

Comparison of The Perception of Smile Esthetics Among General Dentists and Specialist

Original Article

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Received: Oct 28, 2014

Accepted: Dec 2, 2014

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Abstract

Introduction:

The effect of education on esthetic perception is still unclear. This study aims to compare the perception of smile esthetics, under various conditions, among general and specialist dentists.

Materials and methods:

A photograph of a woman's smile was digitally altered using a software image editing program. Alterations were made to the dental midline, anterior gingival display, buccal corridor, golden proportion, and upper lip vermilion border height. The perception of smile in each of the modified images was assessed by orthodontists (n=15), prosthodontists (n=15), maxillofacial surgeons (n=15), esthetic and operative dentists (n=15), and general dentists (n=20), and scored using a Visual Analog Scale (VAS). The mean VAS scores were calculated for each photograph.

Results:

The orthodontists were less tolerant in their perception of a dental midline deviation, and rated a 1mm shift as less attractive, whereas, the maxillofacial surgeons perceived a smile as less attractive when the midline was deviated by 3mm. Dentists from all groups perceived smiles with less gingival display and reduced vermilion height as the most attractive. In addition, an average buccal corridor area was preferred by most dentists in all groups. Golden proportion in the anterior teeth was perceived as attractive only by the orthodontists. In each image no significant difference was discovered between the scores of different groups of the participants.

Conclusion:

The range of perception and sensitivity about each factor in specialists and general dentists was different but the ideal image was the same.

Key words:

•Esthetics •Dental •Smiling •Dentists

Introduction

During the course of evolution, humans have learned to use their smile as presentation of the state of joy. The effect of smiling, on social life is undeniable.^(1,2) An attractive smile results from the coordination between the teeth and the intra- as well as extra-oral soft tissues.⁽³⁾ Therefore, a golden smile can be achieved by applying certain beauty standards that originate from various sources such as, the principles of beauty in art, the measured values of a certain race, and the studying of a group of people who are generally considered pretty.⁽⁴⁻⁶⁾ Yet, none of the values and standards described in literature have proven to be successful for clinical use.⁽⁴⁾

A recent study investigated the influence of orthodontic treatment, midline position, axial midline angulations, buccal corridor, and smile arc on the beauty of smile.⁽⁷⁾ In addition, the golden proportion a ratio that defines the dimensions between lengths, has been used in esthetic dental treatment. Nevertheless, the role of education on the judgment of beauty is still not clear.

In this study, we evaluated the perception of beauty among general dentists, and those from various dental specialties including orthodontics, prosthodontics, esthetic and operative dentistry, and maxillofacial surgery, based on the following factors: dental midline deviation, anterior maxillary gingival display, buccal corridor, vermilion height, and golden proportion in width of maxillary incisors.

Materials and Methods

This cross-sectional study was performed at the School of Dentistry, Medical Science University, Iran. Five groups of evaluators were included in this study: general dentists (n=20); and dental specialists (n=60) comprising orthodontists (n=15), prosthodontists (n=15), maxillofacial surgeons (n=15) and esthetic and operative dentists (n=15).

Standardized frontal extra oral photographs of a young woman with ideally aligned teeth and a pleasing smile were taken. The photographs were digitally modified using Adobe Photoshop CS8, and 20 variations comprising combinations of the factors, dental midline deviation, anterior maxillary gingival display, buccal corridor, vermilion height, and golden proportion in width of

maxillary incisors, were created (Figures 1-6). The photographs were grouped based on the modifications made to the photographs as follows:

- Alteration group 1:dental midline deviation (n = 9)

The maxillary midline was progressively moved by increments of 1 mm to the right and left, up to a maximum of 4 mm (Figures 1, 2).

- Alteration group 2:buccal corridor (n = 5)

The photograph was modified to create dark spaces (between the buccal surfaces of the maxillary teeth and the corners of the mouth) of five different sizes in the buccal corridors; (5%, and 10% (narrow buccal corridor), 15% and 20% (average buccal corridor), 25% (wide buccal corridor). (Figure 3)

- Alteration group 3:maxillary anterior gingival display (n = 5)

Gingival exposure was studied by increasing and decreasing the lip-gingival distance, and were classified as G-2, covering 2 mm of the teeth from the margin of the gingival; G0, at the margin of the maxillary central incisors; G2, 2 mm increase in gingiva-lip distance using the labial gingival margins of maxillary central incisors as reference gingival; G4, 4 mm increase in gingiva-lip distance; and G6, 6 mm increase in gingiva-lip distance. (Figure 4)

- Alteration group 4: lip form (n = 3)

The vertical vermilion height was altered increasing or decreasing the vermilion border of the lip at the midline by 2 mm. (Figure 5)

- Alteration group 5: golden proportion (n = 3)

The golden proportion was evaluated by increasing and decreasing the width of the lateral incisors bilaterally, by 1 mm. (Figure 6)

There were 20 altered and 6 unaltered photographs in total. Each of the altered photographs consisted of one modification and was assigned an exclusive code. (Figures 1-6) All 26 photographs were arranged randomly in an album and presented to the evaluators, who were then asked fill out a questionnaire. The questions included details such as age, sex, field, and level of education of the evaluators.

Smile attractiveness in each photograph was assessed by the evaluators, and scored based on a 10-point visual analog scale (VAS) with 0 indicating the least attractive smile and 10 the most

attractive. The evaluators were required to score the photographs within the optional duration after viewing all of them from the first to the last one. To test the reliability of our study, 10 evaluators were selected randomly among the participants, and asked to score the photographs again following the same procedure after a 2-week interval. Statistical analyses were performed with the statistical software SPSS V.22. One way ANOVA with Tukey post hoc tests were used to analyze differences between groups. $P < 0.05$ was considered statistically significant.

Results

The overall intraclass correlation coefficient The overall intraclass correlation coefficient (ICC; with 95% confidence interval was 0.96 (0.85–0.99).

A moderately high correlation coefficient for reliability (0.88) has been reported while using VAS for the evaluation of dental attractiveness. The mean age of the participants was 31.93 ± 5.4 . There were no statistically significant differences between the ratings of males and females in each group ($P = 0.25$). The VAS score for the alteration groups 1–5 given by the orthodontists, prosthodontists, esthetic and operative dentists, maxillofacial surgeons, and general dentists are shown in Tables 1–5. The threshold levels at which the general and specialist dentists perceived smile esthetics in each alteration group are depicted in Table 6.

Table 1. Mean visual analog scores for altered images in alteration group 1

	Dental midline Shift	Mean	Std. Deviation	F value	P value
Orthodontists	M0	6.93	2.017	35.066	<0.001
	M1	6.00	1.832		
	M2	4.667	1.960		
	M3	3.267	1.556		
	M4	2.200	1.292		
Prosthodontists	M0	5.40	1.882	24.259	<0.001
	M1	5.533	1.432		
	M2	3.800	1.264		
	M3	2.567	1.193		
	M4	1.600	1.055		
Esthetic & operative Dentists	M0	5.60	1.595	22.805	<0.001
	M1	5.467	1.381		
	M2	4.400	1.441		
	M3	3.267	1.474		
	M4	2.133	1.767		
Maxillofacial Surgeons	M0	5.60	2.261	17.665	<0.001
	M1	5.533	1.529		
	M2	4.400	1.681		
	M3	3.267	1.556		
	M4	2.533	1.043		
General Dentists	M0	6.37	1.802	20.875	<0.001
	M1	6.211	1.685		
	M2	4.605	1.904		
	M3	3.842	2.021		
	M4	2.079	1.626		

M0, unaltered image; M1–4, progressive shift of dental midline in increments of 1 mm.

Table 2. Mean visual analog scores for altered images in alteration group 2

	Buccal Corridor	Mean	Std. Deviation	F value	P value
Orthodontists	B5, B10	5.95	1.831	35.066	<0.001
	B15, B20	6.65	1.669		
	B25	4.60	1.454		
Prosthodontists	B5, B10	5.23	1.682	4.900	<0.016
	B15, B20	5.40	1.882		
	B25	4.47	1.506		
Esthetic &operative Dentists	B5, B10	5.73	1.740	3.526	<0.044
	B15, B20	5.66	1.595		
	B25	5.27	1.534		
Maxillofacial Surgeons	B5, B10	6.03	1.870	4.263	<0.025
	B15, B20	5.66	1.944		
	B25	5.00	1.890		
General Dentists	B5, B10	6.21	2.218	4.470	<0.014
	B15, B20	5.84	1.802		
	B25	4.47	1.896		

Five sizes of the dark spaces in the buccal corridors: B5 and B10, 5% and 10%, respectively (narrow buccal corridor), B15 and B20, 15% and 20%, respectively (average buccal corridor);and B25, 25% (wide buccal corridor)



Figure 1. Extraoral photographs from alteration group 1 displaying dental midline shift by 4mm to the right. M0, unaltered image; M1–4, progressive shift in dental midline by increments of 1 mm towards the right.



Figure 2. Extraoral photographs from alteration group 1, displaying dental midline shift by 4 mm to the left. M0, unaltered image; M1–4, progressive shift in dental midline by increments of 1 mm towards the left.

Results from the ANOVA test showed that orthodontists were less tolerant in their evaluation of dental midline discrepancies, and rated more than 1 mm shifts as less attractive, whereas, prosthodontists, esthetic and operative dental specialists, and general dentists found smiles with more than 2 mm shift as unattractive. A midline shift higher than 3 mm was perceived as unattractive by the maxillofacial surgeons in this study (Tables 1, 6).



Figure 3. Extraoral photographs from alteration group 2 displaying buccal corridor area. Five sizes of dark space in the buccal corridors area shown: B5 and B10, 5% and 10%, respectively (narrow buccal corridor); B15 and B20, 15% and 20%, respectively (average buccal corridor), and B25, 25% (wide buccal corridor)

Comparison of the perception of smile Esthetics



Figure 4.Extraoral photographs fromalteration group 3 displaying maxillary anterior gingival display. G-2, covering 2 mm of the teeth from the margin of the gingiva; G0, at the margin of the maxillary central incisors; G2, 2 mm distance between the gingiva and the lip, using the labial gingival margins of maxillary central incisors as reference (unaltered image); G4, 4 mm distance between the gingiva and the lip; andG6, 6 mm distance between the gingiva and the lip



Figure 5.Extraoral photographs fromalteration group 4 displaying size of the upper lip vermilion border. LIP0, unaltered image; Lip-2, 2 mm decrease; and Lip2, 2 mm increase the height of vermilion border



Figure 6.Extraoral photograph fromalteration group 5 displaying the Golden proportion. Lat0, unaltered image; Lat-1, 1 mm decrease; and Lat1, 1 mm increase in lateral incisor's width.

As illustrated in Table 2, mean VAS scores for altered images in alteration group 2 (size of buccal corridor) revealed the average buccal corridor (mean score of B15 and B20) as the most preferred size for an esthetic smile; the orthodontists were the most critical f this variable, when compared the dentists in the other groups. Table 3 shows the mean analogue scores for altered images in alteration group 3 (gingival display). No gingival display without covering the tooth was considered the most attractive among all groups. Moreover, this variable had the highest score when compared with the rest of the variables in the study (Figure 7). Table 4 shows that the smile with the narrow lip (2 mm decrease in height of upper lip vermilion) was considered as the most esthetic among all groups. Table 5 shows the mean VAS scores for the alteration group 5, and compares the perception of the existence of golden proportion in the anterior teeth among the groups; orthodontists considered the smile in unaltered photographs as most attractive, whereas, the dentists in the other groups preferred the smile with a 1 mm increase lateral incisor width.

The results of ANOVA showed that there were no significant differences in the scores between the groups for each image. (P-values>0.05)

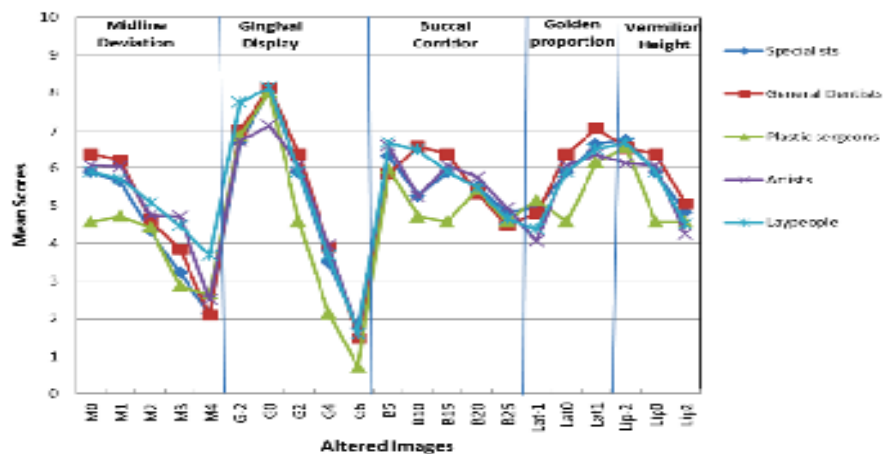


Diagram 1. The perception comparison between the groups

Table 3. Mean visual analog scores for altered images in alteration group 3

	Gingival Display	Mean	Std. Deviation	F value	P value
Orthodontists	G-2	6.27	1.486	38.158	<0.001
	G0	8.20	1.207		
	G2	6.93	2.017		
	G4	2.87	2.642		
	G6	1.67	1.633		
Prosthodontists	G-2	7.60	1.639	32.895	<0.001
	G0	7.47	1.552		
	G2	5.40	1.882		
	G4	3.93	1.100		
	G6	2.13	1.642		
Esthetic & operative Dentists	G-2	7.27	1.981	45.377	<0.001
	G0	8.47	1.356		
	G2	5.60	1.595		
	G4	3.53	2.031		
	G6	1.57	1.345		
Maxillofacial Surgeons	G-2	5.60	2.028	91.568	<0.001
	G0	8.07	1.668		
	G2	5.60	2.261		
	G4	3.67	1.759		
	G6	1.53	1.060		
General Dentists	G-2	7.00	1.856	48.211	<0.001
	G0	8.11	2.105		
	G2	6.37	1.802		
	G4	3.89	2.052		
	G6	1.47	1.577		

G-2, covering 2 mm of the teeth from the margin of the gingiva;G0,at the margin of the maxillary central incisors gingiva;G2, 2 mm distance from the gingiva to the lip, using the labial gingival margins of the maxillary central incisors as reference (unaltered image);G4, 4 mm distance from the gingiva to the lip;G6, 6 mm distance from the gingiva to the lip

Comparison of the perception of smile Esthetics

Table 4. Mean visual analog scores for altered images in alteration group 4

	Vermilion Height	Mean	Std. Deviation	F value	P value
Orthodontists	LIP0	6.93	2.017	12.896	<0.001
	LIP-2	7.07	2.774		
	LIP2	4.53	1.624		
Prosthodontists	LIP0	5.40	1.882	9.218	<0.003
	LIP-2	6.40	1.363		
	LIP2	5.00	1.298		
Esthetic & operative Dentists	LIP0	5.60	2.261	15.327	<0.001
	LIP-2	6.67	1.656		
	LIP2	4.93	1.302		
Maxillofacial Surgeons	LIP0	5.60	1.595	10.688	<0.002
	LIP-2	6.87	1.792		
	LIP2	4.80	1.633		
General Dentists	LIP0	6.37	1.802	8.512	<0.003
	LIP-2	6.53	2.412		
	LIP2	5.05	1.870		

LIP0, unaltered image; Lip-2,2 mm decrease; and Lip2,2 mm increase in the height of vermilion border

Table 5. Mean visual analog scores for altered images in alteration group 5

	Golden Prportion	Mean	Std. Deviation	F value	P value
Orthodontists	Lat0	6.93	2.017	15.730	<0.001
	Lat-1	4.67	1.995		
	Lat1	6.13	2.350		
Prosthodontists	Lat0	5.40	1.882	6.054	<0.014
	Lat-1	4.73	1.246		
	Lat1	6.53	1.751		
Esthetic & operative Dentists	Lat0	5.60	1.595	4.324	<0.036
	Lat-1	5.13	1.595		
	Lat1	6.40	1.995		
Maxillofacial Surgeons	Lat0	5.60	2.261	9.183	<0.003
	Lat-1	5.20	1.765		
	Lat1	7.40	1.207		
General Dentists	Lat0	6.37	1.802	11.937	<0.001
	Lat-1	4.79	2.123		
	Lat1	7.05	1.870		

Lat0,unaltered image; -1,1 mm decrease; 1,1 mm increase in the width of the lateral incisors

Table 6: Threshold levels of significance difference (mm) for altered images

	Orthodontists	Prosthodontists	Maxillofacial-Surgeons	Cosmetic Dentists	General Dentists
Midline Deviation	1 mm	2 mm	3 mm	2 mm	2 mm
Gingival Display	2 mm	2 mm Except covering tooth	2 mm Except covering tooth	2 mm	2 mm
Buccal Corridor	10%	20%	20%	20%	20%

Discussion

The quest for a better appearance is an issue of considerable importance today. Among the different factors involved, the esthetics of a smile has a major influence on the perception of an individual's appearance and personality.^(8, 9) Understanding the perception of esthetics is extremely significant especially during dental treatments. The present study compared the perception of smile esthetics among dental specialists and general dentists. A standard photograph of a young woman with an attractive smile was used in this study. Alterations, based on dental midline deviation, anterior maxillary gingival display, buccal corridor, vermilion height, and golden proportion were made to the photograph. This approach aims to eliminate the possibility of factors such as tooth alignment, color, and size, among others, affecting the results. The number of dentists participating in this study was calculated in order to achieve sufficient power, and significant statistical differences among the groups in the main outcome indicate that the sample size was adequate. This is not a representative survey, and population extrapolation should not be performed. However, since cultural aspects are important with regards to esthetic perception, all dentists in this study belonged to the same area; therefore, cultural differences are unlikely to have biased the results. The VAS has been widely used for evaluating subjective feelings, and has demonstrated good levels of reproducibility and validity.^(10, 11) There was no significant statistical difference in the mean scores between the male and female dentists within each group, and hence, mean scores of all dentists (both genders) were obtained for each group. This is in contrast with the findings of Geron and Wasserstein⁽¹²⁾, where females were found to be more tolerant of upper

gingival display.

There is a dearth of information in the literature regarding the perception of dental asymmetries on smile esthetics. The study by Sergio Pinho et al comparing the impact of midline shift on smile perception among orthodontists, prosthodontists, and laypersons revealed differences between the groups; midline shifts were perceptible at 1 mm by orthodontists, and 3 mm by prosthodontists, while the laypersons did not notice the midline shifts.⁽¹³⁾ Another study reported that a midline shift of 2 mm was perceived by 83% of orthodontists.⁽¹⁴⁾ Furthermore, it has been suggested that midline shifts greater than 2 mm is perceived by most people, and orthodontists and general dentists are the least tolerant of this dental asymmetry.⁽¹⁵⁾ In contrast to our findings, it has been reported that orthodontists classified smiles as least attractive when the midline shift reaches 4 mm.⁽¹⁶⁾ These conflicting findings might be attributed to differences in the digital manipulation of photographs, data collection instruments, or statistical tests used or sociocultural aspects. Midline shift is an important factor in orthodontics; therefore, it is natural for orthodontists to be less tolerant.

Alterations in gingiva-to-lip distance have been performed to determine the detection and perception of asymmetric dental discrepancies. Sarver⁽¹⁷⁾ believes that gingival display in a female was the most ideal due of its youthful appearance. The findings from our study are in concordance with those reported recently, where slight tooth coverage on a posed smile has been considered as ideal.⁽¹⁸⁻²⁰⁾ The study by SantoshKummar et al. demonstrated that orthodontists, unlike lay people and general dentists who did not show any threshold for unattractiveness, rated 2 mm of gingival exposure as unattractive.⁽²¹⁾ However, our results demonstrated that orthodontists and general dentists rated up to 2 mm of gingival

exposure as desirable, whereas, dentists belonging to the other specialties considered gingival exposures less than 2mm as ideal. Moreover, a comparison of the scores obtained from all the altered images revealed that gingival display was considered as the most important factor affecting the dentists' perception of smile esthetics in this study.

The average buccal corridor was perceived as most attractive, in this study, when compared to the extremely wide or narrow buccal corridors. A broad smile (minimal buccal corridors) has been considered as more attractive by lay people and orthodontists as opposed to a narrow smile (larger buccal corridors) in several studies. (22-25) On the other hand, some studies have reported that the buccal corridor space does not influence smile esthetics. (7, 26-28) In another study, Yang, I.H. et al. concluded it is necessary to control the buccal corridor area in order to achieve better smile esthetics after fixed orthodontic treatment. (29) In the present study, the buccal corridor was received less importance when compared to gingival display.

In a study evaluating the influence of the upper lip vermilion border on smile esthetics, Craig R. Scott et al. demonstrated an association between thicker vermilion borders and attractiveness; however, they also suggested that orthodontists might have a tendency to provide treatment based on their occupational focus, which may not represent the subjective treatment needs of the patient. (30)

In the present study, all the dental specialists considered the lips to have a considerable effect on smile esthetics. In the study by Farkas and Munro (31), a thin vermilion border was considered more attractive among the participants in all groups, whereas a thicker vermilion was considered unpleasant.

However, based on the findings in the present study, orthodontists, maxillofacial surgeons and general dentists were less inclined to be influenced by the thin and medium vermilion borders, and no significant difference was observed between the perceptions of the two vermilion border heights in these two groups.

The golden proportion was altered by manipulating the widths of the maxillary lateral incisors; the width ratio was altered. Only the orthodontists perceived the smile with the unaltered golden ratio as attractive, whereas, the dentists in the other groups rated the smile with wider lateral incisors as more attractive. Thus, the impact of golden proportion, on smile esthetics, was not significant when compared with the other esthetic factors in the present study.

Although some studies have reported that golden proportion in the anterior teeth is not commonly considered as a factor affecting smile esthetics (32, 33), very few studies have evaluated the perception of this factor.

One of the factors that might have affected the scores in the present study was the display of all 21 pictures together in one album; so the most important factor caused that the evaluators couldn't respect properly on others, but the benefit of this method of display revealed the importance degree of factors.

Conclusion

Our findings showed that all evaluator groups' found the same image as the ideal one but The findings from the present study reveal the differences in the range of perception and sensitivity with regard to each factor between the specialists and the general dentists, thereby indicating that educational differences can affect the judgment and perception of an esthetic smile.

References

1. McLeod C, Fields HW, Hechter F, et al. Esthetics and smile characteristics evaluated by laypersons. *Angle Orthod* 2011 Mar;81(2):198-205. doi: 10.2319/060510-309.1.
2. Krishnan V, Daniel ST, Lazar D, Asok A. Characterization of posed smile by using visual analog scale, smile arc, buccal corridor measures, and modified smile index. *Am J Orthod Dentofacial Orthop* 2008 Apr;133(4):515-23. doi: 10.1016/j.ajodo.2006.04.046.
3. McNamara L, McNamara JA Jr, Ackerman MB, Baccetti T. Hard- and soft-tissue contributions to the esthetics of the posed smile in growing patients seeking orthodontic treatment. *Am J Orthod Dentofacial Orthop* 2008 Apr;133(4):491-9. doi: 10.1016/j.ajodo.2006.05.042.

- 4.Rodrigues Cde D1, Magnani R, Machado MS, Oliveira OB. The perception of smile attractiveness. *Angle Orthod* 2009 Jul;79(4):634-9. doi: 10.2319/030508-131.1.
- 5.Oumeish OY. The cultural and philosophical concepts of cosmetics in beauty and art through the medical history of mankind. *Clin Dermatol* 2001 Jul-Aug;19(4):375-86.
- 6.Peck H, Peck S. A Concept of Facial Esthetics. *Angle Orthod* 1970 Oct;40(4):284-318.
- 7.Janson G, Branco NC, Fernandes TM, et al. Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness. *Angle Orthod* 2011 Jan;81(1):153-61. doi: 10.2319/040710-195.1.
- 8.Beall AE. Can a new smile make you look more intelligent and successful? *Dent Clin North Am* 2007 Apr;51(2):289-97, vii.
- 9.Abu Alhajja ES, Al-Shamsi NO, Al-Khateeb S. Perceptions of Jordanian laypersons and dental professionals to altered smile aesthetics. *Eur J Orthod* 2011 Aug;33(4):450-6. doi: 10.1093/ejo/cjq100. Epub 2010 Nov 1.
- 10.Faure JC, Rieffe C, Maltha JC. The influence of different facial components on facial aesthetics. *Eur J Orthod* 2002 Feb;24(1):1-7.
- 11.An KY, Lee JY, Kim SJ, Choi JI. Perception of maxillary anterior esthetics by dental professionals and laypeople and survey of gingival topography in healthy young subjects. *Int J Periodontics Restorative Dent* 2009 Oct;29(5):535-41.
- 12.Geron S, Atalia W. Influence of sex on the perception of oral and smile esthetics with different gingival display and incisal plane inclination. *Angle Orthod* 2005 Sep;75(5):778-84.
- 13.Pinho S, Ciriaco C, Faber J, Lenza MA. Impact of dental asymmetries on the perception of smile esthetics. *Am J Orthod Dentofacial Orthop* 2007 Dec;132(6):748-53.
- 14.Johnston CD, Burden DJ, Stevenson MR. The influence of dental to facial midline discrepancies on dental attractiveness ratings. *Eur J Orthod* 1999 Oct;21(5):517-22.
- 15.Beyer JW, Lindauer SJ. Evaluation of dental midline position. *Semin Orthod* 1998 Sep;4(3):146-52.
- 16.Kokich VO Jr, Kiyak HA, Shapiro PA. . Comparing the perception of dentists and lay people to altered dental esthetics. *J J Esthet Dent* 1999;11(6):311-24.
- 17.Sarver DM. The importance of incisor positioning in the esthetic smile: the smile arc. *Am J Orthod Dentofacial Orthop* 2001 Aug;120(2):98-111.
- 18.Ker AJ, Chan R, Fields HW, et al. Esthetics and smile characteristics from the layperson's perspective: a computer-based survey study. *J Am Dent Assoc* 2008 Oct;139(10):1318-27.
- 19.Springer NC, Chang C, Fields HW, et al. Smile esthetics from the layperson's perspective. *Am J Orthod Dentofacial Orthop* 2011 Jan;139(1):e91-e101. doi: 10.1016/j.ajodo.2010.06.019.
- 20.Chang CA, Fields HW Jr, Beck FM, et al. Smile esthetics from patients' perspectives for faces of varying attractiveness. *Am J Orthod Dentofacial Orthop* 2011 Oct;140(4):e171-80. doi: 10.1016/j.ajodo.2011.03.022.
- 21.Kumar S, Gandhi S, Valiathan A. Perception of smile esthetics among Indian dental professionals and laypersons. *Indian J Dent Res* 2012 Mar-Apr;23(2):295. doi: 10.4103/0970-9290.100456.
- 22.Tikku T, Khanna R, Maurya RP, Ahmad N. Role of buccal corridor in smile esthetics and its correlation with underlying skeletal and dental structures. *Indian J Dent Res* 2012 Mar-Apr;23(2):187-94. doi: 10.4103/0970-9290.100424.
- 23.Moore T, Southard KA, Casco JS, et al. Buccal corridors and smile esthetics. *Am J Orthod Dentofacial Orthop* 2005 Feb;127(2):208-13; quiz 261.
- 24.Parekh SM, Fields HW, Beck M, Rosenstiel S. Attractiveness of variations in the smile arc and buccal corridor space as judged by orthodontists and laymen. *Angle Orthod* 2006 Jul;76(4):557-63.
- 25.Ioi H, Kang S, Shimomura T,et al. Effects of buccal corridors on smile esthetics in Japanese and Korean orthodontists and orthodontic patients. *Am J Orthod Dentofacial Orthop* 2012 Oct;142(4):459-65. doi: 10.1016/j.ajodo.2012.05.011.
- 26.Roden-Johnson D, Gallerano R, English J. The effects of buccal corridor spaces and arch form on smile esthetics. *Am J Orthod Dentofacial Orthop* 2005 Mar;127(3):343-50.
- 27.Ritter DE, Gandini LG, Pinto Ados S, Locks A. Esthetic influence of negative space in the buccal corridor during smiling. *Angle Orthod* 2006 Mar;76(2):198-203.
- 28.Zange SE, Ramos AL, Cuoghi OA, et al. Perceptions of laypersons and orthodontists regarding the buccal corridor in long- and short-face individuals. *Angle Orthod* 2011 Jan;81(1):86-90. doi: 10.2319/031210-145.1.
- 29.Yang IH, Nahm DS, Baek SH. Which hard and soft tissue factors relate with the amount of buccal corridor space during smiling? *Angle Orthod* 2008 Jan;78(1):5-11. doi: 10.2319/120906-502.1.
- 30.Scott CR, Goonewardene MS, Murray K. Influence of lips on the perception of malocclusion. *Am J Orthod Dentofacial Orthop* 2006 Aug;130(2):152-62.
- 31.Grabner TM. Anthropometry of the head and face in medicine. *Am J Orthod* 1982;82(5):438.
- 32.Mahshid M, Khoshvaghti A, Varshosaz M, Vallaei N. Evaluation of "golden proportion" in individuals with an esthetic smile. *J Esthet Restor Dent* 2004;16(3):185-92; discussion 193.
- 33.Parnia F, Hafezeqoran A, Mahboub F, et al. Proportions of maxillary anterior teeth relative to each other and to golden standard in tabriz dental faculty students. *J Dent Res Dent Clin Dent Prospects* 2010 Summer;4(3):83-6. Epub 2010 Sep 16.