Iran J Orthod. 2025 June; 20(1):1-14. doi:10.32592/ijorth.20.1.1199.
Published online 2025 June 1 Research Article
Original Article **Open Access**

The Effect of Lip Protrusion with Different Vermilion Heights on Facial Profile Esthetics: Perspective from Orthodontists, Oral and Maxillofacial Surgeons, and Laypeople

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Received: 2025 February 04; **Revised:** 2025 March 18; **Accepted:** 2025 May 10

Abstract

Aim: This study evaluated the effects of lips protrusion and vermilion height on facial profile aesthetics and the need for tooth extraction from the perspective of orthodontists, oral surgeons, and laypeople.
Methods: Four profile photographs of two men and two women with high (HVH) and low vermilion height (LVH) were selected. The photographs were modified so that the lips were protruded and retruded in the range of -6 to +6 mm relative to the true vertical line to create three photographs with protruded and three with retruded lips. The photographs were rated regarding facial profile attractiveness by 30 orthodontists, 31 oral and maxillofacial surgeons, and 50 laypeople using a visual analog scale. The raters were also asked whether they recommended premolar extraction for correction of lip protrusion. Data were analyzed using ANOVA, the chi-square test, and the Tukey test. $P<0.05$ was considered as significant.
Results: Mostly, the highest score was given to normal lips. The lowest score went to +6 mm protruded lip in the male with HVH. In all retruded cases, the male and female with LVH received lower scores than the male and female with HVH. The differences between the three rater groups were not significant in most images. Concerning the tendency for extraction, there were no significant differences between groups in normal lip and +2-mm protrusion. In the female with +4-mm protrusion, the tendency of laypeople for extraction was significantly lower. In +6, the tendency of laypeople to extract in LVH cases was less than in other groups.
Conclusion: Overall, in cases of LVH, the protrusion was more acceptable, while for HVH cases, retrusion was more tolerable. Laypeople had less desire for tooth extraction, especially in LVH cases.

Keywords: Attractiveness, Facial Profile Esthetics, Lip Protrusion, Tooth Extraction, Vermilion Height.

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Background

Facial attractiveness has a prominent role in the social life of individuals, and it appears that more attractive people have higher social and management skills. Although beauty is a cognitive and subjective concept with no precise definition, some researchers have proposed anthropometric and cephalometric standards for a beautiful and harmonious face by studying the opinions of different individuals (1). Nonetheless, the definition of an attractive face is affected by several social, cultural, ethnic, and age-related factors (2,3).

Facial profile is among the most critical parameters in facial attractiveness (4). The harmonious arrangement of different facial components has a fundamental role in creating an esthetic profile. Lip protrusion, compared with other facial components, is among the influential factors on facial profile esthetics (5). Although some authors have reported that fuller lips are more attractive (6), others have discussed that the opinion of people in this regard varies depending on their race. Some races prefer more prominent, and some others prefer less prominent lips (3,7–9). Also, evidence shows that orthodontists, general dentists, and laypeople often have different opinions regarding the most attractive degree of lip protrusion on profile views. Moreover, the opinions of males and females differ on this topic (3,10,11).

In addition to lip protrusion, lip form is vital in facial esthetics. Studies on vermilion height are more limited than those on lip protrusion. Bisson and Grobbelaar (12) compared a group of models with ordinary people and showed that the upper and lower lip heights were significantly greater in models than regular people. Heidekrueger et al. (7) reported that oral and maxillofacial (OMF) surgeons and laypeople of different races and ethnicities had different opinions regarding the most attractive vermilion height.

Although several studies have been conducted to determine the most attractive level of lip protrusion (3,13,14), the combined effect of vermilion height and lip protrusion on facial profile esthetics has not been investigated. Several factors can affect the lip profile, among which changing the tooth position by orthodontic treatment or jaw position by orthognathic surgery has the most significant effect (3). Tooth extraction, particularly premolars, is among the factors that change lip protrusion. Extraction orthodontic treatment is often associated with tooth retrusion, while non-extraction orthodontic treatment is often associated with tooth protrusion. The magnitude of retrusion of the lips is two-thirds of the magnitude of retrusion of the teeth by orthodontic treatment, albeit it could vary in different populations (15). Thus, knowledge about the appropriate lip position significantly affects orthodontic treatment planning for patients. The mid-face profoundly affects facial esthetics, and assessing the anteroposterior position of the lips in orthodontic diagnosis and treatment planning is paramount (16).

On the other hand, the opinions of different individuals regarding facial esthetics are influenced by race and culture. A great focus has been placed on the lips and their role in facial esthetics. Also, patients would like to actively participate in treatment planning. Thus, knowledge enhancement of orthodontists and OMF surgeons regarding patient preferences in different populations can play a fundamental role in achieving more favorable results and meeting patient satisfaction. Since the combined effect of vermilion height and lip protrusion on facial profile attractiveness has not been previously investigated, this study aimed to assess the impact of protrusion of lips with high and low vermilion height on facial profile esthetics and the need for tooth extraction (to correct it) from the perspective of orthodontists, OMF surgeons, and laypeople.

Methods

This descriptive study was conducted on 30 orthodontists, 31 OMF surgeons, and 50 laypeople aged 25–55. The study was approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.DENTISTRY.REC.1399.127).

The sample size was calculated at n=27 according to a study by Modarai et al. (14), assuming α=0.05, a standard deviation of 2.5, and a confidence interval of 1 using the confidence interval for one mean of PASS 15. To increase the power of the study, the sample size was increased to include 30 orthodontists, 31 OMF surgeons, and 50 laypeople.

Preparation of Photographs

Four profile view photographs of two women and two men were selected. One man and one woman had lower-than-average upper and lower lip vermilion height (LVH), and one man and one woman had higher-than-average upper and lower lip vermilion height (HVH). The average vermilion height was considered to be 7.5 mm for the upper and 12 mm for the lower lip (9) (Figure 1). The photographs met the required criteria for orthodontic photographs with patients' heads in natural head position. The subjects had normal

occlusion with skeletal Class I relationship with ANB angle between 2 and 4 degrees. To ensure a normal facial profile, the normal values of Ricketts and Arnett-McLaughlin analyses; also, Holdaway ratio were used (1,17,18) in the four subjects.

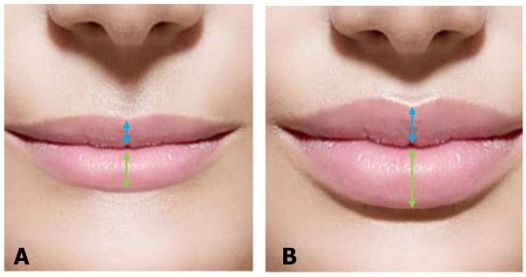


Figure 1. A) low vermilion height, B) high vermilion height

After obtaining written informed consent from the patients to use their photographs for this study, the photographs were altered using Adobe Photoshop (CC 2017; Adobe Inc., San Jose, CA, USA). For this purpose, first, the eyes and other facial structures, except the lips, chin, and nose, were cropped to eliminate their confounding effect on raters' judgment. Skin defects were corrected, and the color tone of the lips and skin in the four photographs was standardized by the software. True vertical line (TVL) was drawn according to Arnett soft tissue cephalometric analysis, and the lips were then protruded and retruded by +2, +4, +6, -2, -4, and -6 mm relative to this line to create six altered images with the method used by Ioi et al. (13) (Figure 2). The altered images, plus the original image of each person, were randomly arranged in an electronic album. Four albums were created as such, including two albums of a male image, one with LVH (Figure 3) and the other one with HVH (Figure 4), and two albums of a female image, one with LVH (Figure 5) and the other one with HVH (Figure 6), and made available online in Porsline.ir. The link to the albums was emailed or sent through social media applications to the orthodontists and surgeons. Laypeople were mostly collected from those who accompanied the clinic patients who were not dentists, physicians, or dental and medical students. Each image had a 1–10 visual analog scale attached to it at the bottom. The raters were asked to rate the facial profile attractiveness of each image by allocating a score from 1 (indicating the least attractive) to 10 (indicating the most attractive) (9,19).

Also, the raters were asked whether they believed that tooth extraction is required to correct the form of the lips. The former question was asked for normal and protruded lips. After two weeks, a reminder message was sent to those who did not reply. The participants were included until the sample size was met. The raters comprised 30 orthodontists, 31 OMF surgeons, and 50 laypeople between 25 to 55 years.

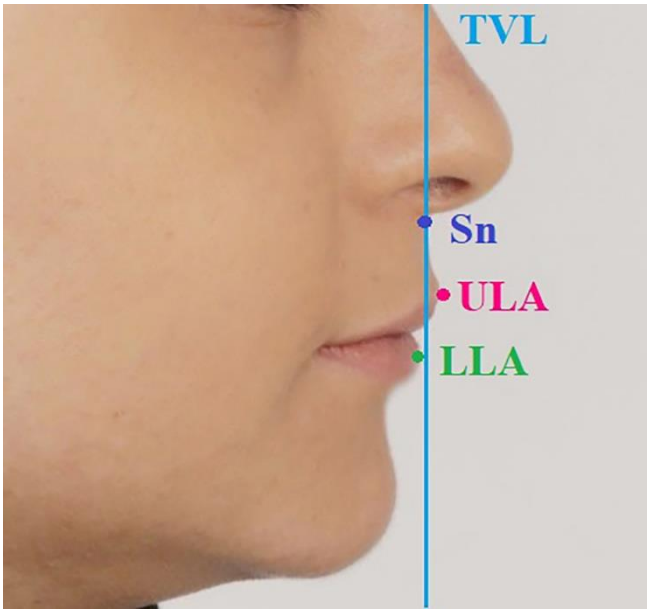


Figure 2. Arnett soft tissue cephalometric analysis. TVL: True vertical line, Sn: subnasale, ULA: upper lip anterior, LLA: lower lip anterior



Figure 3. Male case with low vermilion height with different amount of lip retrusion and protrusion

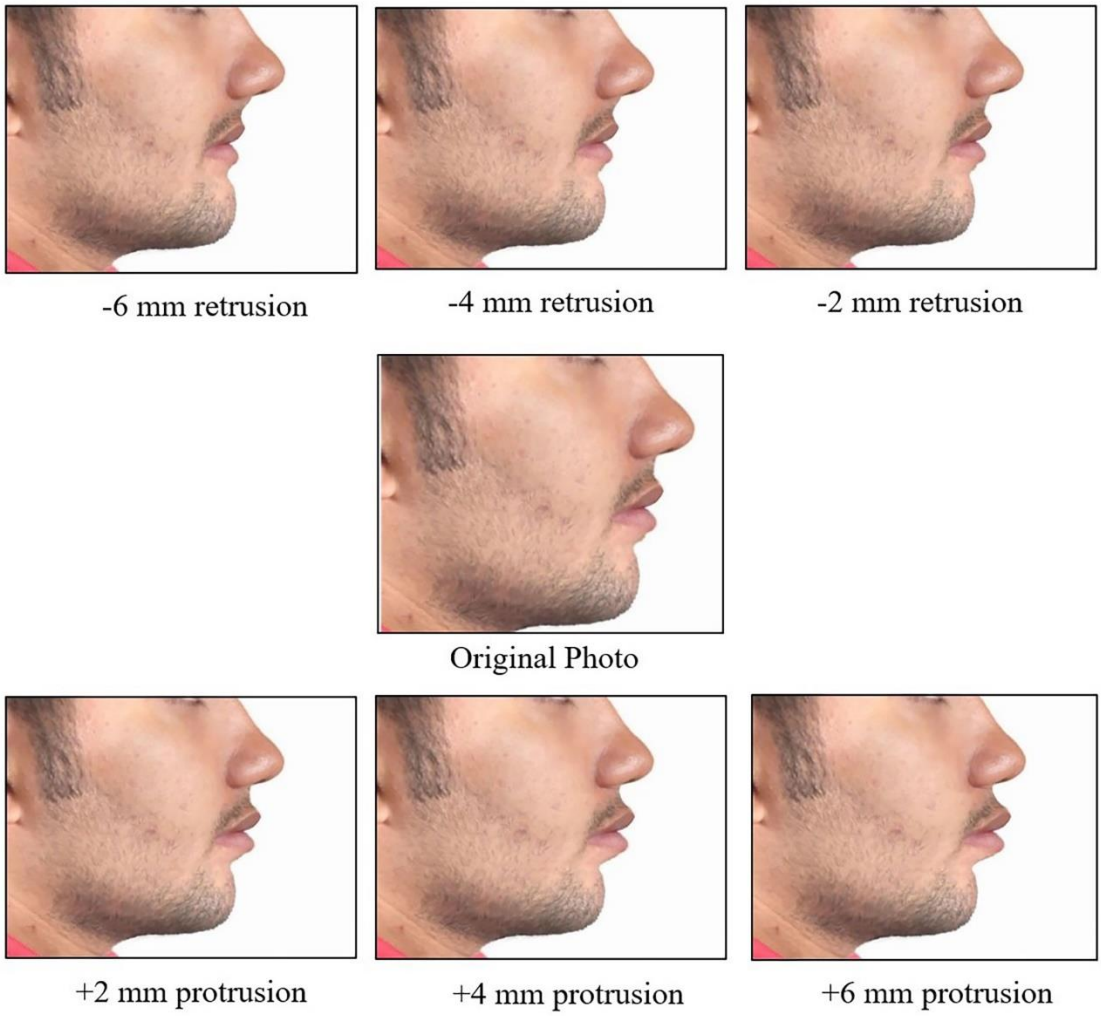


Figure 4. Male case with high vermilion height with different amount of lip retrusion and protrusion

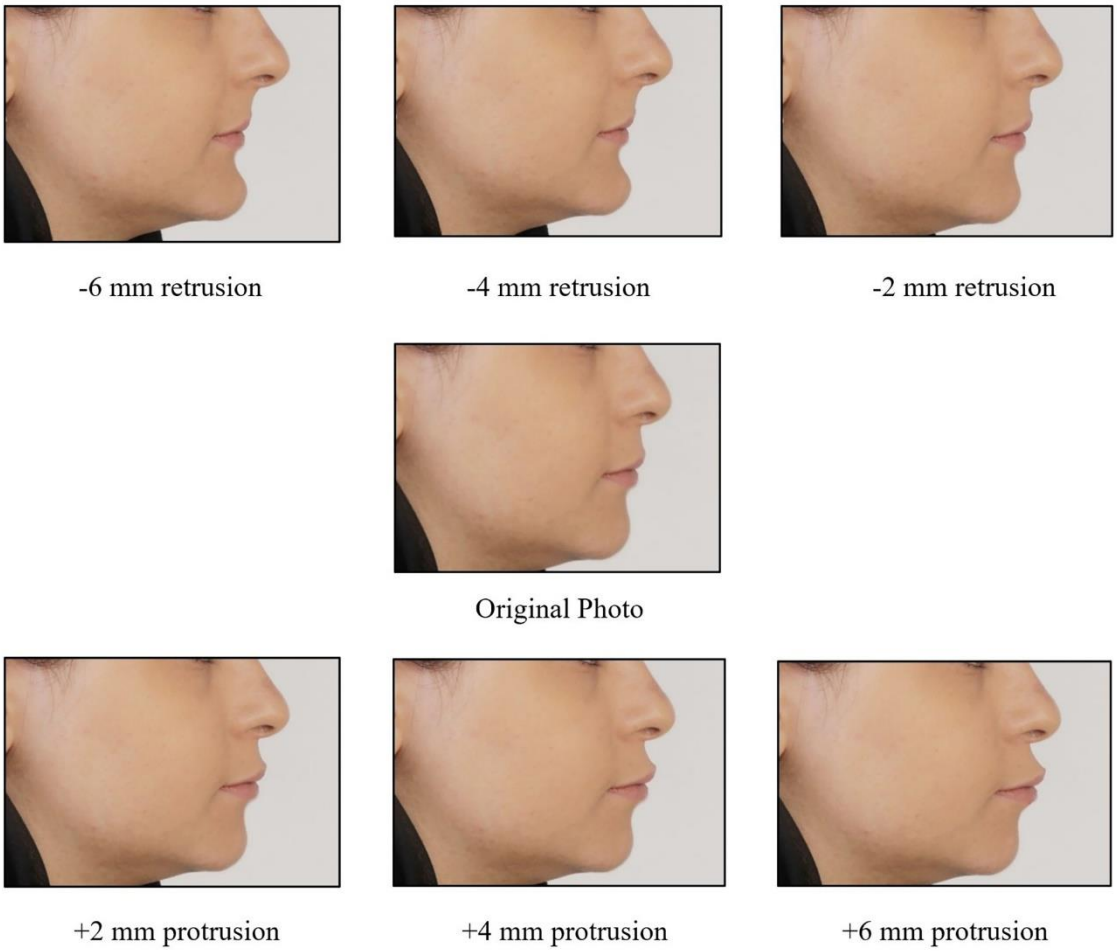


Figure 5. Female case with low vermilion height with different amount of lip retrusion and protrusion



Figure 6. Female case with high vermilion height with different amount of lip retrusion and protrusion

Statistical Analysis

Data were analyzed by SPSS (Version 26; IBM Corp., Armonk, NY, USA) using ANOVA, the chi-squared test, and the Tukey test at $P<0.05$ significance level.

Results

High Vermilion Height (HVH)

Table 1 presents the esthetic scores given by the three groups of raters to male and female cases with HVH and different amounts of lip protrusion.

In the male case with HVH, the maximum score by all three groups of raters was allocated to the normal lip. In the female case with HVH, the highest score was given to the +2-mm lip protrusion.

Table 1. Esthetic scores given by the three groups of raters to male and female cases with high vermilion height and different amounts of lip protrusion

Gender		Orthodontists (n=30)	Oral and maxillofacial surgeons (n=31)	Laypeople (n=50)	P-value
Male with high vermilion height	-6-mm retrusion	4.63±1.991	4.45±1.804	4.08±1.998	0.435
	-4-mm retrusion	5.70±2.070	6.16±1.864	5.26±2.039	0.145
	-2-mm retrusion	6.33±1.936	6.68±1.600	6.56±2.012	0.768
	Normal lip	6.73±1.741	6.71±1.296	6.70±2.073	0.997
	+2-mm protrusion	4.60±1.754	5.87±1.821	5.08±2.127	0.039*
	+4-mm protrusion	3.30±1.643	3.74±1.125	3.68±1.921	0.518
	+6-mm protrusion	2.77±1.223	2.74±1.064	2.92±1.523	0.806
Female with high vermilion height	-6-mm retrusion	5.63±2.008	5.42±1.858	4.32±2.290	0.012*
	-4-mm retrusion	6.43±1.906	6.32±1.661	5.16±2.093	0.005*
	-2-mm retrusion	7.37±2.312	6.90±1.955	5.76±2.335	0.005*
	Normal lip	7.10±2.090	6.61±2.076	7.12±2.057	0.524
	+2-mm protrusion	7.50±1.996	7.29±1.936	7.28±1.990	0.877
	+4-mm protrusion	3.40±1.354	3.81±1.302	4.08±2.108	0.238
	+6-mm protrusion	2.57±1.135	3.06±1.548	3.28±2.157	0.220

*P-value<0.05

HVH Male Case

According to ANOVA, the mean esthetic score given by the three groups of raters was not significantly different (P>0.05) for any photograph except for the one with a +2-mm lip protrusion (P=0.039). For the photograph with a +2-mm lip protrusion, the Tukey test was applied for pairwise comparisons, which showed that OMF surgeons gave a significantly higher score to this case than orthodontists (P=0.033). No other significant difference was noted (P>0.05).

HVH Female Case

The highest score was given to the photograph with a +2-mm protrusion. According to ANOVA, the mean scores of normal and protruded lips were not significantly different between the three rater groups (P>0.05). However, the difference between the three groups was significant for the photographs with -6-mm (P=0.012), -2-mm (P=0.005), and -4-mm (P=0.005) retrusion (Table 1). The Tukey test showed that laypeople gave a significantly lower score to cases with -6-mm (P=0.021) and -2-mm (P=0.006) retrusion. Laypeople also gave lower scores to the photograph with a -4-mm retrusion compared with orthodontists (P=0.014) and oral and maxillofacial surgeons (P=0.026). No other significant difference was noted (P>0.05).

Low Vermilion Height (LVH)

Table 2 presents the esthetic scores given by the three groups of raters to male and female cases with LVH and different amounts of lip protrusion. In both male and female cases with LVH, the highest score by all three rater groups was given to the normal lip.

Table 2. Esthetic scores given by the three groups of raters to male and female cases with low vermilion height and different amounts of lip protrusion

Gender		Orthodontists (n=30)	Oral and maxillofacial surgeons (n=31)	Laypeople (n=50)	P-value
Male with low vermilion height	-6-mm retrusion	4.87±2.080	4.55±1.804	3.48±1.919	0.004*
	-4-mm retrusion	6.13±2.255	6.06±1.861	4.28±1.938	0.000*
	-2-mm retrusion	6.10±2.325	6.45±1.748	5.10±2.297	0.016*
	Normal lip	7.53±2.255	7.26±1.949	5.32±2.343	0.000*
	+2-mm protrusion	7.13±2.145	6.90±1.814	4.86±2.286	0.000*
	+4-mm protrusion	4.90±1.863	5.16±1.614	4.52±2.063	0.320
	+6-mm protrusion	3.47±1.332	3.97±1.110	3.06±1.707	0.028*
Female with low vermilion height	-6-mm retrusion	4.40±2.044	4.55±2.079	3.62±1.937	0.084
	-4-mm retrusion	4.70±1.705	4.97±1.449	4.54±2.197	0.612
	-2-mm retrusion	6.73±2.164	6.65±1.799	4.96±2.138	0.000*
	Normal lip	7.17±1.949	7.39±2.108	5.56±2.305	0.000*
	+2-mm protrusion	5.63±1.650	5.77±1.627	5.22±2.384	0.436
	+4-mm protrusion	4.17±1.464	4.23±1.499	4.14±2.020	0.977
	+6-mm protrusion	2.80±1.215	3.16±1.369	2.98±1.545	0.609

*P-value<0.05

LVH Male Case

According to ANOVA, the mean score was significantly different between the rater groups for all photographs (P<0.05) except for +4-mm protrusion (P=0.32). The Tukey test showed that laypeople gave a significantly lower score to the photographs of the -2-mm lip retrusion (P=0.020) and +6 mm-lip protrusion (P=0.021) compared with OMF surgeons. Laypeople gave a significantly lower score to all other photographs compared with both orthodontists and surgeons (P<0.05).

LVH Female Case

ANOVA revealed a significant difference in the mean scores given by the three rater groups only to photographs with a -2-mm retrusion and the normal lip (P=0.000). The Tukey test showed that laypeople gave a significantly lower score to photographs with -2-mm retrusion and the normal lip compared with orthodontists and OMF surgeons (P<0.05).

Esthetic Scores Based on Rater Group

Orthodontists

For the HVH female case, orthodontists gave the highest score to the photograph with +2-mm protrusion. In other cases, orthodontists gave the highest score to the normal lip.

In all four cases, orthodontists gave the lowest score to the +6-mm lip protrusion. In -4-mm retrusion, the female with HVH acquired the highest score, and the female with LVH acquired the lowest score. In +4-mm protrusion, the male with LVH acquired the highest, and the male with HVH acquired the lowest score.

OMF Surgeons

For the female case with HVH, OMF surgeons gave the highest score to the photograph with the +2-mm protrusion. In other cases, they gave the highest score to the normal lip. In all cases, the lowest score was given to the +6-mm protrusion.

ANOVA showed there was a significant difference between the scores given by OMF surgeons to cases with -2-mm retrusion in females with high and low vermilion height. In -2-mm retrusion, females with LVH and males with HVH acquired the highest scores, while in +2-mm protrusion, the female with HVH and the male with LVH acquired the highest scores.

Laypeople

Concerning normal lip protrusion, the female case with HVH received the highest score. In -2-mm retrusion, the HVH male case and in +2-mm protrusion, the female with HVH acquired the highest scores.

Overall Assessment

Table 3 presents the overall mean scores given by all the participants to the four cases with different amounts of lip protrusion. In both male and female cases with LVH, the highest score was given to the normal lip.

There were significant differences in all the groups except for normal lip protrusion. In all retruded cases, the male and female with LVH received lower scores than the male and female with HVH.

Table 3. Overall mean scores given to the four cases with different amounts of lip protrusion

	Male with high vermilion height	Female with high vermilion height	Male with low vermilion height	Female with low vermilion height	P-value
	Mean and SD	Mean and SD	Mean and SD	Mean and SD	
-6-mm retrusion	4.33±1.942	4.98±2.170	4.15±2.014	4.09±2.034	0.004*
-4-mm retrusion	5.63±2.018	5.83±2.008	5.28±2.187	4.70±1.876	0.000*
-2-mm retrusion	6.53±1.872	6.51±2.319	5.75±2.230	5.91±2.214	0.009*
Normal lip	6.71±1.781	6.97±2.065	6.46±2.430	6.50±2.308	0.271
+2-mm protrusion	5.17±1.990	7.34±1.961	6.05±2.368	5.49±2.008	0.000*
+4-mm protrusion	3.59±1.654	3.82±1.733	4.80±1.897	4.17±1.731	0.000*
+6-mm protrusion	2.83±1.320	3.03±1.776	3.42±1.499	2.98±1.408	0.026*

SD: Standard deviation
*P-value<0.05

In all protruded cases, the male with LVH received a higher score than the male with HVH. However, in females, in the +2-mm protrusion, the HVH case received a higher score.

In general, in lip retrusion, cases with LVH acquired a lower score, while in lip protrusion, the male case with HVH acquired the lower scores.

Opinions Regarding Tooth Extraction

Table 4 shows the correlation between lip protrusion and the opinions of the three rater groups regarding the need for tooth extraction. All three rater groups had the highest tendency for tooth extraction in the +6-mm lip protrusion of all four cases. In the normal lip and +2-mm protrusion, there were no significant differences between the groups. However, there were some differences in +4 and +6 mm protrusion.

HVH Male Case

No significant differences were noted between the three rater groups regarding the need for extraction in any case with lip protrusion (P>0.05).

HVH Female Case

In the +4-mm protrusion, the differences between the three rater groups were significant (P=0.040), such that 90% of orthodontists, 80.6% of OMF surgeons, and 66% of laypeople were in favor of extraction. The differences were not significant regarding the normal lip and +2-mm and +6-mm protrusion (P>0.05).

LVH Male Case

In the +4-mm protrusion, a significant difference existed between the three rater groups, such that 23.3% of orthodontists, 25.8% of OMF surgeons, and 52% of laypeople were in favor of extraction (P=0.012). In the +6-mm protrusion, the differences between the three groups were significant, such that orthodontists had a significantly higher tendency for tooth extraction than OMF surgeons and laypeople (P=0.038). The differences were not significant regarding the normal lip and +2-mm protrusion (P>0.05).

LVH Female Case

In the +6-mm protrusion, a significant difference existed between the three rater groups, such that orthodontists had a significantly higher tendency for extraction than OMF surgeons and laypeople (P=0.045). The differences were not significant regarding the normal lip and +2-mm and +4-mm protrusion (P>0.05).

Table 4. Correlation of lip protrusion and the opinion of the three rater groups regarding the need for tooth extraction

	Observers	Male with high vermilion height	Female with high vermilion height	Male with low vermilion height	Female with low vermilion height
Normal lip	Orthodontists	1 (3.3%)	2 (6.7%)	1 (3.3%)	0 (0.0%)
	Oral and maxillofacial surgeons	1 (3.2%)	2 (6.5%)	1 (3.2%)	2 (6.5%)
	Laypeople	4 (8.0%)	6 (12.0%)	7 (14.0%)	5 (10.0%)
	Total	6 (5.4%)	10 (9.0%)	9 (8.1%)	7 (6.3%)
	P value	0.549	0.608	0.120	0.204
+2-mm protrusion	Orthodontists	9 (30.0%)	1 (3.3%)	1 (3.3%)	2 (6.7%)
	Oral and maxillofacial surgeons	3 (9.7%)	3 (9.7%)	3 (9.7%)	1 (3.2%)
	Laypeople	13 (26.0%)	5 (10.0%)	9 (18.0%)	9 (18.0%)
	Total	25 (22.5%)	9 (8.1%)	13 (11.7%)	12 (10.8%)
	P value	0.120	0.532	0.130	0.079
+4-mm protrusion	Orthodontists	24 (80.0%)	27 (90.0%)	7 (23.3%)	19 (63.3%)
	Oral and maxillofacial surgeons	20 (64.5%)	25 (80.6%)	8 (25.8%)	19 (61.3%)
	Laypeople	36 (72.0%)	33 (66.0%)	26 (52.0%)	25 (50.0%)
	Total	80 (72.1%)	85 (76.6%)	41 (36.9%)	63 (56.8%)
	P value	0.403	0.040*	0.012*	0.424
+6-mm protrusion	Orthodontists	29 (96.7%)	30 (100.0%)	29 (96.7%)	29 (96.7%)
	Oral and maxillofacial surgeons	28 (90.3%)	27 (87.1%)	23 (74.2%)	29 (93.5%)
	Laypeople	40 (80.0%)	41 (82.0%)	38 (76.0%)	40 (80.0%)
	Total	97 (87.4%)	98 (88.3%)	90 (81.1%)	98 (88.3%)
	P value	0.080	0.051	0.038*	0.045*

Discussion

This study assessed the effect of lip protrusion with high (HVH) and low (LVH) on facial profile esthetics and the need for tooth extraction from the perspective of orthodontists, OMF surgeons, and laypeople. The results showed that all three rater groups gave the highest score to normal lips, except for the female case with HVH, for which the highest score was given to the +2-mm protrusion. This image acquired the highest score, indicating that all three rater groups preferred higher vermilion height and slightly more-than-normal protruded lips for females. In a comparison of the three rater groups (except for one case of a male with HVH and +2-mm protrusion to which OMF surgeons gave a significantly higher score than orthodontists), no significant difference existed between the opinions of orthodontists and surgeons. In some cases, which mostly had retrusion, the opinion of laypeople differed from that of specialists, and laypeople gave a lower score to all such cases, indicating that retrusion was more unpleasant to laypeople than specialists.

In assessing the effect of lip thickness on profile esthetics in the presence of the -4-mm retrusion, the female case with HVH acquired the highest score, while the female case with LVH acquired the lowest score. In total, cases with HVH generally acquired a higher score, indicating that higher lip thickness could successfully camouflage the unattractiveness of retrusion. A relatively similar pattern was observed in the presence of the 2-mm retrusion. However, the differences between the four cases were not significant according to specialists' opinions, probably because of an insignificant amount of retrusion. Laypeople gave a significantly lower score to the female case with LVH. In contrast, in the +4-mm protrusion, male cases with HVH acquired the lowest score, indicating that lip thinness could camouflage the unattractiveness of protrusion.

The differences between the four cases were not significant in the presence of high retrusion or protrusion (-6 and +6 mm). However, cases with retrusion and HVH and cases with protrusion and LVH acquired a higher score. Therefore, in general, in the treatment planning of borderline cases, it should be noted that the teeth should not be retruded if the vermilion height is low, and the teeth should not be protruded if the vermilion height is high or the lips are thicker. In other words, slight lip protrusion is more acceptable in cases with low lip thickness and vice versa.

Regarding the opinions of raters regarding the need for tooth extraction, the majority of laypeople did not recommend tooth extraction and retrusion of the lips, compared with specialists; this difference was mainly noticeable for the female case with HVH and +4-mm protrusion and female case with LVH and +6-mm protrusion.

Murakami et al. (11) reported different opinions of laypeople and orthodontists regarding the effect of lip position on facial esthetics. Bor et al. (19) found that laypeople preferred protruded lips compared to retruded lips, which was in line with the present findings. Shimogaki (20) reported similar opinions of laypeople and orthodontists regarding the role of lip position in facial esthetics; both rater groups in their study preferred normal lips for straight profiles, retruded lips for retrognathic profiles, and protruded lips for prognathic profiles. Their results were different from the present findings. Ahmed and Orth (21) showed that images closer to average were more attractive to raters. In their study, orthodontists, postgraduate students of orthodontics, and patients believed that images with -0.5-, 0-, and +0.5-mm vermilion height were the most attractive, while images with -2-, -1.5-, and +2-mm vermilion height were the least attractive.

In the present study, the opinions of orthodontists were similar to those of OMF surgeons, and the preferred amount of protrusion was the same in both groups. This finding can be attributed to the academic instructions they received regarding facial profile esthetics. However, the opinions of specialists were significantly different from those of laypeople, which may be due to different definitions of facial attractiveness for laypeople. This finding highlights the significance of paying attention to patient demands in treatment planning, which was in line with previous studies comparing the opinions of clinicians and laypeople regarding profile esthetics (3, 11).

Auger and Turley (22) evaluated the fashion magazines published in the 1900s and found that the perceptions of an ideal female face had changed during the 20th century. Nguyen and Turley (23) also evaluated the images of male models published in fashion magazines in the past 65 years. They found significant changes in perceptions of an ideal male model, especially in the lip area. They noticed an increasing tendency to higher lip protrusion, curled lips, and vermilion show. In the present study, in cases with HVH, profiles with normal lips for males and +2-mm protrusion for females were more attractive to the raters, whereas lips with +6-mm protrusion for females and males were the least attractive. In

cases with LVH, profiles with normal lips were considered to be more attractive for both males and females, and lips with +6-mm protrusion were the least attractive for both males and females. In a study by Naini et al. (24), the observers believed protruded lips were more attractive than retruded lips. This is particularly important in cases with an extraction treatment plan since extraction of four premolars can cause lip retrusion by 3–4 mm (19). Sodagar and Borujeni (3) assessed the profiles of an Iranian population and reported that profiles with the highest level of lip protrusion were the least attractive and added that slight retrusion contributes to an attractive profile, consistent with the present results. These findings are consistent with the results of studies that reported a tendency for lip protrusion (6,19).

In a study by Bor et al. (19), a lip profile with +4-mm protrusion was less attractive than a lip profile with +2-mm protrusion, which was partly consistent with the present findings. Türkkahraman and Gökalp (25) evaluated the preferred profiles from the perspective of a Turkish population and found that in orthognathic profiles, fuller and more prominent lips were more attractive for females, while retrusive lips with a prominent nose and chin were more attractive for males. Ioi et al. (26), in their study on Japanese dental students and orthodontists, found that profiles with slightly retruded lips were more attractive. In contrast, profiles with protruded lips had the least attractiveness. Their results regarding retrusion were different from the present findings, which might be due to the use of silhouettes in their study. Also, they altered the lip profile by 1 mm. Moreover, definitions for facial esthetics vary in different countries. All these factors can explain the discrepancies in the results. However, the results of Ioi et al. (26) regarding the protruded lip profile being the least attractive were in line with the present findings. In another study, Ioi et al. (13) reported that Japanese and Korean dental students preferred profiles with slightly retruded lips, which differed from the present results. This difference can be due to the use of silhouettes in their study versus colored photographs in the present study. Moreover, this disparity can be attributed to the effect of culture on esthetic perceptions and gender differences. The current study was performed on a Persian population. Imani et al. (27) assessed the perceptions of Persian orthodontists, oral surgeons, and laypersons concerning facial profile attractiveness using G'-Sn-Pg' angle and concluded that most participants preferred a more protrusive mandible for male models compared with female models. They also reported a slight difference between the laypersons' perceptions and those of the clinicians.

Regarding the tendency toward tooth extraction, it was observed that in cases with +2-mm and +6-mm lip protrusion, not much differences existed between the three groups of raters. However, in the +4-mm protrusion, some disparities existed, with most laypeople exhibiting less tendency for tooth extraction than orthodontists and OMF surgeons. In cases with LVH, less tendency for extraction was observed compared to HVH cases. Thus, in clinical decision-making for tooth extraction in borderline cases, more attention should be paid to the patient's lip form, and orthodontists should be more conservative in ordering tooth extraction for patients with LVH lips.

It has been reported that the vermilion height can be high in cases with bimaxillary protrusion due to labially inclined anterior teeth. Such patients can be treated by extraction of premolars to straighten the profile and enhance the lip seal (28). Bills et al. (29) concluded that extracting four premolars results in flattening lips in patients with bimaxillary protrusion. Thus, this treatment method may decrease vermilion height from the frontal view.

Overall, orthodontists and OMF surgeons should consider patients' opinions when planning treatment. They should also set their esthetic goals according to the interaction of different factors rather than just focusing on the general standard of each item separately. Further studies are required on facial profile attractiveness regarding the interaction of lip form on other aspects of smile esthetic.

Limitations

The most important limitation of this study is the subjective nature of facial esthetics assessment, which may vary based on individual preferences and cultural differences in perceptions of beauty.

Conclusion

The three groups of orthodontists, OMF surgeons and laypeople did not have much disagreement regarding the effect of lip protrusion on facial profile esthetics. In most cases, all three rater groups gave the highest score to normal lips.

The scores given to protruded cases were generally lower than retruded cases, and lips with +6-mm protrusion were the least attractive. The opinions of orthodontists and OMF surgeons were almost the same in all cases.

In total, cases with retrusion and HVH and those

with protrusion and lower vermilion height acquired higher scores. In other words, in cases of LVH, the protrusion was more acceptable, while for HVH cases, retrusion was more tolerable.

In most cases, laypeople were less interested in extraction to correct lip protrusion than specialists, especially for female and LVH cases.

Conflicts of interest

None to declare.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments

Not applicable.

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