimum and 100 the maximum esthetic values.

Ten randomly selected raters from each of the Japanese and Korean orthodontists and orthodontic patients were asked to evaluate 6 images twice at least 2 weeks later to determine reliability. Intraclass correlation coefficients were used for determining intrarater agreement. High levels of reliability were found, since all intraclass correlation coefficients were greater than or equal to 0.7.

**Statistical analysis**

To compare the distributions of the median scores between the male and female raters of each rater group,
the Mann-Whitney U test was used. Differences in the median esthetic scores in the 6 levels of buccal corridor were analyzed by using the Kruskal-Wallis test. The minimum level of statistical significance was set at $P < 0.05$.

Visual analog scales have been used for pain research, and generally a minimum clinically significant difference ranges from 9% to 13% of the scale.21-23 Parekh et al6 applied a 15% visual analog scale difference as a clinically significant difference to differentiate the smile esthetics. We also used a 15% visual analog scale difference to determine the clinical significance of the esthetic scores.

RESULTS

There was no significant difference in judging the effects of buccal corridors on smile attractiveness between the men and women for both the Japanese and Korean orthodontists. Therefore, the pooled data of male and female raters for Japanese and Korean orthodontists were used for the following analysis. The median values and ranges of the esthetic scores of each buccal corridor space for the Japanese and Korean orthodontists are shown in the Table and Figure 2. For the Japanese orthodontists, the median esthetic scores increased gradually from 0% to 10% buccal corridors and then decreased to become clinically significant (15% visual analog scale score difference) from 10% to 25% buccal corridors. For the Korean orthodontists, the median esthetic scores increased to become clinically significant from 0% to 5% buccal corridors and then decreased from 5% to 25% buccal corridors; particularly, the scores decreased clinically significantly from 10% to 25% buccal corridor. Moreover, no clinically significant difference was observed in the median visual analog scale scores between the Japanese and Korean orthodontists for each level of buccal corridor.

There were significant differences in judging the effects of buccal corridors on the smile attractiveness between the male and female Japanese orthodontic patients. The median values and ranges of the esthetic scores for each level of buccal corridor for the Japanese and Korean male orthodontic patients are shown in the Table and Figure 3. For both the Japanese and Korean male orthodontic patients, the median esthetic score increased gradually from 0% to 5% buccal corridors, and then it decreased from 5% to 25% buccal corridors. In particular, it decreased to become clinically significant from 10% to 25% buccal corridors, except between 15% and 20% in the Korean raters. No clinically significant difference was observed for the median visual analog scale score between the Japanese and Korean male patients for each level of buccal corridor.

The median values and ranges of the esthetic scores for each buccal corridor space for the Japanese and Korean female orthodontic patients are shown in the Table and Figure 4. For both the Japanese and Korean female orthodontic patients, 0% to 10% buccal corridor smiles were preferred to the other smiles to become clinically significant. No clinically significant difference was
observed for the median visual analog scale score between the Japanese and Korean female patients for each level of buccal corridor.

**DISCUSSION**

To date, there has not been ample evidence to determine what is esthetically attractive in the smiles of Japanese and Korean populations. Worldwide communications through the media, such as the Internet, television, movies, and magazines, have expanded in recent years. Although Japan and Korea are different counties, they appear to be integrated into the international community. Furthermore, young people who are potential candidates for orthodontic treatment are likely to be profoundly influenced by such media. With these points, we inferred that there might be a consensus on the contemporary perception of smile esthetics between these countries because of an increase in worldwide access to variations. The objectives of this study were to assess and compare the effects of the amounts of buccal corridor on smile esthetics rated by Japanese and Korean people, and to identify the threshold where the amounts of buccal corridor begin to diminish the smile esthetics. Another objective was to focus on the comparison of the raters’ categories: orthodontists as health care providers and orthodontic patients as health care receivers.

There was no significant difference in the esthetic scores between the male and female raters for both the Japanese and Korean orthodontists. Parekh et al reported that no significant difference was recognized between attractive ratings for male and female orthodontists. Moore et al found no significant differences in judging smile esthetics between male and female subjects, or between male and female judges. Gracco et al and Martin et al also reported that the raters’ sex and age were not significant in the rating of buccal corridor preferences. However, for judging 15% and 25% buccal corridors, the Japanese male orthodontic patients had significantly higher scores than did the female patients. This tendency was also observed for the Korean orthodontic patients for judging 20% and 25% buccal corridors. These results suggest that the male patients were more tolerant of narrow smiles than were the female patients in the 2 countries.

The main finding of our study was that no clinically significant difference was observed for the median visual analog scale scores between the Japanese and Korean raters of both the orthodontists and the orthodontic patients. Overall, the raters of all groups preferred narrow or medium buccal corridors (0%-10%) to medium-broad (15%) or broad buccal corridors (20%-25%). These results might imply that a similar perception of smile esthetics has been established across the borders of Japan and Korea. However, in Western countries, McLeod et al, who compared Canadian laypersons’ perceptions of smile esthetics with those in the United States, stated that cultural differences exist related to smile characteristics. Canadian laypersons were more discriminating to deviations from ideal and had a narrower range of acceptability. Sharma et al reported that no statistically significant difference was found for buccal corridor evaluation between Indians in the United States and those in India. The similarity of the preferences of buccal corridor evaluation in our study might be due to the closeness of the cultures in the 2 counties. In Western countries, although there are some disagreements regarding the effects of buccal corridors on smile attractiveness, several researchers have stated that orthodontists and laypeople rated smiles with small buccal corridors as significantly more attractive than those with large buccal corridors. The previous reports of ideal buccal corridor size vary from 2% to 19%. Ker et al reported that the ideal

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**Table. Median values and ranges of the esthetic scores for each level of buccal corridor space**

<table>
<thead>
<tr>
<th>Raters</th>
<th>Buccal corridor space level</th>
<th>0% Median</th>
<th>P25</th>
<th>P75</th>
<th>5% Median</th>
<th>P25</th>
<th>P75</th>
<th>10% Median</th>
<th>P25</th>
<th>P75</th>
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<tr>
<td>Japanese orthodontists</td>
<td>0%</td>
<td>74.5</td>
<td>53.1</td>
<td>87.8</td>
<td>78.7</td>
<td>57.7</td>
<td>88.7</td>
<td>82.0</td>
<td>43.1</td>
<td>96.2</td>
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<tr>
<td>Korean orthodontists</td>
<td>0%</td>
<td>63.4</td>
<td>33.9</td>
<td>81.7</td>
<td>89.6</td>
<td>69.2</td>
<td>99.4</td>
<td>74.1</td>
<td>61.4</td>
<td>90.3</td>
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<td>Japanese orthodontic patients</td>
<td>0%</td>
<td>73.3</td>
<td>64.2</td>
<td>86.0</td>
<td>82.2</td>
<td>62.4</td>
<td>94.0</td>
<td>75.6</td>
<td>52.4</td>
<td>88.1</td>
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<td>Male</td>
<td>82.1</td>
<td>59.2</td>
<td>95.4</td>
<td>78.6</td>
<td>61.1</td>
<td>88.6</td>
<td>71.4</td>
<td>52.1</td>
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<tr>
<td>Female</td>
<td>79.2</td>
<td>50.5</td>
<td>91.6</td>
<td>86.1</td>
<td>71.2</td>
<td>93.3</td>
<td>73.1</td>
<td>52.4</td>
<td>83.2</td>
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<td>Korean orthodontic patients</td>
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<td>76.3</td>
<td>42.4</td>
<td>93.1</td>
<td>79.5</td>
<td>51.1</td>
<td>93.0</td>
<td>70.4</td>
<td>56.1</td>
<td>83.9</td>
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P25, The 25th percentile; P75, the 75th percentile.
Table. Continued

<table>
<thead>
<tr>
<th></th>
<th>15%</th>
<th></th>
<th></th>
<th>20%</th>
<th></th>
<th></th>
<th>25%</th>
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<th>Kruskal-Wallis test</th>
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<tr>
<td></td>
<td>Median</td>
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<td>P75</td>
<td>Median</td>
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<td>57.2</td>
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<td>9.8</td>
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<td>6.0</td>
<td>2.3</td>
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<td>9.8</td>
<td>41.2</td>
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<td>26.3</td>
<td>54.2</td>
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<td>11.3</td>
<td>46.3</td>
<td>8.8</td>
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<tr>
<td>40.9</td>
<td>24.6</td>
<td>58.1</td>
<td>27.7</td>
<td>13.2</td>
<td>43.4</td>
<td>11.6</td>
<td>4.2</td>
<td>24.4</td>
<td>&lt;0.0001</td>
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<tr>
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<td>29.2</td>
<td>79.5</td>
<td>21.4</td>
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<td>37.8</td>
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<td>1.8</td>
<td>12.0</td>
<td>&lt;0.0001</td>
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</table>

Fig 2. Median values and ranges of the esthetic scores for each buccal corridor space: A, Japanese orthodontists; B, Korean orthodontists. *Clinically significant.

Fig 3. Median values and ranges of the esthetic scores for each buccal corridor space: A, Japanese male orthodontic patients; B, Korean male orthodontic patients. *Clinically significant.
buccal corridor size was 16%, and their acceptability range was 8% to 22%. In Eastern and Western countries, people appear to prefer smaller buccal corridor spaces. We also found that the median visual analog scale scores sharply decreased from 10% to 15% buccal corridor spaces in all groups. It is highly important to point out that this 5% difference of 10% to 15% buccal corridor caused a clinically significant difference (15% visual analog scale score difference) in the preference of smile esthetics. From these results, we propose a 10% to 15% buccal corridor as a threshold for esthetic smile evaluations.

The perception of esthetics varies from person to person and is influenced by personal experiences and social environments. Thus, there can be differences of opinion regarding smile evaluations between laypersons and professionals. If the orthodontist’s perception of esthetics is not congruent with the patient’s perception, the treatment results might not be acceptable to the patient, even if the patient’s function is improved. Parekh et al previously reported no clinically significant difference between lay and orthodontic raters for smile evaluations, and this finding was also consistent with those of Gracco et al and Ritter et al. On the other hand, Roden-Johnson et al found a difference in esthetic perceptions among orthodontists, general dentists, and laypersons for buccal corridor spaces. In our study, although we found that orthodontists and orthodontic patients had similar tendencies in evaluating smile esthetics in both countries, for judging 15%, 20%, and 25% buccal corridors, the Japanese male orthodontic patients had relatively higher scores than did the Japanese orthodontists. Moreover, the Korean male and female orthodontic patients tended to prefer narrow buccal corridors (0%) compared with the Korean orthodontists. These results suggest that clinicians need to consider the perceptions of their patients in determining the orthodontic treatment goals.

Originally, the visual analog scale was used as a common tool to assess pain intensity and has been shown to be a valid, reliable, and reproducible method of measuring subjective pain. Since many investigators have used the visual analog scale to judge attractiveness, its use in scoring esthetics should also provide simple, rapid, and reproducible results.

In this study, the attractiveness of the different levels of buccal corridors from 0% to 25% was compared. In similar previous studies evaluating the effects of buccal corridors on smile esthetics, the images were modified from 0% to 26% and 2% to 28%. Parekh et al defined excessive buccal corridors as 14% and 19% for female and male patients, respectively. In light of those studies, the evaluated range in this study was sufficient for investigating the effects of buccal corridors on smile esthetics.

We found that (1) the amount of buccal corridors affected the assessment of smile esthetics; (2) no clinically significant difference was observed in the assessment of smile esthetics between Japanese and Korean people; (3) overall, orthodontists and orthodontic patients had similar tendencies in evaluating smile esthetics in both countries; and (4) a distinct threshold existed when the effects of the buccal corridors on the smile were evaluated. Additional research on the issue of evaluating the perceptions of gingival display or smile arc appears to be warranted.

**Fig 4.** Median values and ranges of the esthetic scores for each buccal corridor space: A, Japanese female orthodontic patients; B, Korean female orthodontic patients. *Clinically significant.
CONCLUSIONS

1. Although there was no significant sex difference in judging the effects of buccal corridors on smile attractiveness for both the Korean and Japanese orthodontists, significant sex differences were observed for the Japanese orthodontic patients. The Japanese male orthodontic patients had significantly higher scores than did the female patients for judging 15% and 25% buccal corridors.

2. Overall, both the Korean and Japanese raters preferred smiles with narrow or medium buccal corridors (0%-10%) to those with medium-broad (15%) or broad buccal corridors (20%-25%).

3. Smile esthetics might have been established across the borders of Japan and Korea.

4. Orthodontists and orthodontic patients had similar tendencies in evaluating smile esthetics in both countries. However, our results suggest that clinicians should consider the perceptions of their patients in determining the orthodontic treatment goals.

5. We propose a 10% to 15% buccal corridor as a threshold of esthetic smile evaluations for both Japanese and Korean people.

We thank Drs Ze’ev Davidovitch and Amy L. Counts for their valuable help with this article.

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