

# Effect of Facial Convexity on Antero-posterior Lip Positions of the Most Favored Japanese Facial Profiles

Hideki Ioi<sup>a</sup>; Shunsuke Nakata<sup>b</sup>; Akihiko Nakasima<sup>c</sup>; Amy Counts<sup>d</sup>

**Abstract:** Soft tissue analyses are basic tools in planning orthodontic treatment. However, the perception of a well-balanced Japanese facial profile has not yet been established, particularly with respect to changes in facial convexity. The purpose of this study was to assess and determine the range of antero-posterior (A-P) lip positions of the top three most favored, well-balanced profiles from a series of various facial silhouettes with changing facial convexity. The average profile was constructed from the profiles of 30 Japanese males and females with Class I occlusions. Changes in facial convexity were established by altering the A-P chin position by protruding or retruding the chin in increments of 5° and 10° from the average profile. A series of 11 profiles were developed from each of the four changes in facial convexity. The lips were then protruded or retruded in one-mm increments from the average profile. Forty orthodontists were asked to rate the top three most favored, well-balanced profiles. We found that the raters tended to prefer more retruded lip positions as facial convexity decreased, for both males and females. The raters also tended to prefer slightly more protruded lip positions as the facial convexity increased. Because chin position is inherent in each patient, others may equate a retrusive or protrusive chin with certain personalities, thus, it is important for orthodontists to take into account the balance between the lips and the chin. (*Angle Orthod* 2005;75:326–332.)

**Key Words:** Facial convexity; Lip position; Facial profile preference; Japanese facial profiles

## INTRODUCTION

Treatment planning goals for orthodontic treatment and orthognathic surgery are based upon established normal values for each ethnic group. For example, the average antero-posterior (A-P) lip position in Japanese adults is regarded as relatively protrusive compared with that of Caucasians.<sup>1</sup> A well-balanced, pleasing profile is necessary because the goal of orthodontic treatment is not only to achieve a functional occlusion but also to create an esthetic profile.<sup>2</sup>

Soft tissue analyses of well-balanced Japanese faces have been conducted previously.<sup>3–14</sup> However, few studies of the

Japanese population have evaluated the preference of facial profiles with varying facial convexity. Because facial convexity is an expression of the patient's inherent underlying skeletal pattern, it is difficult to alter during orthodontic treatment. Therefore, it is important for clinicians to take into account the balance between the lips and the chin.

This study was aimed at determining the perception of orthodontists of well-balanced, pleasing profiles in Japanese adults with varying facial convexity. The purpose of this study was to assess and determine the range of soft tissue A-P lip positions of the top three most favored, well-balanced profiles from four series of facial silhouettes with varying facial convexity.

## MATERIALS AND METHODS

### Construction of the average Japanese facial profile

To avoid subjective considerations, facial silhouettes rather than facial photos were chosen for rating facial profiles.<sup>15,16</sup> Average Japanese silhouettes were constructed from 30 cephalometric radiographs of Japanese adults (15 males and 15 females; aged 22 to 26 years). Inclusion criteria for this study were an ANB angle between 2° and 5°, Class I occlusion with minor or no crowding, all teeth pres-

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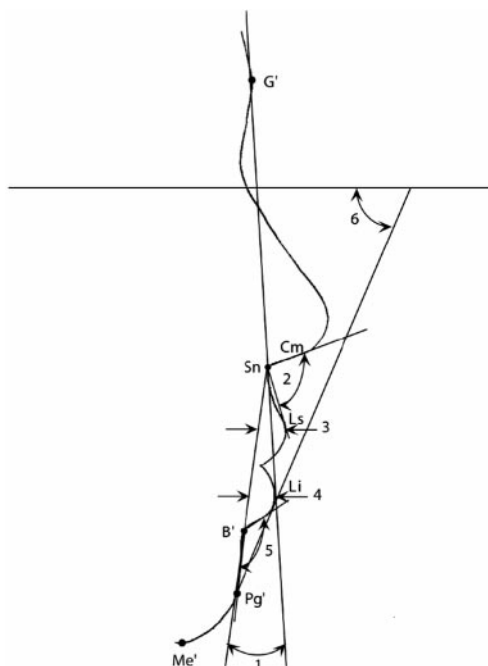
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**FIGURE 1.** Soft tissue cephalometric reference points and analysis: (1) Facial convexity (G'-Sn-Pg'), (2) Nasolabial angle (Cm-Sn-Ls), (3) Upper lip protrusion (Ls to Sn-Pg'), (4) Lower lip protrusion (Li to Sn-Pg'), (5) Inferior labial sulcus angle, and (6) Z-angle (chin/lip line to Frankfort horizontal plane).

ent except third molars, no previous orthodontic treatment, and no prosthetic replacement of teeth.

All lateral cephalometric radiographs were taken with the teeth in maximal intercuspation, in a cephalostat oriented to the Frankfort horizontal plane. All radiographs were traced by hand on matte acetate sheets and digitized by one orthodontist to eliminate interexaminer variability. Cephalometric analyses were performed with the aid of a cephalometric software program (Winceph 5.5, Rise, Sendai, Japan) on a personal computer. Soft tissue reference points and angles are given in Figure 1. Four angular, two linear, and one ratio-related measurement were examined for the soft tissue analysis (Table 1).

The means and standard deviations (SD) for soft tissue measurements were determined for each sex (Table 1). An average Japanese profile silhouette was constructed for males and females. These values were found to be within one SD of the current Japanese cephalometric norms.<sup>17</sup>

### Reliability

Method error was assessed by the random selection and tracing of 10 cephalometric radiographs on three separate occasions. One-way analysis of variance, used to test the equality of means for the cephalometric measurements, suggested that this was done in a consistent manner. Mean scores for the soft tissue measurements ( $P = .82$ ) did not significantly differ for the three measurements. The method error can thus be considered negligible.

### Construction of a series of profiles

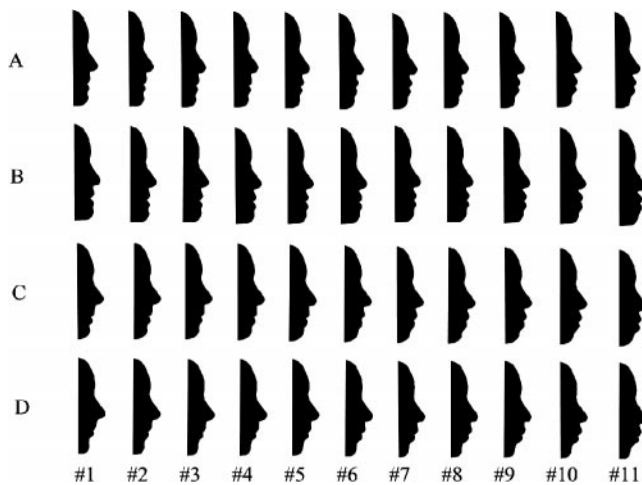
The changes in facial convexity were generated by altering the A-P position of the chin. Chin positions were protruded or retruded by 5° and 10° from the average profile. In each silhouette, the average lip-protrusion position in relation to Sn-Pg' was maintained for males and females. For each of the four facial convexities, a series of 11 profiles were developed (Figures 2 and 3): (1) 5° chin protrusion from the normal position, (2) 10° chin protrusion from the normal position, (3) 5° chin retrusion from the normal position, and (4) 10° chin retrusion from the normal position. The profile with average lip protrusion (no. 6) occupied the middle position in the series. The lip positions were protruded or retruded in one-mm increments from the average profile and were changed to parallel the Frankfort horizontal plane. Left to right, profile no. 1 depicted the most retrusive lip position and no. 11 the most protrusive lip position.

### Profile raters

The profile raters were 40 Japanese orthodontists (18 males, age  $38.1 \pm 11.5$  years; 22 females, age  $27.5 \pm 2.2$

**TABLE 1.** The Mean and Standard Deviation (SD) for Soft Tissue Measurements in the Japanese

Variables	Male		Female	
	Mean	SD	Mean	SD
Soft tissue value				
Facial form				
Facial convexity (G'-Sn-Pg') (°)	11.5	2.9	13.2	4.9
Vertical height ratio (G'-Sn/Sn-Me')	0.95	0.05	0.92	0.09
Lip position				
Nasolabial angle (Cm-Sn-Ls) (°)	93.8	11.3	99.8	8.5
Upper lip protrusion (Ls to Sn-Pg') (mm)	6.4	1.6	6.5	1.5
Lower lip protrusion (Li to Sn-Pg') (mm)	5.7	1.9	6.4	1.9
Inferior labial sulcus angle (°)	129.6	13.7	140.5	13.8
Z-angle (chin/lip line to Frankfort horizontal plane) (°)	69.0	5.4	66.6	7.1



**FIGURE 2.** Series of 11 male profiles with change of facial convexity: (A) 5° chin protrusion from the average position, (B) 10° chin protrusion from the average position, (C) 5° chin retrusion from the average position, and (D) 10° chin retrusion from the average position.

years) from Kyushu University in Fukuoka, Japan. They were asked to choose the top three most favored profiles in each group of the four changing facial convexities.

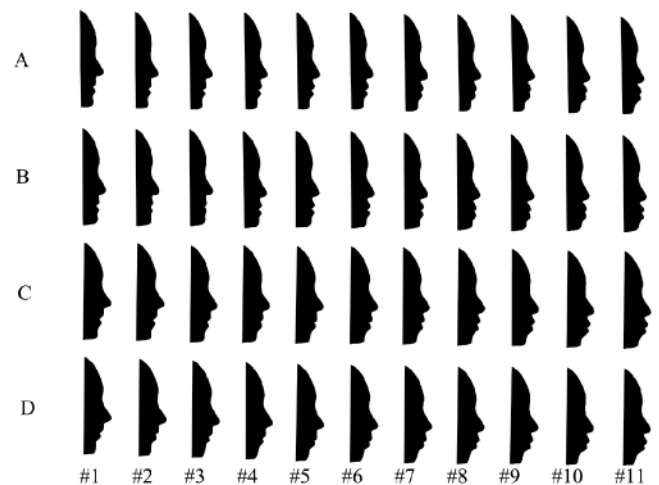
**Statistical analysis**

The Fisher’s exact probability tests were used to compare the differences in the scores between the top three most favored profiles and the other profiles. A probability of less than .05 was considered as statistically significant.

**RESULTS**

**The effect of 5° protrusion from the average facial convexity on A-P lip positions of the most favored Japanese facial profiles**

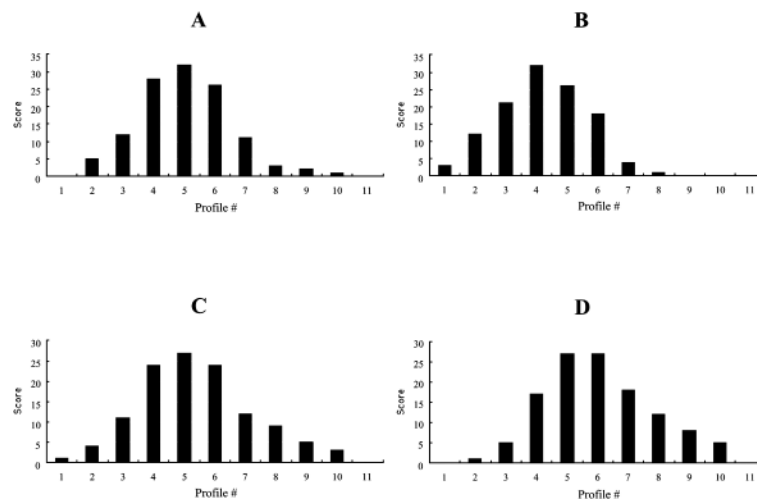
The top three most favored male profiles were nos. 5, 4, and 6 (Figure 4A). The scores in these top three profiles



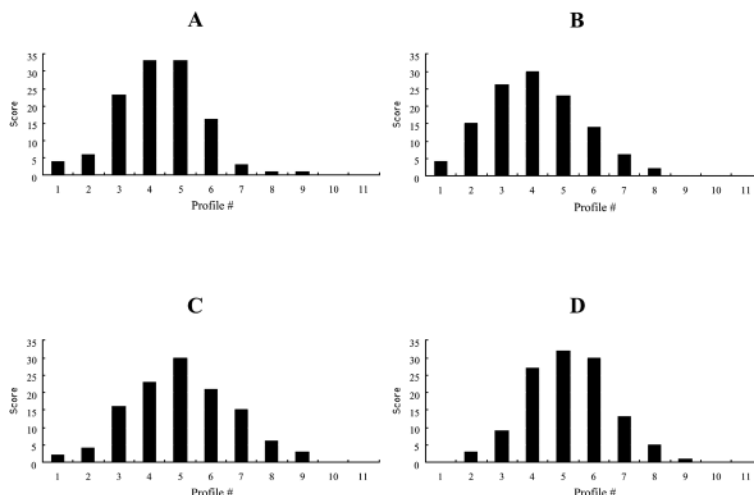
**FIGURE 3.** Series of 11 female profiles with change of facial convexity: (A) 5° chin protrusion from the average position, (B) 10° chin protrusion from the average position, (C) 5° chin retrusion from the average position, and (D) 10° chin retrusion from the average position.

were significantly larger than the other profiles ( $P < .05$ ). On the other hand, the top three most favored female profiles were nos. 4, 5, and 3 for 5° protrusion from the average facial convexity (Figure 5A). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ), except between nos. 3 and 6. From these most favored profiles, the range of the following soft tissue measurements was determined: lip protrusion to Sn-Pg’ or the esthetic line (Table 2).

For males, the raters chose the following range: the most favored lip-protrusion values relative to Sn-Pg’ ranged from 4.4 to 6.4 mm for the upper lip and 3.7 to 5.7 mm for the lower lip. The most favored lip protrusion relative to the esthetic line ranged from -5.5 to -3.5 mm for the upper lip and -2.0 to 0 mm for the lower lip (Table 2).



**FIGURE 4.** The distribution of the most favored male profiles: (A) 5° chin protrusion from the average position, (B) 10° chin protrusion from the average position, (C) 5° chin retrusion from the average position, and (D) 10° chin retrusion from the average position.



**FIGURE 5.** The distribution of the most favored female profiles: (A) 5° chin protrusion from the average position, (B) 10° chin protrusion from the average position, (C) 5° chin retrusion from the average position, and (D) 10° chin retrusion from the average position.

**TABLE 2.** Range of the Preferred Japanese Lip-Position Values for 5° Protrusion to the Average Facial Convexity

Variables	Range (mm)	
	Male	Female
Lip position		
Upper lip protrusion (Ls to Sn-Pg')	4.4 ~ 6.4	3.5 ~ 5.5
Lower lip protrusion (Li to Sn-Pg')	3.7 ~ 5.7	3.4 ~ 5.4
Upper lip to E-line (Ls to E-line)	-5.5 ~ -3.5	-5.5 ~ -3.5
Lower lip to E-line (Li to E-line)	-2.0 ~ 0	-2.0 ~ 0

For females, the most favored lip-protrusion values relative to Sn-Pg' ranged from 3.5 to 5.5 mm for the upper lip and 3.4 to 5.4 mm for the lower lip. The most favored lip protrusion relative to the esthetic line ranged from -5.5 to -3.5 mm for the upper lip and -2.0 to 0 mm for the lower lip (Table 2).

For females, the most favored lip-protrusion values relative to Sn-Pg' ranged from 3.5 to 5.5 mm for the upper lip and 3.4 to 5.4 mm for the lower lip. The most favored lip protrusion relative to the esthetic line ranged from -5.0 to -3.0 mm for the upper lip and -1.5 to 0.5 mm for the lower lip (Table 3).

**The effect of 10° protrusion to the average facial convexity on A-P lip positions of the most favored Japanese facial profiles**

The top three most favored male profiles were nos. 4, 5, and 3 (Figure 4B). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ), except between nos. 3 and 6, and between nos. 5 and 6. On the other hand, the most favored female profiles were nos. 4, 3, and 5 for 10° protrusion to the average facial convexity (Figure 5B). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ) except between nos. 2 and 5.

**The effect of 5° retrusion to the average facial convexity on A-P lip positions of the most favored Japanese facial profiles**

The top three most favored male profiles were nos. 5, 6, and 4 (Figure 4C). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ). On the other hand, the most favored female profiles were nos. 5, 4, and 3 for 5° retrusion to the average facial convexity (Figure 5C). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ), except between nos. 3 and 4, between nos. 3 and 6, between nos. 4 and 7, and between nos. 6 and 7.

For males, the raters chose the most favored lip-protrusion values relative to Sn-Pg' ranging from 3.4 to 5.4 mm for the upper lip and 2.7 to 4.7 mm for the lower lip. The most favored lip protrusion relative to the esthetic line ranged from -6.0 to -4.0 mm for the upper lip and -2.5 to -0.5 mm for the lower lip (Table 3).

For males, the most favored lip-protrusion values relative to Sn-Pg' ranged from 4.4 to 6.4 mm for the upper lip and 3.7 to 5.7 mm for the lower lip. The most favored lip-protrusion range relative to the esthetic line was from -4.5 to -2.5 mm for the upper lip and -1.0 to 1.0 mm for the lower lip (Table 4).

**TABLE 3.** Range of the Preferred Japanese Lip-Position Values for 10° Protrusion to the Average Facial Convexity

Variables	Range (mm)	
	Male	Female
Lip position		
Upper lip protrusion (Ls to Sn-Pg')	3.4 ~ 5.4	3.5 ~ 5.5
Lower lip protrusion (Li to Sn-Pg')	2.7 ~ 4.7	3.4 ~ 5.4
Upper lip to E-line (Ls to E-line)	-6.0 ~ -4.0	-5.0 ~ -3.0
Lower lip to E-line (Li to E-line)	-2.5 ~ -0.5	-1.5 ~ 0.5

**TABLE 4.** Range of the Preferred Japanese Lip-Position Values for 5° Retrusion to the Average Facial Convexity

Variables	Range (mm)	
	Male	Female
Lip position		
Upper lip protrusion (Ls to Sn-Pg')	4.4 ~ 6.4	4.5 ~ 6.5
Lower lip protrusion (Li to Sn-Pg')	3.7 ~ 5.7	4.4 ~ 6.4
Upper lip to E-line (Ls to E-line)	-4.5 ~ -2.5	-3.5 ~ -1.5
Lower lip to E-line (Li to E-line)	-1.0 ~ 1.0	0 ~ 2.0

**TABLE 5.** Range of the Preferred Japanese Lip-Position Values for 10° Retrusion to the Average Facial Convexity

Variables	Range (mm)	
	Male	Female
Lip position		
Upper lip protrusion (Ls to Sn-Pg')	5.4 ~ 7.4	4.5 ~ 6.5
Lower lip protrusion (Li to Sn-Pg')	4.7 ~ 6.7	4.4 ~ 6.4
Upper lip to E-line (Ls to E-line)	-4.0 ~ -2.0	-3.0 ~ -1.0
Lower lip to E-line (Li to E-line)	-0.5 ~ 1.5	0.5 ~ 2.5

For females, the raters chose the most favored lip-protrusion values relative to Sn-Pg' as 4.5 to 6.5 mm for the upper lip and 4.4 to 6.4 mm for the lower lip. The most favored lip protrusion relative to the esthetic line ranged from -3.5 to -1.5 mm for the upper lip and 0 to 2.0 mm for the lower lip (Table 4).

#### **The effect of 10° retrusion to the average facial convexity on A-P lip positions of the most favored Japanese facial profiles**

The top three most favored male profiles were nos. 5, 6, and 7 (Figure 4D). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ), except between nos. 4 and 7, and between nos. 7 and 8. On the other hand, the most favored female profiles were nos. 5, 6, and 4 for 10° retrusion to the average facial convexity (Figure 5D). The scores in these top three profiles were significantly larger than the other profiles ( $P < .05$ ).

For males, the most favored lip-protrusion values relative to Sn-Pg' ranged from 5.4 to 7.4 mm for the upper lip and 4.7 to 6.7 mm for the lower lip. The most favored lip-protrusion range relative to the esthetic line was from -4.0

to -2.0 mm for the upper lip and -0.5 to 1.5 mm for the lower lip (Table 5).

For females, the raters chose the most favored lip-protrusion values relative to Sn-Pg' as 4.5 to 6.5 mm for the upper lip and 4.4 to 6.4 mm for the lower lip. The most favored lip protrusion relative to the esthetic line ranged from -3.0 to -1.0 mm for the upper lip and 0.5 to 2.5 mm for the lower lip (Table 5).

#### **DISCUSSION**

The objective of orthodontic treatment is to achieve facial balance through stabilization of the dentition and the production of pleasing facial and dental esthetics.<sup>18</sup> As a preliminary study, we assessed the most favored or most well-balanced profile from a series of varying A-P lip positions of facial silhouettes, rated by a group of Japanese orthodontists and by a group of young adult Japanese dental students. We found that Japanese orthodontists and young adults tended to prefer a retruded profile compared with the average silhouette. Our hypothesis is that the perception of beauty might have changed on the basis of an increase or decrease of facial convexity inherent in each of the patients.

The objective of this study was to determine, assess, and compare the range of values of well-balanced facial profiles when facial convexity was increased or decreased 5° and 10°.

If the raters in this study chose the average lip position as the well-balanced one, they should have selected no. 6. For males, the raters regarded no. 5 as the best profile for 5° protrusion of facial convexity, whereas they chose no. 4 as the best for 10° protrusion of facial convexity. For females, this distinct tendency was not found, but the tendency to prefer a little more retruded lip position was demonstrated. Ultimately, we found that the raters showed the tendency to prefer a slightly more retruded lip position as facial convexity decreases.

Because chin position is inherent in each patient, others may equate a retrusive or protrusive chin with certain personalities. Thus, it is important for orthodontists to take into account the balance between the lips and the chin because the beauty of the facial profile would depend on this relationship. In light of these facts, a more retruded incisal position might be recommended for a person who has a relatively protruded chin. If it is a borderline decision between nonextraction and extraction treatment, extraction treatment might be selected for that reason in this case.

For males, the raters regarded no. 5 as the best profile for 5° retrusion of facial convexity, whereas they chose nos. 5 or 6 as the best for 10° retrusion of facial convexity. For females, although this distinct tendency was not found, the tendency to prefer a little more protruded lip position was demonstrated. Ultimately, we found that the raters showed the tendency to prefer a slightly more protruded lip position as the facial convexity increases. A more protruded incisal position might be recommended for a person who has a relatively retruded chin. If analyses show a borderline between nonextraction and extraction treatment, the nonextraction treatment should be suggested for that reason.

These findings may go against the traditional concept that in a patient with a tendency toward a protruded chin, a more forward lower incisor position would be preferred to keep the lip curves within that profile. Similarly, in a patient with a tendency toward a retruded chin with lip strain, one may well decide to extract teeth to reduce that lip strain. In such a patient who needs an orthognathic surgery to modify a jaw disharmony, one should apparently align the incisor position ideally to obtain good facial balance after the orthognathic surgery. Thus, the nonextraction therapy would be recommended for a mandibular prognathic case, whereas the extraction therapy would be preferred for a mandibular retrognathic case.

However, in patients with small amount of jaw imbalances, we often align the teeth to compensate jaw disharmonies. This leads to the extraction of the lower teeth for the mandibular prognathic cases and results in nonextraction of lower teeth for the mandibular retrognathic cases.

Our study showed that these tendencies might be reasonable from the point of view of the esthetic facial profile.

Clinicians must consider the great variability in soft tissue thickness between individuals when incisal position is determined. Conventional treatment plans, which are determined automatically from the data of skeletal normal values, should be avoided.

For males, the actual values of the most favored lip-protrusion range relative to Sn-Pg' was from 4.4 to 6.4 mm for the upper lip and 3.7 to 5.7 mm for the lower lip for 5° protrusion of facial convexity. Similarly, the judges regarded 3.4 to 5.4 mm for upper lip and 2.7 to 4.7 mm for the lower lip protrusion for 10° protrusion of facial convexity. For females, we found that the raters chose the most favored lip protrusion relative to Sn-Pg' ranging from 3.5 to 5.5 mm for the upper lip and 3.4 to 5.4 mm for the lower lip for both 5° and 10° protrusion of facial convexity. The normal values of upper and lower lip protrusion to Sn-Pg' in Japanese male were 6.4 and 5.7 mm, respectively, whereas the normal value of upper and lower lip protrusion to Sn-Pg' in Japanese females was 6.5 and 6.4 mm, respectively.

Alcalde et al<sup>14</sup> compared the differences in lip position between a normal Japanese group and a supernormal, pleasant Japanese group. The supernormal sample was selected by the lay judges as individuals with esthetically pleasant profiles. They described the lip protrusion relative to Sn-Pg' for the normal Japanese group as 5.79 mm at the upper lip and 5.03 mm at the lower lip, including males and females, whereas the supernormal, pleasant Japanese group was 4.68 mm at the upper lip and 3.05 mm at the lower lip. These findings showed that the flatter profile was favored for Japanese males and females in the case of chin protrusion.

For males, the actual values of the most favored lip-protrusion range relative to Sn-Pg' were 4.4 to 6.4 mm for the upper lip and 3.7 to 5.7 mm for the lower lip for 5° retrusion of facial convexity. They regarded 5.4 to 7.4 mm for the upper lip and 4.7 to 6.7 mm for the lower lip to 10° retrusion of facial convexity. For females, the raters chose the most favored lip-protrusion range relative to Sn-Pg' as that from 4.5 to 6.5 mm for the upper lip and 4.4 to 6.4 mm for the lower lip to both 5° and 10° retrusion of facial convexity. We found the tendency of a slightly more protruded lip position would be allowed, particularly in males with 10° chin retrusion compared with chin protrusion cases.

In this study, we established a range of soft tissue lip position values for the most favored Japanese profile with changes in chin position. The standards of beauty may vary among the professions or according to the age of raters. Additional researches on the issues of the preference of facial profiles for the lay judges and the different age groups would be necessary.

We should not treat all patients identically. Some patients

may not want their facial features to be altered to those considered as well balanced. Different racial groups have different perceptions of what is attractive.<sup>18</sup>

### CONCLUSIONS

- Raters tended to prefer a more retruded lip position as the facial convexity decreases for both males and females.
- Raters tended to prefer a slightly more protruded lip position compared with chin protrusion cases as the facial convexity increases.
- These results might be helpful in decisions between extraction and nonextraction treatment in borderline cases.
- Additional research on the issue of hard tissue analysis in the case of most favored profiles in young adult Japanese appears to be warranted.

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