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Effect of lower facial height and anteroposterior lip position on esthetic preference for Korean silhouette profiles

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Objective: The purpose of this study was to evaluate the esthetic preference for various Korean silhouette profiles. **Methods:** The Korean average male and female profiles were modified by changing the lower facial height and anteroposterior lip position to produce nine types of profiles. In order to test intrarater reliability, the average profile was copied once more to be included for evaluation. A questionnaire containing 10 profiles for each sex, each of which had to be rated for preference on a numerical rating scale from 0 to 10, was administered to 30 adult orthodontic patients, 30 dental students, 30 orthodontists, and 30 dentists excluding orthodontists. The data were statistically analyzed using the intraclass correlation coefficient (ICC), independent *t*-test, and one-way ANOVA. **Results:** The ICC of overall intrarater reliability was 0.629. For several profiles, significantly higher scores were given to male profiles than to female profiles ($p < 0.05$). However, no significant differences were found in the scores for all profiles among the four rater groups. Among the short profiles, a significantly higher score was given to the retruded profile, and among the vertically average and long profiles, a significantly higher score was given to the horizontally average profile ($p < 0.001$). Among all the profiles, significantly lower scores were given to the protruded profile ($p < 0.001$). **Conclusions:** This study revealed good overall intrarater reliability, with several types of male profiles being esthetically preferred over female profiles. Moreover, while retruded and horizontally average profiles were generally preferred, protruded profiles were not.
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Key words: Esthetics, Lower facial height, Anteroposterior lip position

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INTRODUCTION

Recently, facial esthetics and attractiveness have gained great importance.[1,2] One of the main goals of orthodontic treatment is to improve the esthetics of the facial profile.[3,4] Orthodontic diagnosis is performed in three dimensions, but the most emphasized part in the treatment plan is the esthetics of the facial profile, particularly, the lower third of the profile.[5,6] In addition, studies have suggested that a harmonious relationship among the lip, chin, and nose is essential to achieve a pleasant face.[7]

Owing to the acceleration of globalization in recent decades, it is easy to assume that the future orthodontic community will be made up of patients and orthodontists of different races and ethnicities in many countries worldwide.[8] Some studies[8,9] have investigated the racial and ethnic differences in esthetic preferences. Nomura et al.[8] showed that Hispanic American and Japanese raters preferred more retruded lip profiles than did African raters. Moreover, Ioi et al.[9] concluded that both Korean and Japanese dental students tended to prefer slightly more retruded lip positions. The average profiles established in each ethnic group are taken into account when planning orthodontic treatment and orthognathic surgery.[9]

Various cephalometric measurements and evaluation methods are used when analyzing soft-tissue profiles. Among them, lower facial height is defined as the vertical distance from the subnasale to the soft-tissue menton. Jacobson[10] mentioned that the ideal ratio of middle facial height to lower facial height is 1:1. According to a study by the Korean Association of Orthodontists,[11] the mean value of the ratio of middle facial height to lower facial height in Korean normal adults is 1.1:1.

Various studies have investigated the preferred anteroposterior lip position in different modifications of profiles. Ioi et al.[12] reported that with a decrease in facial convexity, a more retruded lip position tended to be preferred, whereas with an increase in facial convexity, a more protruded lip position was preferred. Murakami et al.[13] concluded that a retruded lip position was preferred in short facial profiles, and a protruded lip position was preferred in long facial profiles.

Furthermore, many studies have examined the different preferences for anteroposterior lip position between male and female profiles. According to Ioi et al.,[9] the tendency to prefer a more retruded lip position was more definite in female profiles. However, Nomura et al.[8] reported that a more retruded lip position was preferred for male profiles than for female profiles.

The consensus between laypeople and professionals on facial attractiveness is still controversial. Coleman et al.[14] reported no significant differences in the preferred lip position among three rater groups (adolescent orthodontic patients, parents of the patients, and orthodontists). Additionally, Maple et al.[4] concluded that there was general agreement between laypeople and orthodontists in their perception of facial attractiveness. However, Foster[15] and Hier et al.[16] reported discordances in the preferred lip position between laypeople and orthodontists.

To date, few studies have investigated the esthetic preference for Korean facial profiles, and fewer studies have evaluated the profiles with diverse lower facial heights or vertical patterns. Moreover, studies evaluating Korean facial profiles by combining different lower facial heights and anteroposterior lip positions are lacking. Furthermore, most studies included only two rater groups, i.e., laypeople and orthodontists.

Therefore, the purpose of this study was to visualize the esthetic preference of various rater groups by modifying the lower facial heights and anteroposterior lip positions of the Korean average silhouette profiles by using the numerical rating scale (NRS).

MATERIALS AND METHODS

Construction of silhouette profiles

The male and female silhouette profile images were constructed according to the average soft-tissue profile measurements[17] of Korean adults with normal occlusion and well-balanced faces, as reported by Hwang et al.,[18] by using a computer software (Illustrator; Adobe Systems, San Jose, CA, USA). The silhouette profiles were oriented parallel to the Frankfort horizontal line. Moreover, the profiles were constructed in black to prevent distraction such as hair, skin complexion, and cosmetics.[19-21] The measurements reported by Hwang et al.[18] were angular measurements; thus, the actual-size silhouette profiles were developed by using the mean value of the lower facial height of Korean adults, as suggested by Baik et al.[22] By this process, the Korean average male and female profiles were constructed (Figure 1).

By manipulating the lower facial height of the Korean average male and female profiles, short and long profiles were constructed for each sex. In order to determine the amount of vertical length modification, standard deviation values of the lower facial height presented by Baik et al.[22] were used. One sigma was subtracted and added from the mean value of the lower facial height to construct the short and long profiles, respectively. Therefore, three vertical pattern profiles were obtained: short, average, and long profiles. To focus on the esthetic preference of the lower facial height, the ratio of the upper lip height to lower lip height and the mandibular plane angle was kept unchanged.

For each vertical pattern, the lip positions were manipulated anteroposteriorly to construct retruded and

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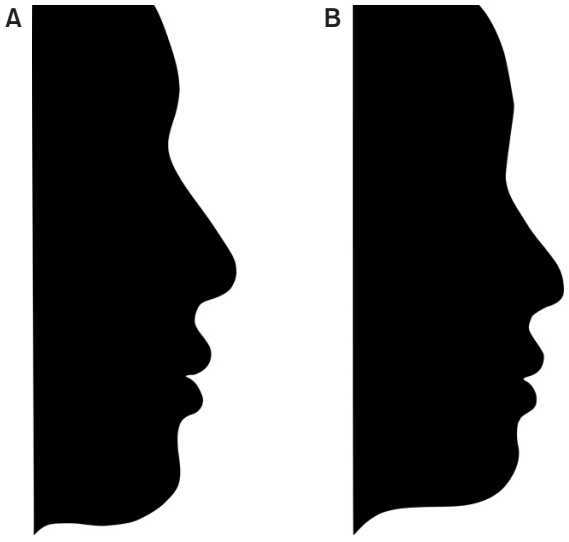

Figure 1. A, Korean average male profile. **B**, Korean average female profile.

protruded profiles. Romani et al.[23] found that orthodontists and laypeople are sensitive to horizontal changes of 3 mm or more. Based on this, the lips were retruded and protruded 3 mm parallel to the Frankfort horizontal line in each of the three vertical patterns. When modifying, the structures between the subnasale and mentolabial sulcus were manipulated. In detail, in the upper lip, the structures from the stomion superius to the labrale superius were manipulated anteroposteriorly, and the structures from the subnasale to the labrale superius were arbitrarily adjusted to obtain a natural outline. Similarly, in the lower lip, the structures from the stomion inferius to the labrale inferius were manipulated, and the structures from the mentolabial sulcus to the labrale inferius were adjusted. Therefore, nine profiles were obtained, namely, the short-retruded, short-horizontally average, short-protruded, vertically average-retruded, vertically-horizontally average, vertically average-protruded, long-retruded, long-horizontally average, and long-protruded profiles.

Noticeably distorted or excessively unnatural areas were arbitrarily corrected by one investigator (K.H.S), and thus, nine silhouette profiles each for males and females were constructed (Figures 2 and 3).

Composition of the questionnaire

A questionnaire was created using Google Forms. The first page of the questionnaire contained an overall description about the questionnaire and a blank space for entering the rater's personal information. From the second page onwards, one facial profile was shown per page, and below each profile, a NRS with scores ranging from 0 to 10 was placed to enable the raters to indicate

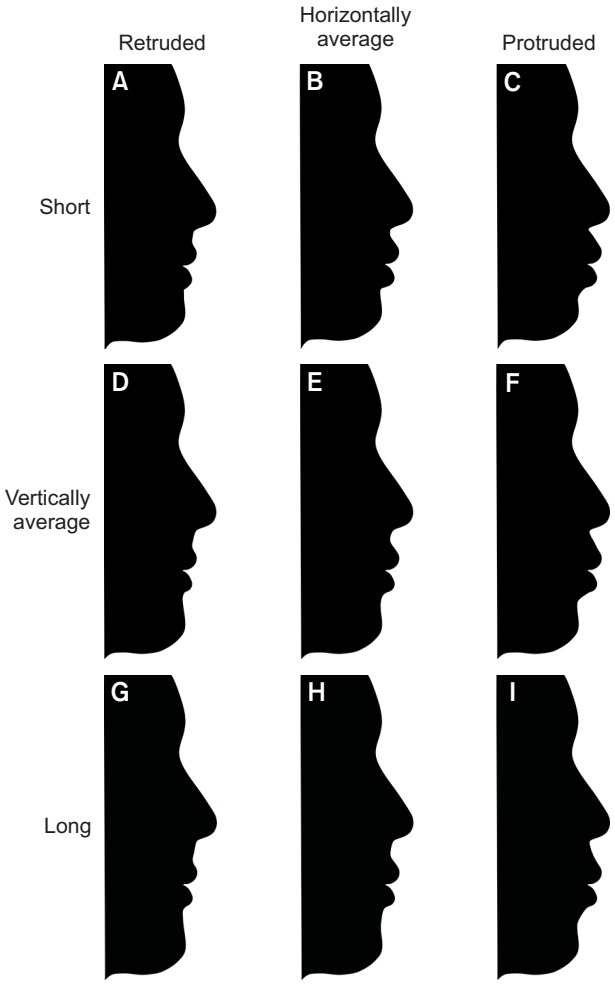

Figure 2. Nine male profiles. **A**, Short-retruded profile. **B**, Short-horizontally average profile. **C**, Short-protruded profile. **D**, Vertically average-retruded profile. **E**, Vertically-horizontally average profile. **F**, Vertically average-protruded profile. **G**, Long-retruded profile. **H**, Long-horizontally average profile. **I**, Long-protruded profile.

their degree of preference. The score 0 represented a "very unattractive" profile, and the score 10 represented a "very attractive" profile (Figure 4). In order to test intrarater reliability, the "vertically-horizontally average profile" was copied once more, and thus, a total of 10 profiles for each sex were included. The raters were blinded to the inclusion of the copied profile. The questionnaire was divided into male and female sections, and the male section appeared first. This order of the questionnaire was explained to the raters so that they could know the sex of the profiles during evaluation. However, the sequence of profiles within each section was randomized.

Rater groups and survey procedure

This study was approved by the Institutional Review

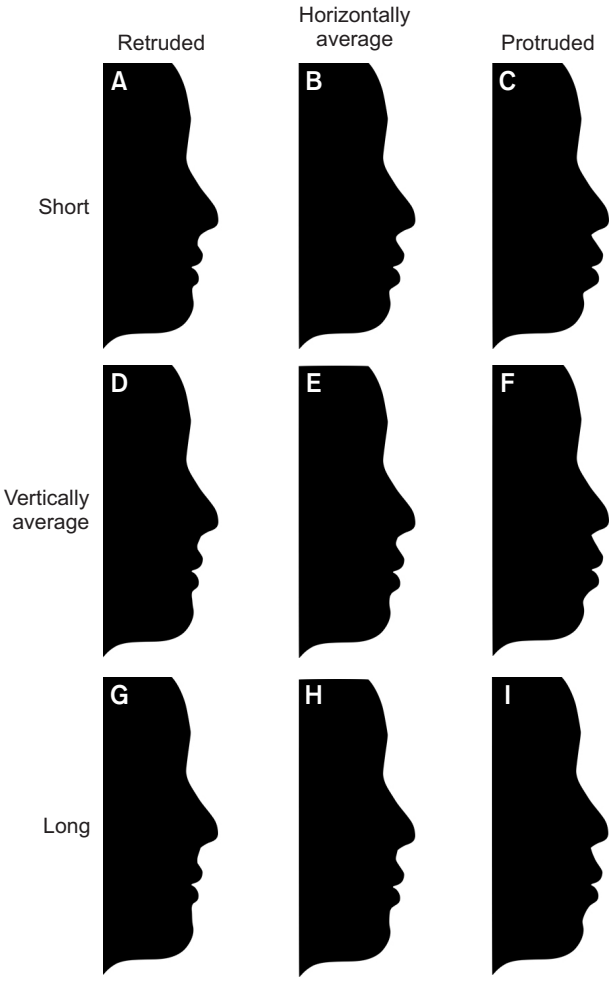

Figure 3. Nine female profiles. **A**, Short-retruded profile. **B**, Short-horizontally average profile. **C**, Short-protruded profile. **D**, Vertically average-retruded profile. **E**, Vertically-horizontally average profile. **F**, Vertically average-protruded profile. **G**, Long-retruded profile. **H**, Long-horizontally average profile. **I**, Long-protruded profile.

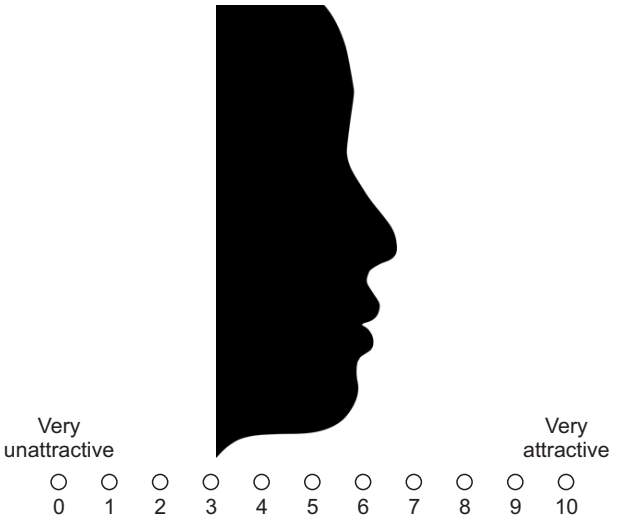

Figure 4. The composition of the questionnaire. A numerical rating scale is placed below the profile. The score 0 represents a "very unattractive" profile, and the score 10 represents a "very attractive" profile.

Board of Wonkwang University Dental Hospital (WKDIRB202010-04) before survey commencement.

The raters were 120 people belonging to four groups: 30 adult orthodontic patients undergoing treatment or who had undergone treatment at Wonkwang University Dental Hospital, 30 junior students at the Dental College of Wonkwang University, 30 highly experienced orthodontists, and 30 dentists excluding orthodontists but including specialists from other departments or general practitioners. In the blank space of the questionnaire, each rater specified their sex, age, and study group; thereafter, they read the provided explanation before starting the evaluation. On each page, the raters marked the score for each profile and proceeded to the next profile. They had no time limit to complete the questionnaire, but they were asked to respond intuitively without thinking too long. Moreover, they were asked not to turn back to the previous page they had already evaluated.

Statistical analysis

Intrarater reliability was tested using the intraclass correlation coefficient (ICC) with 95% confidence intervals. The Shapiro–Wilk test was used to verify the data distribution and normality of scores. The independent *t*-test was applied to compare the scores between the male and female profiles. One-way analysis of variance (ANOVA) was performed to compare the scores of profiles among the four rater groups for each sex. One-way ANOVA was also conducted to compare the scores of the three lip positions in each vertical pattern for each sex, i.e., comparing the retruded, horizontally average, and protruded profiles among the short, vertically average, and long profiles. Tukey's post-hoc test was also performed.

All statistical analyses were performed using SPSS for Windows, Version 12.0 (SPSS Inc., Chicago, IL, USA). The 95% confidence level ($p < 0.05$) was considered statistically significant.

RESULTS

Intrarater reliability

The results of intrarater reliability, including the ICCs and 95% confidence intervals, are shown in Table 1. The ICC of overall intrarater reliability was 0.629, and the ICCs were 0.551, 0.335, 0.825, and 0.660 for adult orthodontic patients, dental college students, orthodontists,

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Table 1. Intraclass correlation coefficients (ICCs) and 95% confidence intervals

Variable	n	ICC	LCB	UCB
Overall	240	0.629	0.522	0.712
Adult orthodontic patients	60	0.551	0.248	0.732
Dental college students	60	0.335	−0.113	0.603
Orthodontists	60	0.825	0.707	0.895
Dentists excluding orthodontists	60	0.660	0.430	0.797

LCB, lower bound of the 95% confidence interval; UCB, upper bound of the 95% confidence interval.

Table 2. Comparison of scores between the male and female profiles

Variable	Total	Male profiles	Female profiles	*p*-value
S-R profile	5.98 ± 1.81	6.24 ± 1.78	5.73 ± 1.81	0.026*
S-HA profile	5.33 ± 1.82	5.34 ± 1.72	5.33 ± 1.92	0.944
S-P profile	2.77 ± 1.35	2.75 ± 1.45	2.78 ± 1.24	0.848
VA-R profile	5.45 ± 1.90	5.68 ± 1.99	5.22 ± 1.78	0.061
VA-HA profile	5.88 ± 1.50	6.20 ± 1.49	5.56 ± 1.44	0.001**
VA-P profile	3.25 ± 1.55	3.54 ± 1.58	2.97 ± 1.48	0.004**
L-R profile	4.82 ± 1.91	4.96 ± 1.97	4.68 ± 1.84	0.250
L-HA profile	5.31 ± 1.86	5.21 ± 1.84	5.42 ± 1.88	0.386
L-P profile	3.66 ± 1.61	3.92 ± 1.65	3.41 ± 1.54	0.014*

Values are presented as mean ± standard deviation.
Independent *t*-test is performed for comparing the mean scores between the male and female profiles.
S, short; R, retruded; HA, horizontally average; P, protruded; VA, vertically average; L, long.
*$p < 0.05$; **$p < 0.01$.

Table 3. Comparison of scores among the four rater groups for the male profiles

Variable	Orthodontic patients	Dental students	Orthodontists	Dentists excluding orthodontists	*p*-value
S-R profile	6.03 ± 1.67	6.47 ± 1.59	6.37 ± 1.61	6.10 ± 2.22	0.750
S-HA profile	5.53 ± 1.90	4.93 ± 1.39	5.13 ± 1.56	5.77 ± 1.92	0.230
S-P profile	2.87 ± 1.57	2.90 ± 1.67	2.56 ± 1.19	2.66 ± 1.37	0.783
VA-R profile	5.60 ± 1.87	5.93 ± 2.07	5.30 ± 1.66	5.87 ± 2.33	0.600
VA-HA profile	6.07 ± 1.43	5.78 ± 1.36	6.67 ± 1.58	6.27 ± 1.53	0.134
VA-P profile	3.67 ± 1.56	3.23 ± 1.36	3.63 ± 1.81	3.63 ± 1.59	0.679
L-R profile	4.73 ± 1.86	5.23 ± 1.92	4.73 ± 1.84	5.13 ± 2.27	0.663
L-HA profile	5.17 ± 1.93	5.00 ± 1.66	5.17 ± 1.88	5.50 ± 1.93	0.386
L-P profile	4.23 ± 2.06	3.60 ± 1.30	3.97 ± 1.56	3.87 ± 1.65	0.523

Values are presented as mean ± standard deviation.
One-way ANOVA is performed for comparing the mean scores among the four rater groups for the male profiles.
S, short; R, retruded; HA, horizontally average; P, protruded; VA, vertically average; L, long.

and dentists excluding orthodontists, respectively.

Comparison of scores between the male and female profiles

The means and standard deviations of the scores for all the profiles, male profiles, and female profiles are shown in Table 2. Among the short-retruded ($p < 0.05$), vertically-horizontally average ($p < 0.01$), vertically average-protruded ($p < 0.01$), and long-protruded profiles ($p < 0.05$), significantly higher scores were given to the

male profiles than to the female profiles. Generally, the scores given to the male profiles were higher than those given to the female profiles.

Comparison of scores among the four rater groups for the male and female profiles

The means and standard deviations of the scores given by the four rater groups for the male and female profiles are shown in Tables 3 and 4, respectively. No significant differences were found in the scores given by the four rater groups to both the male and female profiles.

Comparison of scores among the three lip positions in each of the vertical patterns for the male and female profiles

The means and standard deviations of the scores given to the three lip positions in each of the vertical patterns for male and female profiles are shown in Tables 5 and

Table 4. Comparison of scores among the four rater groups for the female profiles

Variable	Orthodontic patients	Dental students	Orthodontists	Dentists excluding orthodontists	*p*-value
S-R profile	5.60 ± 1.69	6.00 ± 1.53	5.70 ± 1.88	5.60 ± 2.13	0.808
S-HA profile	5.33 ± 2.05	5.37 ± 2.11	5.60 ± 1.79	4.80 ± 1.71	0.363
S-P profile	3.07 ± 1.26	2.77 ± 1.10	2.53 ± 1.22	2.77 ± 1.23	0.427
VA-R profile	4.93 ± 1.76	5.80 ± 1.73	5.10 ± 1.58	5.03 ± 1.97	0.219
VA-HA profile	5.52 ± 1.28	5.27 ± 1.31	6.13 ± 1.54	5.32 ± 1.49	0.072
VA-P profile	3.33 ± 1.83	2.93 ± 1.34	2.70 ± 1.37	2.90 ± 1.32	0.411
L-R profile	4.60 ± 1.79	4.97 ± 1.77	4.47 ± 1.80	4.67 ± 2.04	0.760
L-HA profile	5.67 ± 1.63	4.97 ± 1.85	5.57 ± 2.12	5.47 ± 1.89	0.486
L-P profile	3.37 ± 1.49	3.33 ± 1.24	3.63 ± 1.97	3.30 ± 1.39	0.833

Values are presented as mean ± standard deviation.
One-way ANOVA is performed for comparing the mean scores among the four rater groups for the female profiles.
S, short; R, retruded; HA, horizontally average; P, protruded; VA, vertically average; L, long.

Table 5. Comparison of scores among the three lip positions in each vertical pattern for the male profiles

Variable	Retruded profile	Horizontally average profile	Protruded profile	*p*-value
Short profile	6.24 ± 1.78[a]	5.34 ± 1.72[b]	2.75 ± 1.45[c]	0.000***
Vertically average profile	5.68 ± 1.99[b]	6.20 ± 1.49[a]	3.54 ± 1.58[c]	0.000***
Long profile	4.96 ± 1.97[a]	5.21 ± 1.84[a]	3.92 ± 1.65[b]	0.000***

Values are presented as mean ± standard deviation.
One-way ANOVA is performed for comparing the mean scores among the three lip positions in each vertical pattern for the male profiles. Tukey's post-hoc test is also performed.
***$p < 0.001$.
[a-c]Same letters in superscript in the same row indicate no statistically significant differences, otherwise different letters indicate statistically significant differences.

Table 6. Comparison of scores among the three lip positions in each vertical pattern for the female profiles

Variable	Retruded profile	Horizontally average profile	Protruded profile	*p*-value
Short profile	5.73 ± 1.81[a]	5.33 ± 1.92[a]	2.78 ± 1.24[b]	0.000***
Vertically average profile	5.22 ± 1.78[a]	5.56 ± 1.44[a]	2.97 ± 1.48[b]	0.000***
Long profile	4.68 ± 1.84[b]	5.42 ± 1.88[a]	3.41 ± 1.54[c]	0.000***

Values are presented as mean ± standard deviation.
One-way ANOVA is performed for comparing the mean scores among the three lip positions in each vertical pattern for the female profiles. Tukey's post-hoc test is also performed.
***$p < 0.001$.
[a-c]Same letters in superscript in the same row indicate no statistically significant differences, otherwise different letters indicate statistically significant differences.

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6, respectively. Among the short profiles for both males and females, significantly higher scores were given to the retruded profile ($p < 0.001$), and among the vertically average and long profiles, significantly higher scores were given to the horizontally average profile ($p < 0.001$). Among the male and female profiles, significantly lower scores were given to the protruded profile ($p < 0.001$).

DISCUSSION

The purpose of this study was to evaluate the preference for facial profiles among various rater groups by modifying the lower facial height and anteroposterior lip position of the Korean average silhouette profile.

Many previous studies evaluating profile preferences have used photographs of the patient or silhouettes drawn in two shades of color. Burstone[24] used photographs for esthetic evaluation because viewing all aspects of a patient's face provides a genuine description of what we see and how we might interpret the face as esthetic or beautiful. In addition, Hockley et al.[25] found that rater preferences for photographs were more approximate to the established esthetic norm than were those for silhouettes when evaluating esthetic profile preferences. However, according to Maple et al.,[4] silhouette profile evaluations have been advocated by several authors because they eliminate extraneous esthetic variables, such as hair, complexion, and makeup, that can influence the rater. Moreover, Shelly et al.[26] mentioned that profile outlines or silhouettes would eliminate some distracting subjective variables, and Spyropoulos and Halazonetis[27] reported that factors such as hairstyle rather than profile outlines can bias the esthetic evaluation. Therefore, in our study, we used silhouette profiles for evaluation. By using these, we removed subjective variables that could cause bias, and the raters could focus on their preferences for different profiles constructed by modifying the lower facial height and anteroposterior lip position.

In this study, the ICC was used to evaluate intrarater reliability. Overall intrarater reliability was good, with orthodontists having the highest coefficient followed by dentists excluding orthodontists, adult orthodontic patients, and dental college students (Table 1). Maple et al.[4] reported that laypeople had higher intrarater reliability than did orthodontists and oral surgeons. They mentioned that laypeople tended to assess the profiles on the basis of their initial perception, whereas the professionals tended to overevaluate each profile. However, in our study, the orthodontists had the highest intrarater reliability. This could be attributed to the fact that orthodontists have been trained to evaluate using constant criteria when assessing the facial profile. In contrast, dental college students showed the lowest intrarater reliability, which was even lower than that of adult orthodontic patients. This indicated that dental college students are still in the course of education and lack sufficient training. Furthermore, the reason most adult orthodontic patients have started orthodontic treatment is that they are interested in the esthetic facial profile, and hence, their evaluation criteria may be steadier.

We observed significant differences in preference between some male and female profiles (Table 2). In particular, in the vertically average-protruded and long-protruded profiles, the male profile was preferred over the female profile. This suggested that the protruded lip was relatively more acceptable in men than in women, except for those with the short profile. This result was consistent with those of Ioi et al.[9] However, among the short profiles, the retruded profile was evaluated as being more esthetic in the male profile, and this result corresponded to the findings of Nomura et al.[8] These findings also suggested that the differences in preference for lip positions between male and female profiles might vary according to the vertical patterns. Additionally, we found an overall tendency wherein higher scores were given to male profiles than to female profiles. This might be because of stricter esthetic standards being applied to female profiles. Since the questionnaire was divided into the male and female sections, the raters could recognize the sex of the profiles during evaluation. Thus, the raters tended to strictly evaluate the profiles in the female section. Therefore, the scores might be relatively higher for the male profiles than for the female profiles.

Our study also found an overall agreement in preferences among the various rater groups (Tables 3 and 4). This might be because laypeople have been exposed to esthetic faces through various media outlets in recent years, and as a result, their interest and knowledge in esthetics has increased to levels seen among the professionals. Therefore, this overall consensus could imply the equalization of esthetic criteria among various groups including laypeople and professionals. Moreover, this agreement could mean that patients and clinicians might have similar esthetic preferences for facial profiles, thereby leading to fewer disagreements during treatment planning.

We found that the preferred anteroposterior lip positions were definite in each vertical pattern for both male and female profiles (Tables 5 and 6), and similar preferences were observed for both male and female profiles. The retruded profile was preferred among the short profiles, and the horizontally average profile was preferred among the vertically average and long profiles. Among all the vertical patterns, the protruded profiles received the lowest scores. Furthermore, among the short profiles for both males and females, the retruded and protruded profiles received the highest and lowest scores, respec-

tively, among all the vertical patterns. This indicated that among the short profiles, lip retrusion and protrusion produced a huge difference in profile esthetics. In contrast, the scores for the retruded and horizontally average profile among the long profiles were lower than those for the other vertical patterns, but the scores for the protruded profile were the highest. These results might imply that protruded profiles were compensated for by the long lower facial height.

CONCLUSION

In this study, we evaluated the preferences for facial profiles by modifying the lower facial height and anteroposterior lip position of the Korean average silhouette profile. The degree of preference was quantified using a NRS, and the raters included adult orthodontic patients, junior dental college students, orthodontists, and dentists excluding orthodontists.

Overall intrarater reliability was good. Among the short-retruded, vertically-horizontally average, vertically average-protruded, and long-protruded profiles, the male profiles were considered more esthetic than were the female profiles. No difference was observed in esthetic preference for both male and female profiles among adult orthodontic patients, junior dental college students, orthodontists, and dentists excluding orthodontists. Among the short profiles for both males and females, the retruded profiles were preferred, and among the vertically average and long profiles, the horizontally average profiles were preferred. However, when considering all the profiles, the protruded profiles were not preferred.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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