

The influence of lower lip position on the perceived attractiveness of chin prominence

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ABSTRACT

Objectives: To evaluate the influence of the lower lip prominence for varying degrees of chin prominence in the sagittal plane and to establish whether lower lip prominence affects the perceived desire for surgery. To assess differences in preference between orthodontists and laypeople as well as the effect of age, gender, and ethnicity of observers on perceptions of attractiveness and desire for surgery.

Materials and Methods: A silhouette of an idealized profile image was created. The image was manipulated to create six images demonstrating different degrees of retrogenia and prognathia altered in 4-mm increments from -12 mm to +12 mm and six images demonstrating chin and lower lip prominence in 4-mm increments from -12 mm to +12 mm. One hundred laypeople and 30 orthodontists ranked the images from the most to the least attractive. A duplicate of one of the images was used in order to assess intraexaminer reliability.

Results: The amount and direction of sagittal chin position and the prominence of the lower lip were found to have a significant effect on image rank. Chin protrusion was less attractive than retrusion and surgery was desired more often for these images. The overall direction of opinion was the same for laypeople and orthodontists.

Conclusions: The chin prominence observed in a progenic patient is deemed less attractive than the combined chin and lower lip prominence observed in a patient with mandibular prognathism. In profiles with a more prominent chin a more protrusive lower lip position was preferred. When the chin was retrusive, a normal lower lip position was preferred to a retrusive lip. (*Angle Orthod.* 2013;83:795–800.)

KEY WORDS: Chin; Lip; Prominence; Attractiveness; Orthognathic

INTRODUCTION

The facial profile comprises five facial prominences: the forehead, nose, lips, chin, and submental-cervical region. The interrelationship of these various components of the facial profile plays an important role in

perceptions of facial esthetics.¹ For example; Aufricht² was one of the first to describe the esthetic significance of chin prominence on the perceived attractiveness of the nose. As a result, surgeons often discuss this relationship with rhinoplasty patients. In the same way, it is valuable to investigate which lower lip positions are considered the most esthetic for different degrees of chin protrusion and retrusion. The lower lip is the adjacent esthetic subunit to the chin.¹ As such, the prominence of the lower lip may influence the perception of chin prominence and thus the overall management plan in terms of camouflage vs orthognathic surgery and extraction vs nonextraction decisions.

Lip prominence may be affected by orthodontic treatment through movement of the dentition as well as through the skeletal and soft tissue changes resulting from orthognathic or facial esthetic surgery.³ Lip thickness, lip tonicity, initial incisor inclination, and lip height will have an impact on the soft tissue changes that occur.^{1,4}

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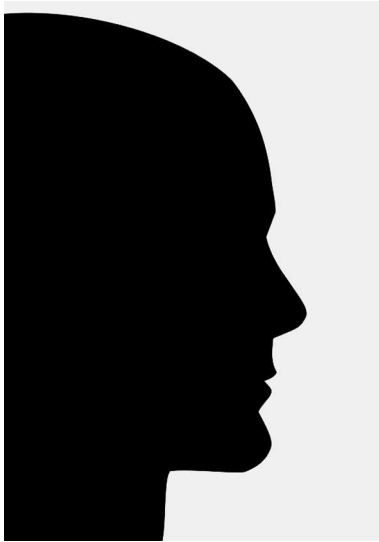


Figure 1. Original idealized image.

Ricketts⁵ described the E-line as a reference line for lip position, highlighting the importance of lip prominence relative to the nose and chin. Steiner⁶ described the S-line, drawn from the midpoint between the subnasale (Sn) and pronasale (Prn) to the soft tissue pogonion (Pog), and lip prominence with reference to this line should ideally be 0 ± 2 mm.

Previous studies have looked at lip positions favored by laypeople and orthodontists as well as chin positions individually. Peck and Peck⁷ found that compared to orthodontists, laypeople preferred lip profiles that were more protrusive.

Czarnecki et al.⁸ found that greater lip protrusion was acceptable for both males and females when a prominent chin or nose was present. Coleman et al.⁹ investigated preferred lip fullness in silhouette images with mandibular prognathism and retrognathism, comparing the perceptions of orthodontists, patients, and their parents. They also found that fuller lip positions were preferred for the more extreme retrognathic and prognathic profiles, whereas more retrusive lip positions were preferred for the more average profiles. No

differences were found among the three evaluator groups or between male and female evaluators.

Morar and Stein¹⁰ compared esthetic preferences of rural and urban South African communities, finding little difference between the two groups. The populations studied preferred a Caucasian-type profile, which may be a reflection of changing perceptions resulting from cultural influences and an international media.

There have been no studies looking at the influence of lower lip prominence on the perception of chin prominence. This study aims to evaluate the influence of the lower lip position for varying degrees of progenia and retrogenia and to establish whether lower lip prominence affects the perceived desire for surgery. It will also assess differences in preference between orthodontists and laypeople and the effect of ethnicity, gender, and age of assessors.

MATERIALS AND METHODS

Ethical review board approval was not required for this study (National Research Ethics Service, NRES, UK). A facial profile silhouette image was created with computer software (Adobe¹® Photoshop[®] CS2 software; Adobe Systems Inc, San Jose, Calif), as previously described.^{11,12} The image was manipulated using the same software to construct an “ideal” facial profile image (Figure 1) with proportions and soft tissue measurements based on currently accepted criteria.^{1,11,12}

The ideal facial profile silhouette was manipulated such that the mandibular prominence (lower lip and chin) was altered in 4-mm increments from -12 mm to $+12$ mm (Figure 2). The same images were manipulated such that the lower lip was not altered and so that only the chin prominence was altered by the same increments (ie, -12 mm to $+12$ mm; Figure 3). A duplicate of one of the images was used in order to assess intraexaminer reliability.

Each image was printed on A5-sized matte photographic paper. The images were presented to 100 laypeople and 30 orthodontists on a table top, arranged in random order. The observers were aged between 18 and 58 years; 50 were male and 80 were

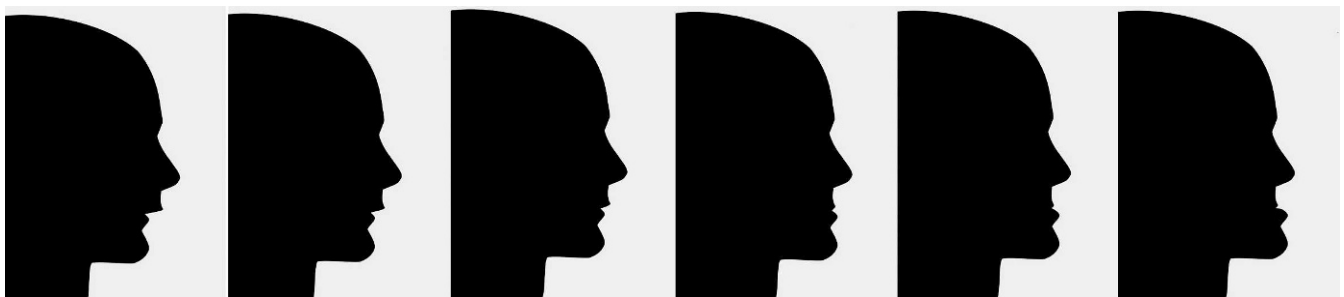


Figure 2. Showing lip and chin manipulation, from left to right: Image 8 (-12 mm), image 7 (-8 mm), image 6 (-4 mm), image 2 ($+4$ mm), image 3 ($+8$ mm), and image 5 ($+12$ mm).

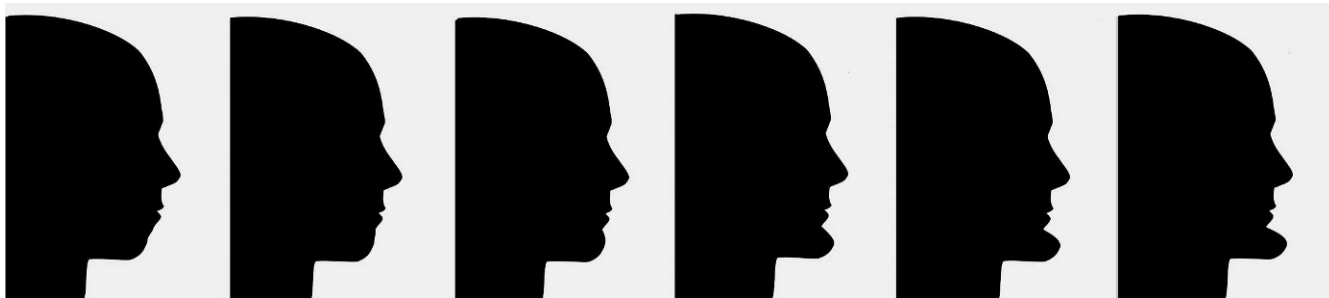


Figure 3. Showing chin-only manipulation, from left to right: Image 14 (–12 mm), image 13 (–8 mm), image 12 (–4 mm), image 9 (+4 mm), image 10 (+8 mm), and image 11 (+12 mm).

female. There were 91 White Caucasian, 11 Black, and 22 Asian observers, and six observers with other mixed ethnicity. The observers were asked to rank the images in order from most attractive to least attractive. They were also asked to state whether they would desire orthognathic correction for each image if it represented their own facial profile.

Statistical Methods

The observers' ranks were recorded from 1 through 14 for each image. Mean ranks across observers were calculated for each image and used to establish a final rank for the 14 images. Linear and logistic regressions were used to model, respectively, the effects of different covariates on the mean ranks and the likelihood of deeming each image as requiring surgery. Univariate regressions were followed by multivariate regressions in order to adjust for the effects of possible confounders (eg, the direction and amount of chin prominence and whether the lower lip was involved in the image manipulation). The multivariate models were fitted in a stepwise manner on those variables showing significance below 0.20 in the univariate models.

Table 1. Mean Rank for Images by Group

Laypeople		Clinicians	
Image	Mean Rank	Image	Mean Rank
12	2.3	12	1.7
1	2.5	1	2.2
6	3.1	13	3.7
13	4.6	6	3.8
2	5.7	2	5.9
7	6.2	7	6.1
9	8.0	14	7.2
14	8.5	9	8.1
8	8.6	8	9.1
4	9.2	3	9.6
3	9.6	4	9.8
10	11.3	5	12.0
11	12.7	10	12.2
5	12.7	11	13.5

RESULTS

Reliability of the Measure

Images 3 and 4 were identical. For these two images, the intraobserver variability was highly significant ($F = 2.3$; $P = .001$), indicating a fair agreement within observers for the two images. The intraclass correlation was 0.40 (95% confidence interval [CI] 0.25 to 0.55), which corresponds to a moderate intraobserver agreement. The mean difference between the two images' mean ranks was not significant (mean difference = -0.21 ; 95% CI -0.68 to 0.26 ; $P = .38$).

Analysis of Mean Ranks

The mean ranks for all images are demonstrated by group (Table 1). The first three favored images, according to the ordered mean ranks, were images 12, 1, and 6. The three most disliked images, according to the ordered mean ranks, were images 11, 5, and 10.

The image that was chosen as first in the preference rank most often was image 12 (with 45.4% of the observers choosing it as first), followed by image 1 (with 34.6% of observers choosing it as first). These two images presented remarkably similar ranks: mean ranks were 2.2 and 2.5, respectively. Images 13 and 6 were also chosen as first favorites by 10% and 7.7% of the observers, respectively.

The image that was chosen as last in the preference rank most often was image 11 (with 51.5% of the observers choosing it as last), followed by image 5 (with 40% of observers choosing it as last). Table 1 demonstrates that there were only minor disagreements in the rank preferences between the two observer groups. The main disagreement was in the position of the three most disliked images.

While the direction and the amount of the deviation were found to be highly significant on univariate regression, no significant difference in the mean ranks of the images that had chin manipulation vs those that had chin and lower lip manipulation (mean difference = 0.21 ; 95% CI 0.47 to 0.88 ; $P = .55$) was found.

Table 2. Multivariate Linear Regression of Mean Ranks

Mean Rank	Coefficient	95% Confidence Interval		P-Value
Direction (protrusion vs retrusion)	4.7	3.78	5.66	.001
Amount of deviation	0.60	0.54	0.66	.001
Interaction of amount by direction	0.10	0.00	0.19	.06
Lower lip (lip vs no lip involvement)	1.5	1.05	2.03	.001
Interaction of lip by direction	-2.3	-2.97	-1.60	.001
Group (clinician vs layperson)	0.00	-0.39	0.39	.98

Neither gender ($P = .99$) nor ethnicity ($P = .94$) was found to reflect any significant difference.

On multivariate linear regression, the direction (mean difference = 4.7; 95% CI 3.8 to 5.7; $P = .001$) and amount of deviation (mean difference = 0.6; 95% CI 0.54 to 0.66; $P = .001$) retained statistical significance. Significant interactions were found between the direction of deviation with both lip involvement ($P = .001$) and amount of prominence ($P = .06$). No significant interaction was found between the amount of manipulation and lip involvement ($P = .33$).

Effect of Direction of Manipulation

The effect of direction was significant, with manipulation in the positive direction making the image more unattractive. Given the significant direction-by-lip interaction, it was found that manipulating in the positive direction made the image more unattractive, even more so if the chin alone was manipulated. The mean rank increased by 4.7 for the images in which chin alone was manipulated in the positive direction and by 2.4 for the images in which chin and lip were manipulated in the positive direction (Table 2).

Effect of Amount of Manipulation

The greater the amount manipulated, the greater the mean rank (less attractive ranking) for the given image. The mean rank increased by 0.6 for each 1-mm increase in the manipulation, regardless of the direction of manipulation, but as a result of the significant amount-by-direction interaction, for those images that were manipulated in the positive direction there was a 0.1 further increase in the mean rank for every 1-mm increase in the manipulation (Table 2).

Effect of Lower Lip Involvement

Although lower lip involvement was not significant on univariate regression (difference = -0.21; 95% CI -0.88 to 0.5; $P = .55$), on multivariate regression a significant interaction between direction (protrusion and retrusion) and lip involvement was found. For images that had lower lip involvement in the manipulation, the mean rank was 1.5 greater (more unattractive) if the manipulation was in the negative direction;

in contrast, it was 0.8 less (less unattractive) if manipulation was in the positive direction. The data therefore indicate that the effect of lower lip involvement on perceived attractiveness depends on the direction of manipulation. After adjusting for these effects, the observer group (clinician or layperson) was not found to have any significant effect on the ranks for attractiveness.

Outcome: Desire for Surgery

Table 3 shows the proportion of observers viewing images as requiring surgery. A mixed logistic regression model showed the likelihood of desire for surgery for an image to be significantly affected by the amount and direction of manipulation, lower lip involvement, and gender, ethnicity, and group of the observer. Lower lip involvement was significant through an interaction with the direction of the manipulation.

The odds of desire for surgery were as follows:

- Thirty percent less for white observers (odds ratio [OR] = 0.7; 95% CI 0.5 to 0.9; $P = .01$) and 40% less for men (OR = 0.6; 95% CI 0.5 to 0.8; $P = .001$);
- Nineteen-fold increased for manipulation in the positive direction (OR = 19; 95% CI 12 to 28; $P = .001$);
- Fifty percent greater for each 1 mm of deviation from the idealized image (OR = 1.5; 95% CI 1.4 to 1.6; $P = .001$);
- Ninety-four percent greater for a manipulation with lower lip involvement retrusion (OR = 1.94; 95% CI 1.4 to 2.8; $P = .001$) and 54% less with lower lip prominence (OR = 0.46; 95% CI 0.33 to 0.65; $P = .001$);
- Two and a half-fold increased for clinicians in relation to laypeople (OR = 2.5; 95% CI 1.8 to 3.3; $P = .001$).

DISCUSSION

Facial attractiveness is a known contributor to psychosocial well-being.¹³ Knowledge of perceptions of attractiveness for different facial parameters may be useful when planning the correction of dentofacial deformities.¹

Table 3. Proportion of Observers Viewing Image as Requiring Surgical Correction

Image	Overall (N = 130), No. (%)		Laypeople (N = 100), No. (%)		Clinicians (N = 30), No. (%)	
	No Surgery	Surgery	No Surgery	Surgery	No Surgery	Surgery
Chin only (no lower lip involvement)						
1	125 (96.2)	5 (3.8)	98 (98)	2 (2)	27 (90)	3 (10)
2	91 (70)	39 (30)	75 (75)	25 (25)	16 (53)	14 (47)
3	41 (31.5)	89 (68.5)	38 (38)	62 (62)	3 (10)	27 (90)
4	37 (28.5)	93 (71.5)	33 (33)	67 (67)	4 (13)	26 (87)
5	13 (10)	117 (90)	11 (11)	89 (89)	2 (7)	28 (93)
6	121 (93.1)	9 (6.9)	95 (95)	5 (5)	26 (87)	4 (13)
7	79 (60.8)	51 (39.2)	69 (69)	31 (31)	10 (33)	20 (67)
8	40 (30.8)	90 (69.2)	38 (38)	62 (62)	2 (7)	28 (93)
Lower lip and chin involvement						
9	62 (47.7)	68 (52.3)	52 (52)	48 (48)	10 (33)	20 (67)
10	21 (16.1)	109 (83.9)	20 (20)	80 (80)	1 (3)	29 (97)
11	10 (7.7)	120 (92.3)	10 (10)	90 (90)	0 (0)	30 (100)
12	124 (95.4)	6 (4.6)	94 (94)	6 (6)	30 (100)	0 (0)
13	100 (76.9)	30 (23.1)	77 (77)	23 (23)	23 (77)	7 (23)
14	56 (43.1)	74 (56.9)	49 (49)	51 (51)	7 (23)	23 (77)

In this study, an idealized profile image was manipulated to create six images demonstrating different degrees of retrogenia and progenia from -12 mm to $+12$ mm and six images demonstrating chin and lower lip prominence from -12 mm to $+12$ mm. These images were ranked by 100 laypeople and 30 orthodontists.

The highest rated, and therefore most attractive, image was image 12 (with a mean rank of 2.3), exhibiting minor chin retrusion from the idealized image. This was closely followed by image 1 (with a mean rank of 2.5), representing an idealized profile with soft tissue pogonion on the true vertical line and unaltered lower lip. Image 6, showing minor retrusion of the lip and chin, was ranked third. The least attractive images were images 11 and 5, respectively, representing 12 mm of protrusion of chin only and 12 mm of protrusion of lip and chin. For every 1-mm deviation from the idealized image, mean rank increased by 0.6, and the odds of an observer desiring surgery increased by 50%. For those images in which the chin was protrusive there was a further increase in the mean rank.

The overall trend demonstrates that minor degrees of chin retrusion or protrusion were rated as more attractive and greater degrees of deviation were rated as progressively less attractive, although the tendency was for protrusive chin and lower lip positions to be rated as less attractive. This confirms previous findings by Naini et al.^{11,12} and Kuroda et al.,¹⁴ which indicated that the greater the amount of sagittal deviation, the more unattractive the image and that the effect is more marked when the chin is protrusive than when it is retrusive.

Surgery was desired for profiles in which the chin deviated more than 4 mm in the positive or negative direction regardless of the position of the lower lip.

The influence of lower lip position on the attractiveness of the facial profile is different for those images with protrusion vs retrusion of the chin. When the chin is protrusive, a forward lower lip position makes the image more attractive. For the more retrusive chin, an unaltered lower lip position was deemed more attractive. This was demonstrated when comparing mean ranks of images 2 and 9. The difference in mean ranks was -2.0 (95% CI -3.5 to -0.53 ; $P = .0004$), which illustrates that when the lips were manipulated in a forward direction by a 4-mm increment the image was deemed to be more attractive, as compared to the exact same image reflecting no alteration to the lip position. It was found that manipulating in the positive direction made the image more unattractive, even more so if the chin alone was manipulated. The mean rank increased by almost twice as much for those images in which the chin alone was manipulated in the positive direction than for those images in which the chin and lip were manipulated in the positive direction.

When the chin was retrusive, a more forward lip position was favored. For example, the mean rank of image 7 was higher by 1.8 when compared to image 13 (95% CI 0.34 to 3.33; $P = .002$), which shows an unaltered ideal lower lip position was favored when the chin was manipulated by 8 mm in a retrusive direction. This may be explained by the fact that such a lower lip position masks, to some extent, the severity of the skeletal Class II pattern, making the profile appear less unattractive.

The effects of lower lip position are also reflected in the desire for surgery. Manipulating the lips in a negative direction with the chin yielded a 94% increase in the odds of desire for surgery, whereas movement of the lips and chin in the positive direction reduced the odds of desire for surgery by 54%.

The results of the present study are consistent with the findings of Czarnecki et al.⁸ in that greater lower lip protrusion was favored where there was a prominent chin, and the least favored profile was an unaltered lip profile with a prominent chin.

Singh¹⁵ found that comparatively fuller lips were preferred for Class II and Class III profiles when compared with Class I profiles, which was also confirmed by the findings of this study. The age, gender, and ethnicity of observers did not affect the rankings. For males, the desire for surgery was less than for females, and white observers had 30% less odds of desire for surgery than did other ethnic groups.

Previous studies¹⁶ have found significant differences between laypeople and clinicians in assessing facial profile attractiveness. In this study, there was no significant difference between orthodontists and laypeople in terms of image rankings. However, orthodontists were twice as likely to desire surgical correction.

These findings indicate that there is agreement between clinicians and laypeople in choosing the preferred profile and that this is not significantly affected by gender, age, or ethnicity. However, the desire for surgery is higher among clinicians and female laypeople. This highlights the importance of taking into account the patients' desires when treatment planning.

Further studies are required to assess changes in the nasolabial region in terms of perceptions of attractiveness.

CONCLUSIONS

- When treatment planning to alter the sagittal prominence of the chin, the position of the lower lip should be taken into consideration. The ideal sagittal position for the chin is on or behind the true vertical line, with the lower lip just behind the upper lip. In skeletal Class II profiles, a lower lip position unaltered from ideal was favored, while in Class III profiles a forward lip position was deemed to be more attractive.
- There was a greater desire for surgery when the lower lip was less prominent in retrusive and protrusive chin profiles.
- The overall direction of opinion was the same for laypeople and orthodontists, but orthodontists favored surgical correction.
- No significant differences were found between observers of different age or ethnicity in terms of

ranking images, but white males were less likely to seek surgical correction.

- Chin protrusion was less attractive than retrusion and surgery was desired more often for these images.
- The most important factor in profile attractiveness was the amount of sagittal discrepancy.

REFERENCES

1. Naini FB. *Facial Aesthetics: Concepts and Clinical Diagnosis*. Oxford, UK: Wiley-Blackwell; 2011.
2. Aufrecht G. Combined plastic surgery of the nose and chin: resume of 27 years of experience. *Am J Surg*. 1958;95:231–236.
3. Kasai K. Soft tissue adaptability to hard tissues in facial profiles. *Am J Orthod Dentofacial Orthop*. 1998;113:674–684.
4. Brock RA, Taylor RW, Buschang PH, Behrents RG. Ethnic differences in upper lip response to incisor retraction. *Am J Orthod Dentofacial Orthop*. 2005;127:683–691.
5. Ricketts RM. Planning treatment on the basis of the facial pattern and an estimate of its growth. *Angle Orthod*. 1957;27:14–37.
6. Steiner CC. Cephalometrics for you and me. *Am J Orthod*. 1953;39:729–755.
7. Peck H, Peck S. A concept of facial esthetics. *Angle Orthod*. 1970;40:284–318.
8. Czarnecki ST, Nanda RS, Currier GF. Perceptions of a balanced facial profile. *Am J Orthod Dentofacial Orthop*. 1993;104:180–187.
9. Coleman GG, Lindauer SJ, Tüfekçi E, Shroff B, Best AM. Influence of chin prominence on esthetic lip profile preferences. *Am J Orthod Dentofacial Orthop*. 2007;132:36–42.
10. Morar A, Stein E. A method of assessing facial profile attractiveness and its application in comparing the aesthetic preferences of two samples of South Africans. *J Orthod*. 2011;38:99–106.
11. Naini FB, Donaldson AN, McDonald F, Cobourne MT. Assessing the influence of chin prominence on perceived attractiveness in the orthognathic patient, clinician and layperson. *Int J Oral Maxillofac Surg*. 2012;41:839–846.
12. Naini FB, Donaldson AN, Cobourne MT, McDonald F. Assessing the influence of mandibular prominence on perceived attractiveness in the orthognathic patient, clinician and layperson. *Eur J Orthod*. 2012;34:738–746.
13. Berscheid E, Gangestad S. The social psychological implications of facial physical attractiveness. *Clin Plast Surg*. 1982;9:289–296.
14. Kuroda S, Sugahara T, Takabatake S, Taketa H, Ando R, Takano-Yamamoto T. Influence of anteroposterior mandibular positions on facial attractiveness in Japanese adults. *Am J Orthod Dentofacial Orthop*. 2009;135:73–78.
15. Singh J. Preference of lip profile in varying mandibular sagittal position. *J Int Oral Health*. 2011;3:47–57.
16. Cochrane SM, Cunningham SJ, Hunt NP. A comparison of the perception of facial profile by the general public and 3 groups of clinicians. *Int J Adult Orthod Orthognath Surg*. 1999;14:291–295.