Original Article

Influence of lower facial height changes on frontal facial attractiveness and perception of treatment need by lay people

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ABSTRACT

Objective: To test the hypothesis that lower facial height has no influence on frontal facial attractiveness and treatment need perception of lay people.

Materials and Methods: Frontal facial silhouettes of a man and a woman with normal lower facial height values (male: 81.5 mm; female: 70.5 mm) were modified by increasing and decreasing their lower facial heights in steps of 1 mm to obtain frontal images with different lower facial height alterations ranging from +6 mm to −6 mm for each sex. A panel of 100 lay people scored each silhouette's attractiveness on a 100-mm visual analogue scale (VAS) and also indicated whether they would seek treatment if the image represented their own. The Wilcoxon signed rank test was used to compare the VAS scores.

Results: Unaltered ±1-mm and ±2-mm silhouettes got the highest VAS scores. Scores were significantly lower ($P \leq .001$) as the divergence from the normal value exceeded 2 mm. Beyond +3 mm and −4 mm in females and +4 mm and −3 mm in males the difference between the scores became statistically insignificant. At ±4 mm, more than 75% of the raters elected to have treatment.

Conclusion: The hypothesis was rejected. (*Angle Orthod.* 2010;80:1159–1164.)

KEY WORDS: Lower facial height; Facial attractiveness

INTRODUCTION

The desire to improve facial esthetics has been the most common reason for seeking orthodontic or combined orthodontic and surgical treatment.[1–6] Orthodontists also consider improvement of facial esthetics an important treatment goal.[7]

Although lower facial height (LFH) can be altered purposefully or unintentionally during orthodontic therapy and vertical discrepancy has been shown to be one of the main reasons for seeking and receiving orthodontic-surgical treatment,[8,9] primary issues of interest have been the relationship between the sagittal changes and facial attractiveness. There has been relatively less discussion and only a limited number of studies on the effects of changes in the vertical dimension. In studies by De Smit and Dermaut[10] and Michiels and Sather[11] profiles with increased vertical features were judged to be the most unattractive. Similarly, Johnston et al.[12] reported that Class I profile silhouettes with increased lower face proportions were rated as significantly less attractive and were more likely to be judged as needing treatment. In a study by Cochrane et al.,[13] long face profiles were ranked as more attractive than the Class II and Class III images. Finally, Maple et al.[14] reported that Class II or Class III profiles, accentuated by extreme vertical deviations, were scored as the least attractive by both lay people and clinicians.

Despite the fact that a patient determines personal attractiveness from the frontal view[15] and the fact that people view each other from the frontal perspective during the usual mode of communication, most of the studies in orthodontics that deal with facial esthetic have either been based on profile images or limited to smile esthetics,[16,17] influence of intereye distance or lips on the perception of attractiveness or malocclusion,[18–20] or dental-facial symmetry if frontal images are

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used.[18,21] To date there has been no report evaluating the effects of vertical dimension on frontal facial attractiveness.

Considering the importance of vertical facial dimension in terms of facial esthetics and the place of the frontal view in the usual mode of communication, the purpose of this study was to test the hypothesis that LFH has no influence on frontal facial attractiveness and the treatment need perception of lay people.

MATERIALS AND METHODS

Raters

The raters consisted of 50 women and 50 men, all of whom were white with Anatolian Turkish ancestors, a mean age of 35.4 years (range, 26–47 years), and no history of orthodontic treatment. They voluntarily agreed to participate in the study, and they read and signed a consent form.

Frontal Facial Images

A man and a woman who were clinically determined to have vertical frontal measurements closely matching the normal values introduced by Arnett and McLaughlin[22] volunteered to participate in the present study and gave their consent by signing a consent form. Using a digital camera (Nikon D200, Tokyo, Japan), their color frontal facial photographs were obtained while they maintained natural head position while standing. Photographs were printed in life-size proportions, and clinically measured values of facial heights were remeasured and verified. The facial height and LFH values were, respectively, 133 mm and 81.5 mm for the male and 122.5 mm and 70.5 mm for the female.

Photographs were scanned to Adobe Photoshop 7.0 ME at a resolution of 600 dpi. LFH (subnasalmenton) was modified in 1-mm steps and frontal images with different LFH alterations ranging from +6 to −6 mm (Figures 1 and 2). A series of 13 frontal images (one unchanged, six with increased LFH values, and six with decreased LFH values) were developed for each gender. Images were converted to black-and-white silhouettes, and the image size was reduced from life size to 4 × 5 inches.

Pilot Study

A pilot study was designed to determine the minimum detectable change in the LFH. Each frontal facial silhouette, with LFH increased or decreased in 1-mm steps, was paired with the unchanged silhouette. Each pair was printed side by side on the same sheet of paper, and two booklets were prepared for each gender. To test the intraexaminer reliability, duplicates of each pair were included in the booklet. Silhouette pairs and their duplicates were randomly ordered in the booklets, and each pair was given a number. Each rater evaluated a total of 52 pairs. The raters were asked to write down the pair number on a form if they thought that there was a difference between the paired images.

Kappa coefficients ranged from 0.69 to 0.94 in the female silhouettes and from 0.67 to 0.98 in the male silhouettes. More than 80% of the raters detected a 1-mm change in both female and male silhouettes. Therefore, the LFH change interval was set at 1 mm in the main study.

Main Study

The same group of lay people participated and the same frontal facial silhouettes were used in the main study. Two booklets (one each for female and male images), each of which consisted of 26 frontal facial silhouettes (one unchanged, 12 with altered LFH values, and their duplicates for intrarater reliability testing) in random order, were prepared. One silhouette was shown per page. Two forms (one each for male and female images), each with twenty-six 100-mm visual analogue scales (VASs), were formed. VASs were numbered correspondingly in the order of the images and anchored on the left as very unattractive and on the right as very attractive. Under each VAS "yes" or "no" check boxes were inserted in order to assess the treatment need perception of the raters.

After the raters were provided the instructions about the use of VASs, booklets and forms, including VASs and "yes" or "no" check boxes, were distributed. The raters were asked to mark on the VAS the point that they felt represented their perception. Each rater scored a total of 52 frontal silhouettes. Additionally, raters were asked to state, using "yes" or "no" check boxes, whether they would seek treatment if the image they were evaluating represented their own frontal image. In the treatment need perception evaluation evaluators assessed only the images belonging to their gender. Both tests were self-administered, and the raters had no time limit in which to complete the booklets.

Statistical Analysis

All statistical analyses were carried out using SPSS (Version 11.5; SPSS, Chicago, Ill). Kappa coefficients and intraclass correlation coefficients with 95% confidence interval were used to test intrarater reliability. The Shapiro-Wilks test revealed that the data were not normally distributed, and, therefore, the Wilcoxon signed rank test was used for the comparison of the scores of (a) altered images with the unaltered images,

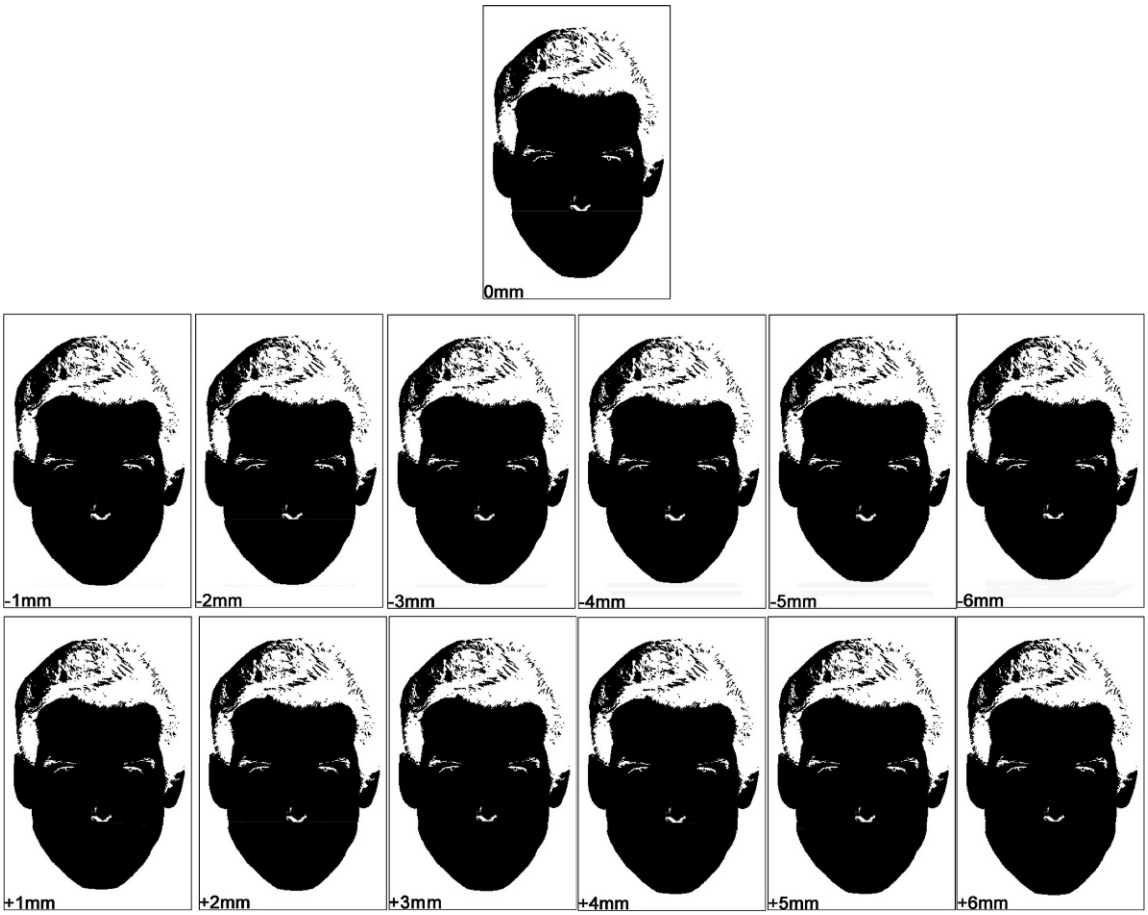

Figure 1. Series of male images.

(b) altered images with each other, and (c) images with increased LFH with those with decreased LFH. The Bonferroni correction was applied to account for multiple comparisons, and the level of significance was set at $P \leq .001$.

RESULTS

The intraclass correlation coefficients for the intrarater reliability of the VAS scores of the raters ranged from 80.3 to 98.7 for male silhouettes and from 69.9 to 93.4 for female silhouettes. Kappa coefficients of the treatment need perceptions of male raters ranged from 0.73 to 0.91, and that of female raters ranged from 0.69 to 0.93.

Attractiveness Scores and Treatment Need

Means and standard deviations of the scores and their comparisons are shown in Table 1 for males and in Table 2 for females. The unaltered ±1-mm and ±2-mm images resulted in the highest scores. The comparison of the scores of ±1-mm and ±2-mm images with the control images did not reveal statistical significance. Scores got significantly lower ($P \leq .001$) as the divergence from the normal value exceeded 2 mm. Among the images with increased LFH, +5-mm and +6-mm male images and +4-mm, +5-mm, and +6-mm female images resulted in the lowest scores; and among the images with decreased LFH, −4-mm, −5-mm, and −6-mm male images and −5-mm and −6-mm female images yielded the lowest scores. The intragroup comparison of the silhouettes with increased and decreased LFHs revealed that there were no statistically significant differences between the scores after 4-mm increase and 3-mm decrease in males and after 3-mm increase and 4-mm decrease in females.

Increased vs Decreased LFH

In males, the raters tended to favor increased LFH over decreased LFH when the deviation from the normal was 3 mm or more ($P \leq .001$). On the other hand, in females, images with decreased LFH produced significantly higher scores ($P \leq .001$) when the deviation from normal was 3 mm and more. The percentage of the raters who would seek treatment if

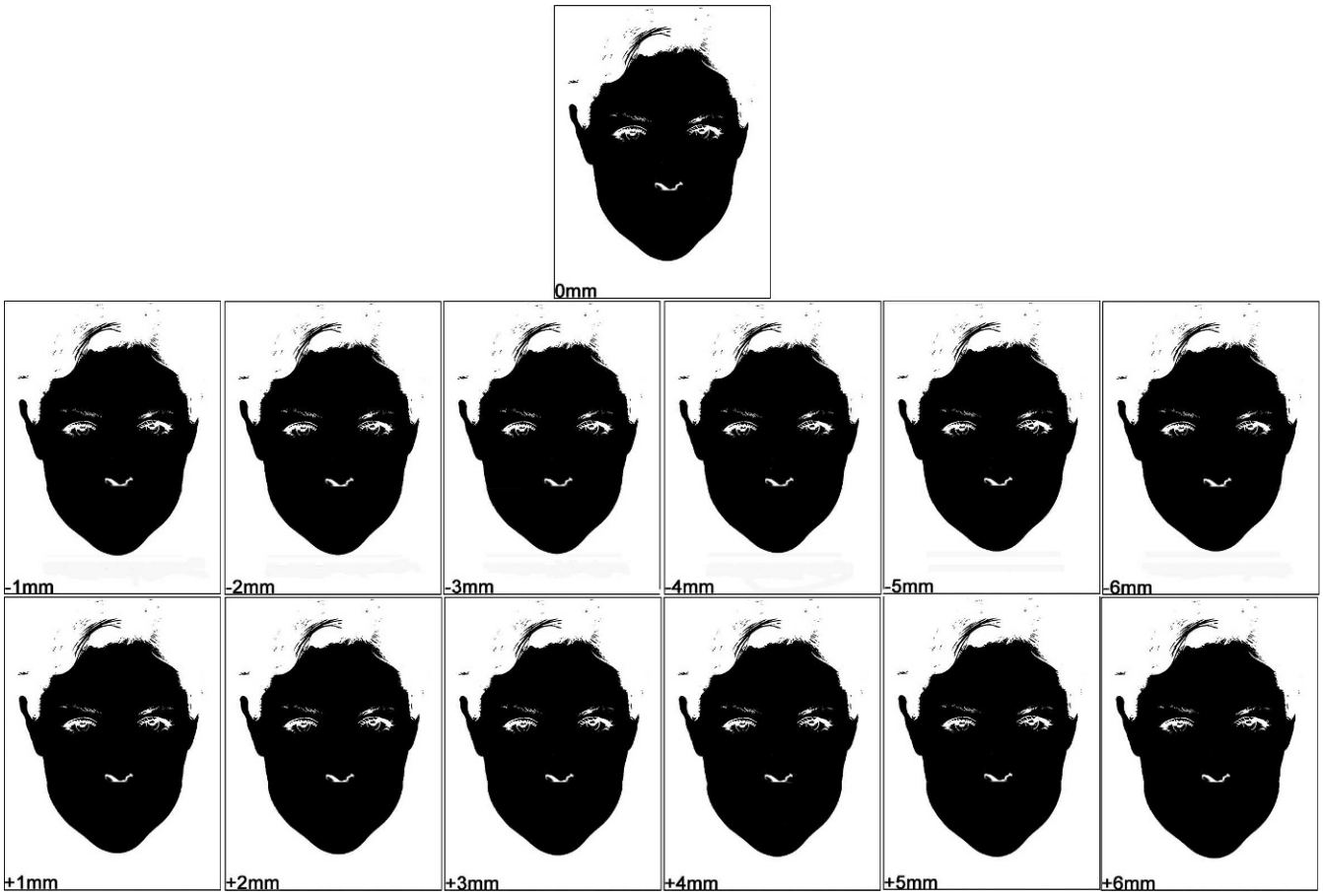

Figure 2. Series of female images.

Table 1. Mean Visual Analogue Scale (VAS) Scores of the Male Silhouettes and Treatment Need Perception Percentages

	Male				
	Mean VAS Scores	SD	Significance [a]	[b] and [c]	Treatment Need, %
0	79.7	11.0	—		0
+1	81.8	10.9	ns	A	0
−1	79.6	11.1	ns	A	0
+2	79.7	8.7	ns	A	0
−2	79.5	9.1	ns	A	14
+3	40.5	12.7	*	B	40
−3	33.7	14.4	*	E	54
+4	18.5	8.6	*	C	76
−4	12.9	5.3	*	F	86
+5	17.1	7.3	*	D	84
−5	10.5	5.9	*	F	94
+6	14.1	8.1	*	D	91
−6	7.4	4.8	*	F	100

[a] Comparison of altered images with unaltered images (0 mm); ns indicates not significant; SD, standard deviation; * $P \leq .001$.

[b] Comparison of altered images with each other.

[c] Comparison of images with increased lower facial height (LFH) with those showing decreased LFH; identical uppercase lettering indicates values that are not significantly different at $P \leq .001$.

the image represented their own is shown in Tables 1 and 2.

DISCUSSION

The intraclass correlation coefficients were quite high, with values of 69.9% and greater. Both the present study and previous studies[14,23,24] that reported similar findings supported the use of VAS as a simple and reliable method. On the other hand, VAS scores are subjective and variable and have their own disadvantages. Anchor terms (''very attractive'' and ''very unattractive'') may not be interpreted similarly and may not convey the same feelings when used by different people. In addition, identical positions on the scales offered by different people may not indicate comparable intensity of feelings; a multiple of a particular rating may not represent a multiple of the intensity of the feeling, nor are all portions of the scale given equal consideration by the evaluators.[25–27]

The use of black-and-white facial silhouettes offers the advantage of eliminating the effects of lips,[20,28] nose,[29,30] eyes,[31,32] interocular distance,[18] hair color

Table 2. Mean Visual Analogue Scale (VAS) Scores of the Female Silhouettes and Treatment Need Perception Percentages

	Female				
	Mean VAS Scores	SD	Significance [a]	Significance [b] and [c]	Treatment Need, %
0	80.1	10.3	—	A	3
+1	79.5	11.0	ns	A	8
−1	81.6	9.9	ns	A	0
+2	77.4	9.5	ns	A	16
−2	79.7	8.4	ns	A	4
+3	40.2	13.9	*	B	48
−3	50.5	11.7	*	D	42
+4	11.5	4.3	*	C	86
−4	31.6	15.2	*	E	82
+5	9.6	5.6	*	C	90
−5	19.5	7.9	*	F	92
+6	9.5	5.9	*	C	94
−6	11.6	6.7	*	F	93

[a] Comparison of altered images with unaltered images (0-mm); ns indicates not significant; SD, standard deviation; * $P \leq .001$.

[b] Comparison of altered images with each other.

[c] Comparison of images with increased lower facial height (LFH) with those showing decreased LFH; identical lettering indicates values that are not significantly different at $P \leq .001$.

and style,[33] and age[34] on the attractiveness of facial expressiveness. In the other hand, the disadvantage of black-and-white silhouettes is that the proportion of LFH to total face height and the harmony values in the LFH are not considered in evaluation, and this can be accepted to be a weak aspect of this study.

According to Arnett and McLaughlin,[22] mean values of lower one-third facial height are 71 ± 3.5 mm for females and 81.1 ± 4.7 mm for males. The current study was based on these values, and the results revealed that the images that had the LFH normal values determined by Arnett and McLaughlin[22] received the highest scores from the raters. Although there are no studies in the literature reporting that the LFH normal values introduced by Arnett and McLaughlin represent the LFH values of the Anatolian Turkish population, the results indicate that such values comply with the attractiveness perception of Turkish people. Nonetheless, when the LFH change exceeded 2 mm, the VAS scores of both male and female silhouettes dropped significantly. This result illustrates that Arnett and McLaughlin[25] normal values can be used at the planning stage of the treatment, but in order to achieve esthetically pleasing results, the value range should be kept to ±2 mm, which is lower than the ±4-mm range recommended by Arnett and McLaughlin. Furthermore, more than 70% of the raters stated that they would seek treatment when the change in the LFH was ±4 mm, which supports the conclusion that the value range should not be as broad ±4 mm.

When the change in the LFH exceeded +3 mm and −4 mm in female silhouettes and +4 mm and −3 mm in male silhouettes, the difference between the VAS scores became statistically insignificant. In clinical practice, these results can be used in treatment planning to determine the vertical correction needed or how much the LFH could be increased or decreased without compromising the front facial esthetic. For example, in a female patient with a LFH that is 6 mm higher than the normal value, in order to obtain an esthetically pleasing result it seems appropriate to decrease the LFH by at least 3 mm.

In this study, there was a preference for the increased LFH over the decreased LFH in male images when the change exceeded 2 mm, and the opposite was true for the female images. Similarly, in a study by Knight and Keith,[35] increased anterior LFH was found to be associated with less attractive faces for females, but no such trend existed for males. Ioi et al.[34] also reported that nonexpert raters rated slightly shorter female profile silhouettes as the most favored. In a study by Johnston et al.,[12] the images with reduced LFH proportions were found to be more attractive, but in that study, the profile silhouette image of a male was used, and the study did not specify whether the raters had any idea about the gender of the silhouette subject. On the other hand, in the study of Maple et al.[14] it was reported that there was no difference between the images when the LFHs were increased and decreased by the same amounts.

A point of discussion in the present study might be the composition of the panel. Some studies report that variables such as the rater's gender,[13,36–38] age,[36–38] education,[36,39,40] self-perceived attractiveness,[30] proficiency,[13,37,38] and personal profile[36] are influential in the scores of attractiveness. The results of this study reflect the preferences of the raters, who comprised nonprofessional low-and middle-class adult Anatolian Turks who had not received any prior orthodontic treatment and who were high school and university graduates.

CONCLUSIONS

- The hypothesis that LFH has no influence on frontal facial attractiveness and the treatment need perception of lay people was rejected.
- The findings of this study can be used to determine the minimum changes required in LFH so that an esthetically satisfying result can be achieved.
- When the LFH values fall outside of the 66.5–74.5-mm range for females and outside of the 77.5–85.5-mm range for males, the majority of the raters report that treatment is needed.

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