

Esthetic evaluation of lip position in silhouette with respect to profile divergence

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Introduction: The aim of this study was to determine the preferred lip position in silhouette profiles with different amounts of divergence. **Methods:** A normal profile was constructed based on normal values and was altered using software (Photoshop CS, version 8.0; Adobe Systems, San Jose, Calif) to produce a series of 15 profiles in 3 sets (straight, anterior, and posterior divergent). Each set consisted of 5 photographs with different lip positions from -4 mm to +4 mm in 2-mm increments. We asked 240 people in 5 panels (79 senior dental students, 26 orthodontists, 27 maxillofacial surgeons, 27 prosthodontists, and 81 laypeople) to rate the profiles. Mann-Whitney and Kruskal-Wallis tests, and intraclass correlation coefficients were used to analyze the data. **Results:** In the anterior and posterior divergent profiles, most groups tended to prefer the original lip positions for both the male and female profiles. In the straight divergent profile, the results were scattered and inconsistent in the different groups. In the posterior divergent profile, the orthodontists and the surgeons selected the 4-mm lip retrusion as the least attractive, and other groups selected the 4-mm lip protrusion as the least attractive. In the anterior and straight divergent profiles, all groups were unanimous in the selection of the 4-mm lip protrusion as the least attractive images. Significant differences were found between the raters in the rankings of some images. No significant difference was found between the male and female raters in the rankings of the profile images. **Conclusions:** It is important to establish a normal lip position, especially for a patient with an anterior or a posterior divergent profile. Posterior divergent patients should be treated cautiously so that excessive lip retrusion does not result. (Am J Orthod Dentofacial Orthop 2016;149:863-70)

Nowadays, a strong focus has been placed on facial beauty and attractiveness.^{1,2} Improvement in facial esthetics is a main reason that patients seek orthodontic treatment; in recent years, it has become even more important for both patients and orthodontists.³ Although orthodontic diagnosis is carried out in 3 dimensions (transverse, anteroposterior, and vertical), much of the emphasis in treatment planning is placed on the esthetics of the face in profile.⁴ The lower third of the face from the

base of the nose to soft tissue menton is an integral part of orthodontic diagnosis and treatment planning.⁵ The importance of soft tissue profile analysis in orthodontic treatment planning has been demonstrated.⁶ The lip posture has also been defined as a crucial element in overall facial esthetics, posttreatment stability, and function.⁷ It has been suggested that a well-balanced relationship between the lips, chin, and nose is required to obtain optimum facial harmony and esthetics.⁸

Several studies have been conducted to evaluate the effect of lip position on esthetic preferences.⁹⁻¹² Yehezkel and Turley¹² concluded that with a change in the esthetic standards for the African American female profile during the 20th century, the public has gravitated toward fuller and more anteriorly positioned lips. It has been proved that facial convexity may affect the preferred lip position.¹³⁻¹⁵ Ioi et al¹³ found that with a decrease in the facial convexity, more retruded lip positions were favored. In another study, it was reported that in extremely retrognathic and prognathic subjects, fuller lip positions were preferred, whereas more retrusive lip positions were preferred for more average profiles.¹⁴ Modarai et al¹⁵ stated that the mandibular position plays an important part in the ideal position of the lower lip. One factor that can be evaluated in the profile view is

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facial divergence. Divergence of the face (the term was first used by the orthodontist-anthropologist Milo Hellman) is defined as “an anterior or posterior inclination of the lower face relative to the forehead” and is affected by the patient’s racial and ethnic background.¹⁶ A straight profile line, regardless of its divergence, does not indicate a problem, but convexity or concavity does.¹⁶ Although authors of previous studies have evaluated the preferred lip position in various facial profiles, to the best of our knowledge, no authors have evaluated the preferred lip position with different amounts of facial divergence. Moreover, because the facial divergence is a characteristic of the patient’s inherent underlying skeletal pattern and does not indicate a problem, the orthodontist or the patient does not wish to change it. Therefore, understanding the preferred lip position with regard to the type of facial divergence can facilitate treatment planning and decision making to obtain the most attractive facial profile upon the completion of orthodontic treatment.

The objective of this study was to develop a series of facial profiles based on the original ideal constructed profile for evaluation by the members of various dental professions and laypeople. By varying the facial divergence and the lip position, we hoped to determine the most and the least desirable combinations and to elucidate whether the rater’s profession and sex affect the preference.

MATERIAL AND METHODS

An ideal profile image in natural head position¹⁴ was constructed according to the method of Jacobson¹⁷ with computer software (Photoshop CS, version 8.0; Adobe Systems, San Jose, Calif) with the following parameters taken into account: Vertical proportion in profile view, angle of facial convexity, nasofacial angle, nasomental angle, mentocervical angle, submental-neck angle, nasolabial angle, upper and lower lips and chin prominence in relation to SnV, upper and lower lips prominence to Sn-Pog’, 0° meridian, lips to E-line, lips to S-line, facial angle, and upper lip curvature. Two-dimensional facial profile silhouettes were used to assess the perceptions of facial profile attractiveness. The facial silhouettes were constructed in black to prevent the effect of distracters.¹⁰ The profile was changed to an androgynous silhouette by removing the hair^{9,10} to reduce the influence of sex-defining features.¹⁴

While maintaining the normal profile convexity, the profile divergence was altered with the Photoshop software, by changing the position of subnasale and soft tissue pogonion horizontally relative to the true vertical line that crosses glabella to create 3 forms of normal profile¹⁸: anterior divergent (glabella-Sn to true vertical

line, +15°, and glabella-Pog’ to true vertical line, +10°); straight divergent (glabella-Sn to true vertical line, +5°, and glabella-Pog’ to true vertical line, 0°); and posterior divergent (glabella-Sn to true vertical line, -5°, and glabella-Pog’ to true vertical line, -10°). To focus on the sagittal aspects of the facial profile, the vertical height of the constructed profile was not changed (Table 1).

For each facial divergence, a series of 5 profiles was developed to represent different lip protrusions (A, B, C, D, and E). The profile with average lip protrusion relative to E-line, S-line, and SnV was placed in the middle of each series (picture C). The lips were then protruded or retruded in 2-mm increments for different lip protrusions or retrusions. Therefore, an 8-mm difference existed between the most retruded profile (picture A, -4 mm) and the most protruded profile (picture E, +4 mm) in each series. The increments or decrements in the positions of the lips were made in a consistent manner in the sagittal plane. The result was 15 photographs (in 3 series) with combinations of different amounts of facial divergence and lip protrusion.

The profiles were presented separately in 3 sets (straight, anterior divergent, and posterior divergent), and each set had 5 photographs with different degrees of lip protrusion (Figs 1-3).

The panel of raters included 240 people: 79 senior dental students enrolled in dental school at the Shiraz University of Medical Sciences; 26 orthodontists; 27 maxillofacial surgeons; and 27 prosthodontists who were either in the faculty practice at Shiraz Dental School or had a private practice in Shiraz; and 81 patients, selected by simple randomization from those referred to Shiraz Dental School for treatment, who were called laypeople. The inclusion criteria for the laypeople were 18 years of age or older, no history of orthodontic or facial surgical treatment, no facial deformities, no facial trauma, and not health care employees. A questionnaire was prepared for rating the profiles based on a Likert type of rating scale.

The Likert scale is largely accepted in the psychology literature as the most useful rating method.^{19,20} All raters were asked to evaluate the profile series of each set in 1 session and score them from 1 to 5: 1, very unattractive; 2, unattractive; 3, neither attractive nor unattractive; 4, attractive; or 5, very attractive. They were asked not to assign the same score to more than 1 profile and to score 1 for the least attractive and 5 for the most attractive silhouette. Some questions regarding the demographic characteristics of the raters (age, sex, and profession) were also included in the questionnaire. The evaluators were asked to grade the

Table I. Definitions of the cephalometric points

Abbreviation	Definition
Sn	The point at which the columella (nasal septum) merges with the upper lip in the midsagittal plane
Pog'	The most prominent or anterior point on the chin in the midsagittal plane
Glabella	The most prominent anterior point in the midsagittal plane of the forehead

profiles separately for the sexes to record whether their perceptions of facial balance include sex bias for facial profiles.

During the rating process, each rater was seated in a quiet area apart from the other raters and given 10 minutes to complete the questionnaires. All questionnaires were filled out anonymously and marked with numeric codes. To determine the reliability of the results, 20% of the evaluators in each group were asked to complete the questionnaires again after 2 weeks.

Statistical analysis

After gathering the data, we performed the statistical analysis using SPSS software (version 19; IBM, Armonk, NY). The means and standard deviations for the rank scores were calculated for all images. Additionally, the means and standard deviations for the rank scores were calculated independently for each sex and group. The Kruskal-Wallis test was used to compare the rankings of the images among the 5 professional groups. The Mann-Whitney test was used to compare the scores of the male and female raters and for pair-wise comparisons in the professional groups. The Mann-Whitney test was also used to compare the scores of the male and female raters for all images. Reproducibility among scores between the 2 evaluations was tested using intraclass correlation coefficients (ICCs) with a 95% confidence interval.

RESULTS

Overall, 240 evaluators—124 women (mean age, 29.20 ± 7.26 years) and 116 men (mean age, 30.62 ± 7.79 years)—participated in the study ($P > 0.05$). No significant difference was found between the male and female raters in the rankings of the profile images ($P > 0.05$). The means and standard deviations of the scores for the male and female profiles as ranked by the groups in each series are shown [Tables II and III](#). No significant differences were found between the mean scores of the male and female profiles among raters except for the anterior divergent profile with a 4-mm lip retrusion (male raters, 2.59 ± 1.25 ; female raters, 2.31 ± 1.24 ; $P < 0.001$) and the anterior divergent

profile with a 2-mm lip protrusion (male raters, 2.99 ± 1.07 ; female raters, 3.16 ± 1.04 ; $P = 0.028$).

Based on the mean rank scores of the male and female profiles in the first series (anterior divergent), the highest and the lowest mean scores were given by all groups to images C (normal lip position) and E (4-mm lip protrusion), respectively ([Tables II and III](#)).

In the second series (straight divergent) of female profiles, the highest mean score was given to image C (normal lip position) by most groups. In the second series (straight divergent) of male profiles, the results were more scattered, and different lip positions were selected as the best by the various groups. In all groups, image E (4-mm lip protrusion) was selected as the least attractive for both the male and female profiles ([Tables II and III](#)).

In the third series (posterior divergent), the highest mean score was given by almost all groups to image C (normal lip position) for both the male and female profiles. The results were more scattered for the least attractive lip position; different lip positions were selected as the worst by different groups ([Tables II and III](#)).

Significant differences were found among the groups in ranking some images ($P < 0.05$), most of which were related to the laypeople, who showed significant differences from the rankings of the other groups ([Table IV](#)).

Since 20% of the raters scored every photograph twice, the reliability of the ratings was tested using the ICC. The ICC was 0.72 (lower bound, 0.64; upper bound, 0.79, with 95% confidence), indicating a high level of agreement among the judges when scoring each photograph.

DISCUSSION

The objectives of orthodontic treatment are to achieve facial balance through stabilization of the dentition and to produce pleasing facial and dental esthetics.²¹ Positioning of the lips is an important factor affecting overall facial balance, especially when changes in the profile position cannot be achieved.¹⁴ As a preliminary study, we assessed the most favorable profile with a series of varying anteroposterior lip positions in facial silhouettes, rated by 240 people (79 senior dental students, 26 orthodontists, 27 maxillofacial surgeons, 27 prosthodontists, and 81 laypeople). Androgynous silhouettes have been advocated for the evaluation of profile esthetics by previous authors because they eliminate the effect of other possible esthetic variables such as hair, skin complexion, and eyes.¹⁴ It has been reported that factors such as hairstyle rather than profile outline shape can bias the esthetic scores.²² On the other hand, another study reported that the average size of some facial features such as large eyes, cheekbones,

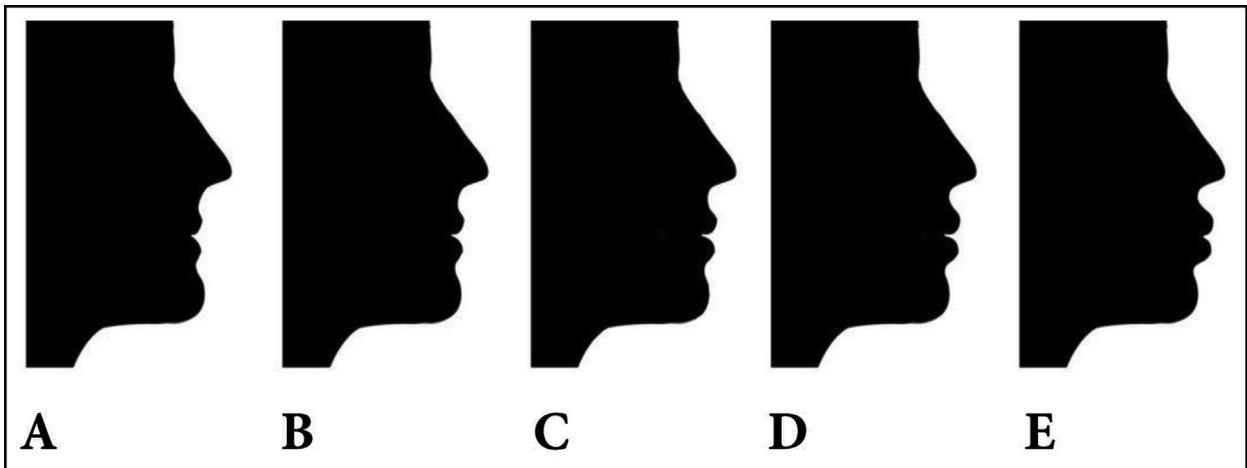


Fig 1. The first set of the profiles (anterior divergent) with different lip positions: **A**, 4-mm lip retrusion; **B**, 2-mm lip retrusion; **C**, normal lip position; **D**, 2-mm lip protrusion; **E**, 4-mm lip protrusion.

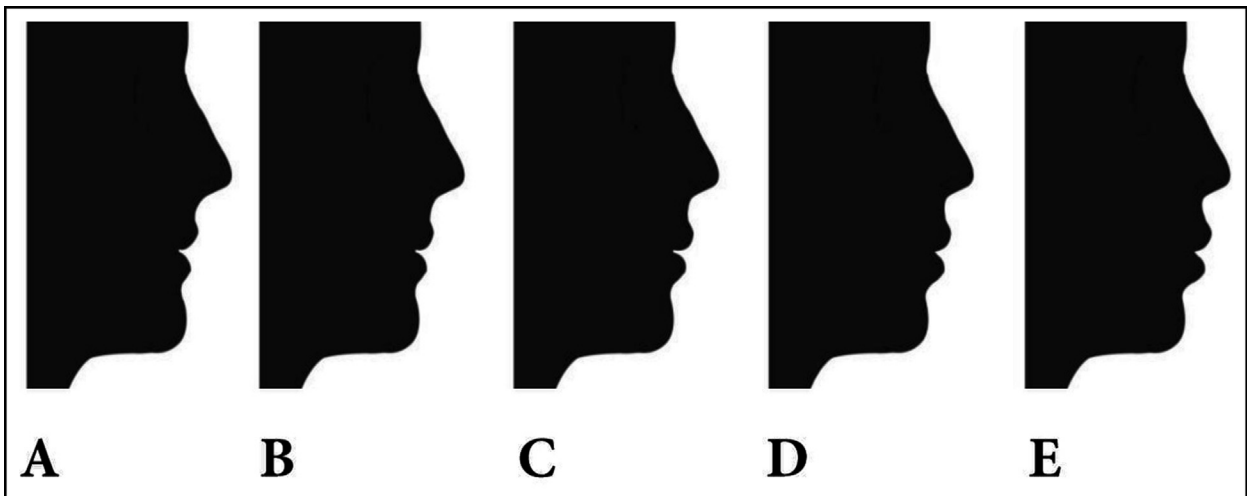


Fig 2. The second set of the profiles (straight divergent) with different lip positions: **A**, 4-mm lip retrusion; **B**, 2-mm lip retrusion; **C**, normal lip position; **D**, 2-mm lip protrusion; **E**, 4 mm lip protrusion.

and chins for men can be perceived as more attractive.²³ However, these might also distract the evaluators from merely assessing the profiles. Similarly, a silhouette can challenge the evaluators' imaginations when they are asked to distinguish between "male" and "female" profiles.¹⁴

Our hypothesis for this study was that the perception of an ideal lip position might be influenced by different profile divergences. No significant differences existed between the mean scores of the male and female profiles in all groups of raters except for the anterior divergent profile with a 4-mm lip retrusion and the anterior divergent profile with a 2-mm lip protrusion, which represented anterior divergent profiles. The 4-mm retruded

lip position received a lower mean score in the female profile than in the male profile, and the 2-mm protruded lip position received a higher mean score in the female profile than in the male profile. Foster⁹ and Czarnecki et al¹⁰ reported that fuller lips are preferred for women compared with men. Coleman et al¹⁴ reported that although a consistent and significant preference for lip position cannot be established for male and female profiles, there was a tendency toward fuller lips in the female profiles. Shimomura et al²⁴ reported that orthodontic patients tended to prefer a slightly retruded lip position compared with an average facial profile for both men and women, but this tendency was more pronounced in the female profile. The difference between

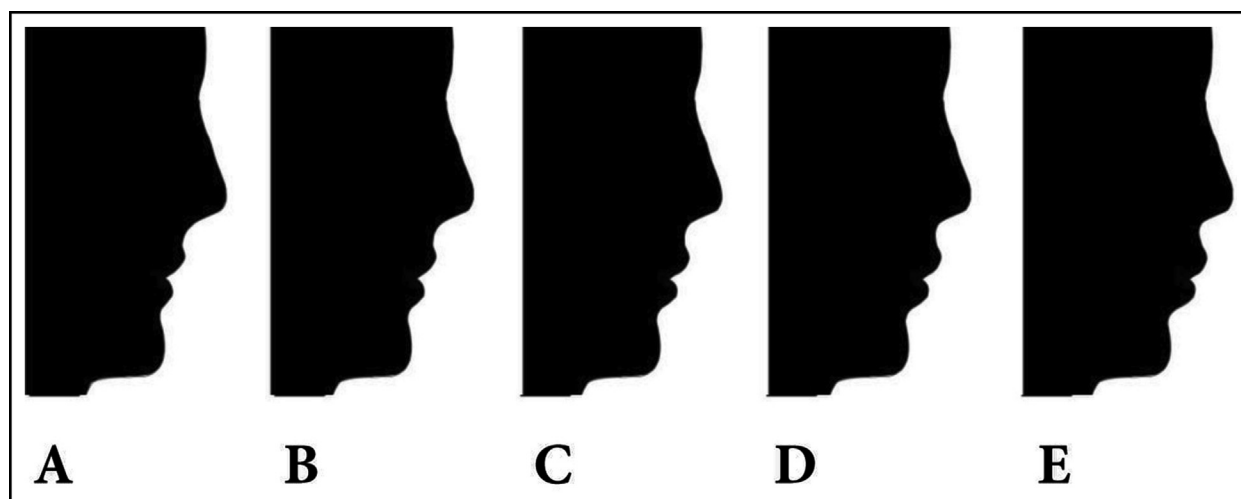


Fig 3. The third set of the profiles (posterior divergent) with different lip positions: **A**, 4-mm lip retrusion; **B**, 2-mm lip retrusion; **C**, normal lip position; **D**, 2-mm lip protrusion; **E**, 4-mm lip protrusion.

Table II. Scores (mean \pm SD) for the male profiles as ranked by the groups in each series

Profile picture	Students	Orthodontists	Surgeons	Prosthodontists	Laypeople	P value
S1mA	2.51 \pm 1.2	2.57 \pm 1	2.37 \pm 0.8	2.66 \pm 1.1	2.71 \pm 1.4	0.826
S1mB	3.82 \pm 1.0	4.03 \pm 0.9	3.85 \pm 0.9	4 \pm 1	3.56 \pm 1.1	0.176
S1mC	4.07 \pm 0.9	4.26 \pm 0.8	4.29 \pm 0.9	4.07 \pm 0.9	4.12 \pm 0.9	0.751
S1mD	3.01 \pm 1.0	2.88 \pm 0.9	3.29 \pm 0.8	2.88 \pm 1	2.93 \pm 1.2	0.411
S1mE	1.56 \pm 1.1	1.23 \pm 0.6	1.18 \pm 0.7	1.37 \pm 0.8	1.65 \pm 1	0.008 [†]
S2mA	2.91 \pm 1.4	3.26 \pm 1.5	2.62 \pm 1.4	3.29 \pm 1.4	2.79 \pm 1.4	0.303
S2mB	3.46 \pm 1.1	3.69 \pm 1.1	3.48 \pm 0.9	3.96 \pm 1.1	3.32 \pm 1.1	0.098
S2mC	3.50 \pm 1	3.57 \pm 0.8	3.77 \pm 1.2	3.37 \pm 0.8	3.24 \pm 1.2	0.291
S2mD	3.30 \pm 1.3	2.92 \pm 1.2	3.37 \pm 1.3	2.96 \pm 1.2	3.40 \pm 1.2	0.264
S2mE	1.84 \pm 1.3	1.53 \pm 1.1	1.74 \pm 1	1.40 \pm 1	2.27 \pm 1.5	0.020*
S3mA	2.39 \pm 1.4	2.07 \pm 1.4	2.00 \pm 1.3	2.14 \pm 1.2	2.30 \pm 1.3	0.595
S3mB	3.44 \pm 1.1	2.92 \pm 1.1	2.96 \pm 1.2	3.25 \pm 1.2	3.19 \pm 1.1	0.221
S3mC	3.56 \pm 1.1	3.84 \pm 0.8	3.92 \pm 0.9	4.29 \pm 0.8	3.75 \pm 1.1	0.049*
S3mD	3.39 \pm 1.1	3.53 \pm 1.2	3.51 \pm 1.1	3.25 \pm 1	3.65 \pm 1.2	0.413
S3mE	2.20 \pm 1.4	2.53 \pm 1.6	2.59 \pm 1.5	2.03 \pm 1.3	2.08 \pm 1.2	0.368

S1, Anterior divergent; S2, straight divergent; S3, posterior divergent; m, male; f, female; A, 4-mm lip retrusion; B, 2-mm lip retrusion; C, normal lip position; D, 2-mm lip protrusion; E, 4-mm lip protrusion.

* $P < 0.05$; [†] $P < 0.01$.

the results of these studies may be attributed to the fact that profile preferences are cultural and can be influenced by ethnic norms.²⁵

In our study, no significant difference was found between the male and female raters for ranking the profiles. Coleman et al,¹⁴ Modarai et al,¹⁵ and Shimomura et al²⁴ reported the same results as in our study. However, Hier et al¹¹ found that women prefer fuller lips than do men. The differences between the results of these studies may be due to different methods used for illustration of the profiles to raters. Hier et al used photographs for the male and female profiles that might have affected the raters' judgment.

Differences in lip position preference among the groups were scattered and inconsistent in our study, and significant differences were found only among the groups in the ranking of 5 images ($P < 0.05$). Coleman et al¹⁴ found no significant differences in the preferred lip position among their 3 groups of raters (adolescent orthodontic patients, parents of the patients, and orthodontists). Modarai et al¹⁵ concluded that laypeople and orthodontists had the same preference for lip position with respect to chin position. However, Foster⁹ reported that orthodontists had different opinions on the preferred lip position compared with laypeople and dentists. Hier et al¹¹ reported that laypeople preferred fuller

Table III. Scores (mean \pm SD) for the female profiles as ranked by the groups in each series

Profile picture	Students	Orthodontists	Surgeons	Prosthodontists	Laypeople	P value
S1fA	2.20 \pm 1.2	2.11 \pm 1	2.07 \pm 1	2.44 \pm 1.1	2.53 \pm 1.3	0.317
S1fB	3.63 \pm 1.1	4 \pm 0.9	3.44 \pm 0.9	4 \pm 0.73	3.81 \pm 1	0.148
S1fC	4.26 \pm 0.9	4.23 \pm 0.9	4.44 \pm 0.8	4.37 \pm 1	3.93 \pm 0.9	0.022*
S1fD	3.16 \pm 1	3.07 \pm 0.8	3.51 \pm 1	2.77 \pm 0.8	3.19 \pm 1.1	0.085
S1fE	1.73 \pm 1	1.57 \pm 1.1	1.51 \pm 0.9	1.40 \pm 0.9	1.51 \pm 0.9	0.221
S2fA	3.10 \pm 1.5	2.80 \pm 1.3	2.25 \pm 1.3	3.14 \pm 1.5	2.92 \pm 1.4	0.115
S2fB	3.46 \pm 1.1	3.57 \pm 1.1	3.11 \pm 1	3.62 \pm 1.1	3.22 \pm 1.2	0.265
S2fC	3.46 \pm 1.1	3.65 \pm 1.1	3.96 \pm 1.1	3.59 \pm 0.9	3.32 \pm 1.2	0.157
S2fD	3.21 \pm 1.2	3.15 \pm 1.4	3.77 \pm 1.1	2.88 \pm 1.1	3.67 \pm 1.2	0.010*
S2fE	1.69 \pm 1.1	1.80 \pm 1.2	1.88 \pm 1.1	1.74 \pm 1.4	1.85 \pm 1.1	0.440
S3fA	2.37 \pm 1.5	2.19 \pm 1.4	1.55 \pm 0.7	2.29 \pm 1.3	2.67 \pm 1.3	0.004 [†]
S3fB	3.11 \pm 1.2	3.11 \pm 1.1	2.92 \pm 1	3.55 \pm 1.3	3.24 \pm 1.3	0.397
S3fC	3.51 \pm 1	3.73 \pm 1	4.03 \pm 1.2	3.88 \pm 0.9	3.54 \pm 1.2	0.113
S3fD	3.45 \pm 1.1	3.61 \pm 1.3	3.66 \pm 1	3.22 \pm 1.1	3.37 \pm 1.2	0.577
S3fE	2.53 \pm 1.6	2.34 \pm 1.4	2.81 \pm 1.4	1.92 \pm 1.3	2.16 \pm 1.4	0.083

S1, Anterior divergent; S2, straight divergent; S3, posterior divergent; *m*, male; *f*, female; A, 4-mm lip retrusion; B, 2-mm lip retrusion; C, normal lip position; D, 2-mm lip protrusion; E, 4-mm lip protrusion.

* $P < 0.05$; [†] $P < 0.01$.

Table IV. Pair-wise comparisons and *P* values of the profile images that received significantly different mean scores by different groups

Image	Groups		P value
S1fC	Students	Laypeople	0.021
	Prosthodontists	Laypeople	0.017
	Surgeons	Laypeople	0.010
S1mE	Orthodontists	Laypeople	0.019
	Surgeons	Laypeople	0.002
	Surgeons	Students	0.026
S2fD	Students	Laypeople	0.021
	Prosthodontists	Surgeons	0.006
	Prosthodontists	Laypeople	0.004
	Students	Surgeons	0.043
S2mE	Prosthodontists	Laypeople	0.005
	Orthodontists	Laypeople	0.029
S3fA	Surgeons	Prosthodontists	0.034
	Surgeons	Laypeople	0.000
	Surgeons	Students	0.023
S3mC	Prosthodontists	Laypeople	0.035
	Prosthodontists	Students	0.003

S1fC, Female anterior divergent, normal lip position; S1mE, male anterior divergent, 4-mm lip protrusion; S2fD, female straight divergent, 2-mm lip protrusion; S2mE, male straight divergent, 4-mm lip protrusion; S3fA, female posterior divergent, 4-mm lip retrusion; S3mC, male posterior divergent, normal lip position.

lips than did the orthodontists. Our study showed that when a difference existed among the groups in the rating of the profile images, laypeople are more forgiving of the deviations from the original lip position, and most of the disparity in ranking the images was related to this group (Table IV). For example, laypeople gave the highest mean scores to the most protruded lip position

(+4 mm) in the anterior and straight divergent male profiles, and also gave the highest mean scores to the most retruded lip position (+4 mm) in the posterior divergent female profile. Differences among the panels may be due to their training, educational background, and knowledge of facial impairments.²⁶⁻²⁸ Additionally, dentists can better distinguish profile changes because during their careers they have observed and studied patients who deviated from normal.²⁹⁻³¹ Moreover, lay judges may tend to concentrate on other extrinsic facial features such as chin shape, size and shape of the nose, and so on, which per se influence the perception of attractiveness.³²

Based on the results of this study, the original lip position according to the values of Ricketts⁸ was selected as the most favorable in the anterior divergent profile by all groups, and the 4-mm lip protrusion was selected as the least attractive by both sexes. In almost all groups, the 2-mm lip retrusion was rated as more favorable than the 2-mm lip protrusion.

In the straight divergent profile, the results regarding the most favorable lip position were not unanimous. Laypeople selected the 2-mm lip protrusion as the best lip position in both sexes. But some dental professionals selected lip position based on Ricketts' values,⁸ and others selected the 2-mm lip retrusion as the most favorable. For the most unattractive lip position, all groups chose the 4-mm lip protrusion, which is the same as the results of the anterior divergent profile. The 2-mm lip retrusion was rated higher than the 2-mm lip protrusion by almost all groups. Foster⁹ reported that all groups of raters except the orthodontists preferred lips located behind the stated mean values for the E and H

lines in men; for women, the preferred lip position was much closer, yet still behind the E and H lines. The difference between the results of our study and Foster's may be related to the differences in the perception and definition of beauty in modern times compared with a few decades ago. Yehezkel and Turley¹² evaluated the effect of modernity on the esthetic preference and showed that the esthetic standards for the African American female profile changed during the 20th century, with a trend toward fuller and more anteriorly positioned lips that is similar to the standards for white profiles. In the study of Hier et al,¹¹ both men and women preferred lip fullness greater than Ricketts' values. But the results of the study by Shimomura et al²⁴ showed that orthodontic patients tended to prefer a slightly retruded lip position than the average facial profile for both male and female profiles.

In the posterior divergent profile, almost all groups preferred the original lip position in the male and female profiles. But the results were inconclusive regarding the least attractive lip position. The 4-mm lip retrusion was selected as the worst lip position by the orthodontists and surgeons for both male and female profiles and by the dental students for the female profiles. Others selected the 4-mm lip protrusion as the least attractive lip position in the male and female profiles. Unlike the anterior and straight divergent profiles, in the posterior divergent profiles, most groups preferred the 2-mm lip protrusion rather than the 2-mm lip retrusion in both the male and female profiles.

The differences between the rankings of the lip position in the different profile divergences might be due to the raters' attempts to compensate for or distract from the profile divergence by a change in lip position. In previous studies, the effect of different underlying skeletal patterns on the preferred lip position has been investigated.^{10,13-15} Ioi et al¹³ changed the chin position in silhouette profiles and concluded that the raters tended to prefer more retruded lip positions as the facial convexity decreased for both men and women, and also tended to prefer slightly more protruded lip positions as facial convexity increased. Coleman et al¹⁴ evaluated preferred lip positions in silhouette profiles with varying degree of mandibular retrognathism or prognathism. They reported that fuller lip positions were preferred in more retrognathic and prognathic profiles, whereas more retrusive lip positions were preferred in more average profiles. Modarai et al¹⁵ also evaluated the influence of lower lip prominence with varying degrees of chin prominence using silhouettes and concluded that in skeletal Class II profiles the ideal lower lip position was preferred, whereas in Class III profiles a more

forward lip position was favored. In our study, almost all groups preferred the original lip position based on Ricketts' values⁸ in the anterior and posterior divergent profiles; this is not consistent with other studies. A possible explanation for this trend is that although the profile divergence was altered in our study, all profiles were within the normal range of facial convexity of a Class I profile.

Orthodontists should take into account the balance between the lips and the profile because the beauty of the facial profile depends on this relationship. According to our results, a lip position based on Ricketts' values⁸ can be recommended as the best lip position for anterior and posterior profile divergences. In the straight and anterior divergent profiles, almost all groups selected the 4-mm lip protrusion as the least pleasant lip position and preferred the 2-mm lip retrusion over the 2-mm lip protrusion. But in the posterior divergent profiles, some dental professionals selected the 4-mm lip retrusion as the least favorable lip position, and almost all groups preferred the 2-mm lip protrusion over the 2-mm lip retrusion. These results might be helpful in decision making between extraction and nonextraction treatment in borderline patients with different amounts of facial divergence. In these cases, nonextraction treatment might be more recommended and acceptable in posterior divergent profiles compared with the other facial divergences.

CONCLUSIONS

Based on the results of this study, for anterior and posterior divergent profiles, the normal lip position is considered to be the most favorable position, but the same does not apply to the straight divergent profile, in which the opinions of different groups were inconclusive. When posterior divergent patients are treated, measures should be considered to prevent excessive lip retrusion. Also, it was shown that the raters' sex did not affect their ratings of images.

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