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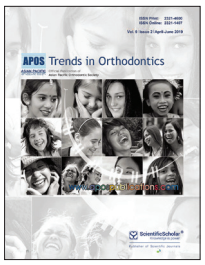

Original Article

Can smile influence the lower anterior vertical facial height on frontal view in an adult Asian female subject? A cross-sectional study

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ABSTRACT

Objectives: Smile is a universal phenomenon, the effect of which is not discovered on the lower anterior facial height (LAFH). The objective of this study was to determine the influence of smile on different LAFH in frontal view as assessed by different panels of raters using visual analog scale (VAS) in a female subject.

Material and Methods: The frontal photographs (at rest and on smile) were taken at natural head position of a female subject aged 28 years old after taking informed consent. LAFH of the photographs was modified using a Photoshop software (Adobe Systems, San Jose, Calif.). Sixty raters equally divided into orthodontic residents, general dentists, and laypersons were given a VAS to make subjective assessments of facial attractiveness of the modified photographs. Comparison of raters' scores was done using Kruskal–Wallis and Mann–Whitney U-tests. Wilcoxon Signed-Rank test was used to compare the esthetic scores of the subject at rest and with smile.

Results: The mean age of the all raters was comparable (early adulthood). All raters preferred normal or slightly shorter LAFH in both postures, that is, at smile and rest. Similarly, all raters disliked long face modifications. On comparing smile and rest photographs at various LAFH, we found less VAS scores for smile. Gender of raters played no role in difference of VAS scores.

Conclusion: All the panels of rater found normal LAFH to be the most attractive; however, the panels disliked long face modifications on both smile and at rest. Smile had no positive influence on the VAS scores as assumed so the effect of "Smiloflage" must be investigated further to understand it properly.

Keywords: Dental, Dimension, Esthetics, Orthodontics, Vertical

INTRODUCTION

A smile is a universal human emotion that connects people throughout the world, as a radiant smile makes you look more attractive, approachable, and youthful.[1] Apart from its attractive facial appeal, smile has multiple health benefits such as relieving stress, boosting immunity, and lowering blood pressure in some cases.[2] Smile is a complex anatomical process involving all the muscle of facial expression, causing deepening of the nasolabial folds and squinting of eyes. Numerous classifications exist[3,4] for different types of smile; however, simpler classification revolves around posed and non-posed smile. A non-posed smile is based on an involuntary reaction resulting from pure joy or happiness. However, a posed smile is a controlled social behavior that can be sustained voluntarily, and usually, it is the prime focus for the clinician as a starting point in the treatment.[5]

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As orthodontists greatly emphasize to improve and meet the ever-increasing esthetic standard of smile. Different aspects of smile have been dissected in the literature in pursuit of finding the most elegant and harmonious smile.[6-8] Sometimes, in understanding the minor details, bigger picture is underestimated which is the face. Numerous studies have reported different ratios and measurements to obtain a balanced smile.[7,8] However, the impact of a balanced or normal smile on facial proportions, especially in the vertical dimension, has not been reported. Controlling vertical dimension in orthodontics has always been of great concern, due to its unpredictable nature. Orthodontists are in center stage to control both the vertical dimension of the face and smile characteristics. Vertical dimension particularly lower anterior facial height (LAFH) can be controlled through different mechanics such as implant-supported intrusion or extrusion of molars in both arches.[9] Similarly, mini and micro smile characteristics can be managed through wire bending in the finishing stage of the treatment, a skill that is invaluable in orthodontics.[10]

In the literature, the ability of the smile to mask or camouflage the underlying LAFH is discovered recently from the lateral aspect; however, no data exist for the frontal view.[11,12] Knowing the impact of smiles on LAFH can enable clinicians to understand the different perceptions present in our society and provide more customized treatment.

The objective of this study was to determine the influence of smile on different LAFH in frontal view as assessed by different panels of raters using visual analog scale (VAS) in a female subject. The null hypothesis was that smile does not influence different LAFH in frontal view.

MATERIAL AND METHODS

Approval from the Ethical Review Committee of the university was taken before commencement of this study. After taking informed consent, photographs of a 28-year-old female patient were taken at rest and on smile. The subject met the following criteria for inclusion: Skeletal and dental class I (ANB 2 ± 2) with dental inclinations within cephalometric norms, a LAFH/Total anterior facial height (TAFH) ratio of 55% according to Eastman's cephalometric standard, ideal dental relationships, normal soft-tissue relationships according to E-line (Rickett's) and Z-angle (Merrifield's), and a balanced social smile.

The sample size was calculated by Open-Epi software version 3.0. The sample size was calculated from the findings of Varlık *et al*.[13] reporting mean VAS ratings at −6% LAFH of 7.4 ± 13.62 and 11.6 ± 6.7 for males and females, respectively. The study was designed to have a power of 80% and a confidence interval of 90%. It was determined that each study group required at least 24 raters. Since we had a total of three different panels of raters (orthodontic residents, [OR], general dentists, and laypersons [LP]), the total sample size was 24 × 3 = 72.

Natural head posture, as proposed by Bass,[14] is a head position, in which the patient's head is neither tilted up nor down. This offers a predictable and repeatable approach for taking photographs in frontal and profile view in clinics.[15] Two sets of photographs were taken with the subject's head in its normal posture, the first with the subject at rest and the second with the subject smiling to show the contour of the gums and the crown of the canine. Photographs were taken from five feet away using a Nikon D3500 camera (24.2 million megapixels) which was stabilized using a tripod.

Adobe Photoshop CS (version 8.0; Adobe Systems Inc., San Jose, Calif.) and Adobe Illustrator CS5 were used to make the necessary adjustments to both images (version 15.0.1). Five photographs with varying vertical heights were produced by stretching and depressing the two designated spots, the subnasale, and the sublabial. Before the adjustments (+4% and −4%, respectively), the normal LAFH/TAFH ratio was at 55%.[16] Using the cephalometric range of Eastman (55 ± 2), each photograph was deviated by four standard deviations (SD), resulting in changes to the LAFH/TAFH ratios of 47%, 51%, 55%, 59%, and 63% at the rest and smiling positions, respectively [Figures 1 and 2].

We were able to reduce the number of photographs with obviously altered facial heights using the four standard deviations away alteration criterion, allowing raters to be more accurate in their assessments. The soft tissues above the columella and below the soft-tissue pogonion were left unaltered to maintain the face's natural appearance.[17] Color preferences bias was also removed by switching to monochrome.

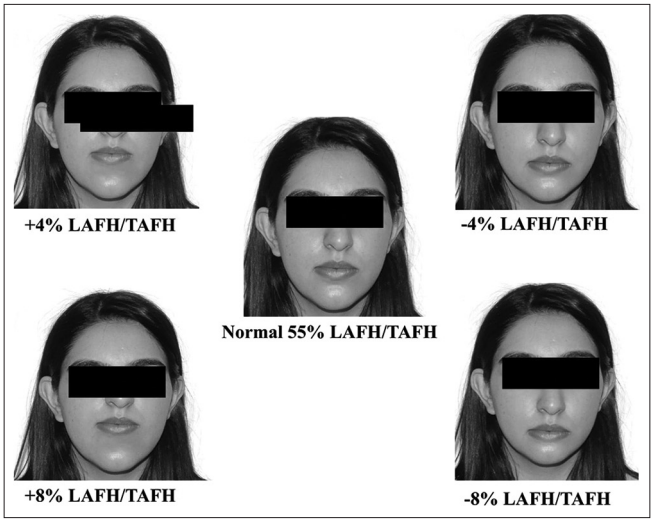

Figure 1: Modified lower anterior facial height at rest.

Images with both normal and altered LAFH/TAFH ratios were presented to the various rater panels. Each image was rated for an unspecified amount of time, and the images were changed out whenever the rater was satisfied. A VAS was created using a 100 mm continuous line, where 0 meant very unattractive and 10 meant very appealing. Using a visual analog scale (VAS), raters determined whether changed LAFH/TAFH ratios were more attractive when the subject was at rest or smiling.

Three randomly selected raters from each panel were given the responsibility of rescoring and reevaluating all the images in order to assess intra-rater reliability. Two weeks had passed after the images were initially rated when this review was conducted. The intraclass correlation coefficient between two esthetic scores (ES) showed high levels of agreement between raters (0.79).

Data analysis

Data were analyzed using SPSS for Windows (version 19.0, SPSS Inc. Chicago). Descriptive statistics, that is, mean and SD was calculated for age of raters and VAS score for each category in the vertical alteration groups for both genders. The Shapiro–wilk test was used to determine the normality of the data. Comparison between the VAS scores for genders was assessed by applying independent *t*-test. One-way ANOVA was used to determine significant differences between various VAS scores for the vertically altered groups among the three raters. Wilcoxon Signed-Rank test was applied to assess the difference between smile and at rest ES on various modifications. The kappa statistic was used to test inter-rater reliability. Level of significance was kept at $P \leq 0.05$.

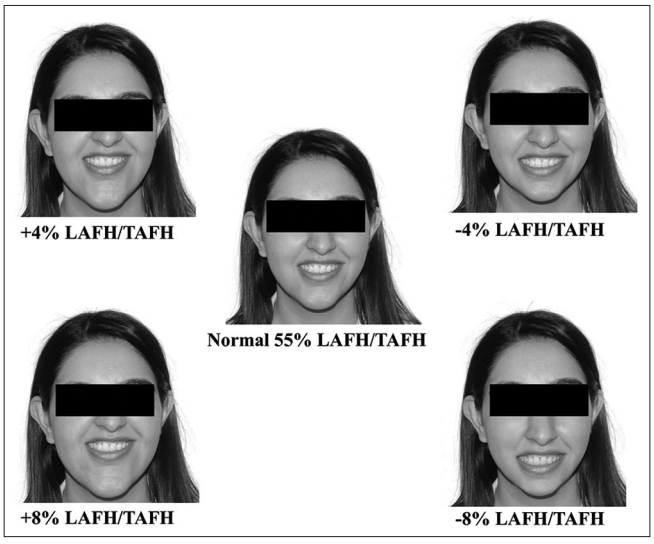

Figure 2: Modified lower anterior facial height on smile.

RESULTS

On comparing the mean age among the three panels of raters, we found that all raters were in early adulthood [Table 1]. GDP on rest preferred normal facial height and slightly shorter face height in female subjects; however, they disliked longer faces. On smile, they had the same positive inclination toward normal and shorter face height as compared to the long face. Similar trends were seen with orthodontist raters as they liked normal and slightly shorter faces to be more attractive in the female subject both at rest and smiling. However, they found long face (64%) to be the least attractive in both postures. Interestingly, LP had the same preferences as compared to professionals at rest and smile in female subjects [Table 2]. On applying Kruskal–Wallis test, we had multiple significant results among the three raters [Table 3]. Mann–Whitney U-test was applied which yielded multiple statistically significant results between orthodontists and GDP, in which generally GDP scored higher as compared to orthodontists. Similarly, in comparison between GDP and LP, we found several variables to be statistically significant showing LP scoring lesser as compared to GDP [Table 4]. When different variables were compared based on smile, and at rest, we found OR and LP had statistically significant difference in ESs for 57% and 47% LAFH/TAFH. On the other hand, GDP had statistically significant difference for 57% LAFH/TAFH only [Table 5]. Based on gender dimorphism, we found no significant difference in ES [Table 6].

DISCUSSION

The present study was conducted to assess the impact of smile on the vertical facial height from the frontal view. The null hypothesis was rejected since smile had a negative influence on the ES. A recently conducted study by Ali *et al*.[12] reported camouflaging effects of smile on various vertical facial height on lateral view in a male subject. However, same study group published another study reporting no effect of smile on vertical dimension in female subject.[11] Our study agrees with the previous study[11] that shows smiling photographs receives less ES. Hence, the concept of "Smiloflage" as claimed by the authors needs to be explored more in different population to understand this phenomenon in depth.[12]

On exploring the literature, multiple studies[13,16-18] have evaluated the impact of lower facial height on frontal and

Table 1: Mean age of the raters.

General dentists (*n*=24) (mean, SD)	Laypersons (*n*=24) (mean, SD)	Orthodontic residents (*n*=24) (mean, SD)
23.00±0.78	33.41±7.64	27.54±1.53

n=72, SD: Standard deviation

Table 2: Esthetic scores for different lower anterior facial height/total anterior facial height at rest.

Photographs	General dentists (*n*=24) (median, IQR)	Laypersons (*n*=24) (median, IQR)	Orthodontic residents (*n*=24) (median, IQR)	*P*-value
−8% (47%)	7.00 (5.25, 7.37)	5.00 (4.00, 6.75)	5.00 (4.00, 6.00)	0.005*
−4% (51%)	8.00 (6.25, 8.00)	7.00 (5.00, 8.00)	7.00 (6.00, 8.00)	0.12
Normal 55%	8.00 (7.00, 9.00)	7.50 (8.00, 6.00)	8.00 (6.25, 8.75)	0.27
+4% (59%)	6.00 (5.00, 7.00)	4.50 (6.00, 3.00)	4.00 (2.25, 5.00)	0.001**
+8% (63%)	6.00 (3.00, 6.00)	4.00 (2.00, 4.75)	3.00 (1.25, 4.00)	0.001**

n=72, IQR: Inter-quartile range, *P*≤0.05*, *P*<0.001** *Kruskal-Wallis test*

Table 3: Esthetic scores for different lower anterior facial height/total anterior facial height on smile.

Photographs	General dentists (*n*=24) (median, IQR)	Laypersons (*n*=24) (median, IQR)	Orthodontic residents (*n*=24) (median, IQR)	*P*-value
−8% (47%)	6.00 (5.00, 7.00)	4.00 (2.25, 5.75)	4.00 (2.00, 5.75)	0.002*
−4% (51%)	7.50 (7.00, 8.00)	6.00 (5.00, 7.00)	7.00 (5.25, 8.00)	0.01*
Normal 55%	8.25 (5.25, 9.00)	7.00 (5.50, 8.00)	7.00 (5.00, 8.00)	0.04*
+4% (59%)	6.00 (3.00, 7.00)	3.00 (2.00, 5.00)	2.50 (1.00, 4.75)	0.001**
+8% (63%)	4.50 (2.00, 6.00)	2.00 (0.25, 4.75)	2.00 (0.00, 3.75)	0.005*

n=72, IQR: Inter-quartile range, *P*≤0.05*, *P*<0.001** *Kruskal-Wallis test*

Table 4: Comparison between panels of raters.

Photographs	GD versus OR (*P*-value)	LP versus OR (*P*-value)	GD versus LP (*P*-value)
At rest −8% (47%)	0.005*	0.66	0.009*
At rest −4% (51%)	0.04*	0.68	0.007*
At rest Normal 55%	0.04*	0.08	0.006*
At rest +4% (59%)	0.001*	0.17	0.007*
At rest +8% (63%)	0.001**	0.08	0.006*
On smile−8% (47%)	0.002*	0.57	0.005*
On smile−4% (51%)	0.01*	0.17	0.001**
On smile Normal 55%	0.03*	0.56	0.09
On smile+4% (59%)	0.001**	0.10	0.03*
On smile+8% (63%)	0.005*	0.57	0.05*

n=72, *P*≤0.05*, *P*<0.001**, GD: General dentist, LP: Layperson, OR: Orthodontic resident, *Mann-Whitney U test*

lateral profile. One study reported that deviation of LAFH from 66.5-mm to 74.5-mm range for females would be considered as less esthetic by the raters from the frontal aspect.[14] These results agree with our results as modification at extreme ranges on either side was considered as least attractive. However, if we compare the long face versus short face, raters were slight more tolerable toward short face in the female subject.[14] Another study altered the chin height and interestingly reported that ESs decreased on reduction of chin height in female subject more dramatically as compared to increase in chin height.[18] This is in contrast with our study that supports the idea that slight shorter or normal face height is considered to be more appealing to the panels of rater. One of the important highlights of this previous study was confirming the Leonardo's canon of the ideal vertical LAFH proportions to be upper lip height as one-third (33.3%), lower lip height as one-third (33.3%), and chin height as one-third (33.3%) of lower anterior face height.[18]

The present study focused on the frontal aspect, but it was interesting that on evaluation of the LAFH on the lateral profile view same results were obtained in the literature.[18] A LAFH/TAFH of 55% was considered the most attractive by different panel of raters on the lateral view in the female subject.[11] Another study found slight shorter face height to be more elegant on lateral facial silhouettes.[16] It would be interesting to assess the different modifications of LAFH/TAFH from both aspects simultaneously from the panel of raters to see the impact of examination view. Similarly, the long face modifications were deemed to be least attractive on the lateral profile view comparable to the frontal view.[17] Considering the panel of raters,' all agreed regarding the most pleasing profile in the frontal view both at rest and on smile. They found normal and short face modifications to be the most attractive and long face modifications to be the least. However, this is not the case in every region that long face subjects are considered unattractive as it is based on personal beliefs and cultural settings as argued by the study from Brazil.[19] Another important feature to be noted that the difference of opinion between the LP and professional is getting very narrow as demonstrated in this present study. This is contrary to the belief that LP is less critical and will allow greater leeway when assessing the esthetic variables. This change in perception might be due to the

Table 5: Comparison of laypersons, orthodontists and general dentists' statistically significant esthetic scores between at rest and on smile.

Photographs	At rest (median, IQR)	Smile (median, IQR)	*P*-value
Laypersons			
−8% (47%)	5.00 (4.00, 6.75)	4.00 (2.25, 5.75)	0.01*
+4% (59%)	4.50 (3.00, 6.00)	3.00 (2.00, 5.00)	0.05*
Orthodontists			
−8% (47%)	5.50 (4.00, 6.00)	4.00 (2.00, 5.75)	0.001**
+4% (59%)	4.00 (2.25, 5.00)	2.50 (1.00, 4.75)	0.001**
General dentists			
+4% (59%)	6.00 (5.00, 7.75)	6.00 (3.00, 7.00)	0.01*

n=72, IQR: Inter-quartile range, $P \leq 0.05$*, $P < 0.001$** *Wilcoxon signed rank test*

Table 6: Gender dimorphism within raters.

Variables	Male raters (*n*=25)	Female raters (*n*=47)	*P*-value
Photographs (LAFH/TAFH at rest)			
−8 (47%)	6.0 (4.0–7.0)	6.0 (4.0–7.0)	0.34
−4 (51%)	7.0 (5.0–8.0)	8.0 (6.0–8.0)	0.21
Normal 55%	7.0 (6.50–8.0)	8.0 (7.0–9.0)	0.74
4 (59%)	5.0 (3.5–6.0)	4.0 (3.0–5.0)	0.51
8 (63%)	3.0 (2.0–4.5)	4.0 (2.0–6.0)	0.61
Photographs (LAFH/TAFH with smile)			
−8 (47%)	4.0 (3.0–6.0)	5.0 (2.0–6.0)	0.77
−4 (51%)	7.0 (5.0–7.5)	7.0 (6.0–8.0)	0.24
Normal 55%	7.0 (6.0–8.0)	8.0 (5.0–8.5)	0.67
4 (59%)	3.0 (2.0–4.5)	4.0 (2.0–6.0)	0.48
8 (63%)	2.0 (0.5–4.5)	3.0 (1.0–5.0)	0.33

Values are median (interquartile range). Significance $P \leq 0.05$. *Mann-Whitney U test*, LAFH: Lower anterior facial height, TAFH: Total anterior facial heigh

increased awareness in the general population regarding dental esthetics. This phenomenon would be confirmed subsequently based on evidence provided by future research.

We utilized black and white pictures for the ratings to prevent any bias toward the color and minimize any influence of other facial features. However, it would nearly be impossible to prevent complete biasness of the raters while evaluating the pictures, as it the virtue of the subjective assessments that can be driven by various factors not in control of the clinicians or researchers. Hence, the idea behind these types of studies should be to give an idea or range to the clinicians that can be used as a guide before embarking on the orthodontic treatment. As the practicing orthodontist knows that "no one size fits all" so studies based on the subjective assessments of various facial features should provide a range of acceptance threshold for the regional patient community.

As with the other studies based on modifications, there were some unnatural distortions of the face, moreover, this was a single-center study with the focus on skeletal class I profile, so the results cannot be generalized to the whole region and different malocclusions. The recommendations would be to conduct study in different skeletal malocclusions to investigate if any sagittal variables would influence the vertical facial height perception. Similarly, it would be a great addition to the literature if evaluation of the face could be conducted simultaneously on both the frontal and lateral profile by different panel of raters.

CONCLUSION

Based on the results, the null hypothesis can be rejected with the following take homes messages.

1. The most preferred the LAFH/TAFH in the frontal view were 55% and 51%
2. Smile had no camouflaging effect on various LAFH/TAFH, the concept of "Smiloflage" needs to be explored more in depth
3. Gender had no significant difference in opinion when evaluating different LAFH/TAFH
4. Long face modification was deemed as the most unattractive profile
5. Layperson was as critical as dental professionals when assessing the photographs.

Declaration of patient consent

The Institutional Review Board (IRB) permission obtained for the study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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