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Original Research

Vertical Anterior Tooth Display and Smile Attractiveness

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ABSTRACT

Introduction
Our study is done to compare and verify if different levels of maxillary central incisal edges and gingival display influence the perception of smile among orthodontists, dentists, orthodontic patients, and laypersons.

Methods
Photographs of the smiles of 1 male and 1 female showing the gingival contours of the incisors and the canines were digitally altered, creating steps from 0 to 2.0 mm in 0.5-mm increments, with and without gingival exposure. The 20 pictures were shown in random order to 160 evaluators divided into 4 groups who were asked to provide attractiveness scores on visual analog scales.

Results
Both the steps (P\0.001) and the gingival exposure (P\0.05) had statistically significant influences on the evaluators in all groups. There was also a statistically significant difference (P\0.001) between the evaluations of orthodontists with the other groups.

Conclusion
Vertical relationship of incisor borders with the 1.0-mm step was given the highest grading. There were significant differences in the evaluation of orthodontists when compared with the other 3 groups, and no significant difference was detected between the other 3 groups. The gingival display holds an important value in the esthetic perception of the smiles evaluated. There were significant differences between the evaluations of the smiles of the man and the woman.

INTRODUCTION

A beautiful smile and an attractive face appears to be connected to each other. Major attention is directed towards the mouth and the eyes of the speaker's face.

This study verifies whether different sizes of maxillary incisal edges and gingival display effects the perception of smile attractiveness in various groups of orthodontists, dentists, orthodontic patients and laypersons.

What according to one group might be an attractive smile may not seem to the other group. So, it is important to address the relationship of the incisal borders for a more esthetic smile, among not only orthodontic patients and orthodontists but also laypersons and dentists.[1]

MATERIAL AND METHODS

This study includes smiles of 2 volunteers - a man and a woman with incisors aligned in a curve parallel to lower lip and showing the gingival contours of the maxillary teeth.This study includes four groups of evaluators: orthodontists, general dentists, laypersons, orthodontic patients.

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Group of orthodontists includes specialists who works with fixed orthodontic techniques. The dentist group are required to have graduated more than 2 years previously and to practice any speciality other than orthodontics. Layperson group are required to have a completed or an uncompleted college degree. Orthodontic patient group are required to be involved in active orthodontic treatment for at least 6 months in private offices or at the orthodontic OPD of Rama Dental College.

Age group for orthodontists – 28-60 years, general dentists – 25-60 years, laypersons - 18-60 years and orthodontic patients was 18-35 years.

MATERIALS USED

Digital camera (CANON EOS REBEL), Adobe photoshop CS5 software, Digital caliper to measure the incisor length, Virtual ruler, G Power software to calculate sample size(version 3.1.9.213), 20 visual analog scales (VAS) 100 mm wide.

Keynote software (version 6.1,Apple) to assemble the 10 manipulated pictures of each model in a presentation. Statistical analysis with software (version 21,IBM)

METHOD

The photographs of smiles of 2 volunteers-a man and a woman showing the gingival contours of the maxillary teeth with incisors aligned in a curve parallel to lower lip.

1. Smiles of the man after manipulation

2. Smiles of the woman after manipulation

Male and female volunteer was chosen according to the following selection criteria:

1. Resident of north india
2. High degree of facial attractiveness
3. Age between 20 and 28 years
4. Smile with characteristics close to esthetic norms

The photographs of the volunteers were taken in a frontal pose, smiling. The smile image of the volunteers was modified in different ways using Adobe photoshop CS5 software

The new manipulation simulated changes to the vertical relationship of the incisor borders, varying from 0 to 2.0 mm in 0.5mm steps exclusively by extrusion of the central incisors.

The real incisors of the volunteers was measured with a digital caliper. A virtual ruler was calibrated in proportion to the measurement in the software to standardize the 0.5mm increments.

Another manipualation, which consists of downward movement of upper lip. The manipulated side was mirrored to ensure perfect symmetry, resulting in 20 images, 10 for each sex. 40 evaluators were recruited in each of 4 groups(orthodontists, dentists, orthodontic patients and laypersons).

After a brief explanation of the study, and how to use the VAS, the evaluators were told to give grades to the following 10 pictures according to their attractiveness, taking 0 as unattractive and 10 as attractive. The grades can be marked at any point of the scale and the transition of pictures will be automatic.

The 10 pictures of each person was displayed at first all together for 20 seconds and then in random order, one by one, for 15 seconds each. The grading must be done when they are displayed one by one. Re-evaluation of the pictures was not allowed.

STATISTICAL ANALYSIS

Data was analyzed using IBM SPSS Statistics- version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) Descriptive statistics included calculation of means, standard deviation, median and percentages. Data distribution was assessed for Normality using Shapiro-Wilk test. Repeated measures analysis of variance (SPANOVA) with Post hoc Tukey test was done. All values were considered statistically significant for a value of $p<0.05$.

RESULTS

The sample consisted of 160 evaluators, out of which, 87 were females and 73 were males. The mean age for the orthodontists group was 35 years whereas the mean age of dentists, patients and laypersons were 29.37, 22.45 and 27.58 years respectively.

The means for each picture were grouped and divided by the evaluator group. The highest ranked pictures without gingival exposure were the 1.0 mm step in all the groups amongst both the genders. While the highest ranked picture in the orthodontist and dentist group with gingival exposure was the 1.5 mm step amongst both the genders. In the patients and laypersons group, the highest ranked picture with gingival exposure was at 0.5 mm step amongst the males. In the females, the highest ranked picture with gingival exposure was at 0 mm step amongst the patients group and in the laypersons group, the highest ranked picture with gingival exposure was at 0.5 mm step amongst the females. (Table 4)

The variations of factors like sex, gingival exposure, step, step + group, sex + step, sex + step + group, gingival exposure + step and sex + gingival exposure + step showed statistically significant differences ($p= 0.001$). (Table 1)

Statistically significant difference was found amongst the orthodontist group when compared with dentist, patients and laypersons (p= 0.001) in the post hoc tukey test. (Table 2)

When the incisal step at 0 mm was compared with 0.5 mm, statistically significant differences were found between them (p = 0.001). The incisal step at 0.5 mm was found to be statistically significant when compared with 1 mm and 1.5 mm (p= 0.001). In addition, when the incisal step at 1.5 mm was compared to 2.0 mm, it was found to be statistically significant (p = 0.01). (Table 3)

The graphic representations of the variations on the estimated marginal means, when crossing group vs step and group vs gingival exposure, whether statistically significant or not, can be seen in Fig 5 and 6.

The results of the SPANOVA are presented in Table 4.

Table 1: Shows the factors causing variation in aesthetic perception in SPANOVA

Source	**P**	**Partial ETA Squared**
Sex	0.001*	0.110
Sex + Group	0.056	0.020
Gingival Exposure	0.001*	0.051
Gingival Exposure + Group	0.44	0.011
Step	0.001*	0.188
Step + Group	0.001*	0.102
Sex + Gingival Exposure	0.007	0.022
Sex + Gingival Exposure + Group	0.582	0.004
Sex + Step	0.001*	0.272
Sex + Step + Group	0.001*	0.028
Gingival Exposure + Step	0.001*	0.266
Gingival Exposure + Step + Group	0.001*	0.039
Sex + Gingival Exposure + Step	0.001*	0.115
Sex + Gingival Exposure + Step + Group	0.462	0.007

*Statistically significant (p <0.05)

Table 2: Shows the comparison between evaluator groups overall means(Post Hoc Tukey test)

Group	**Mean Difference**	**SD**	**P**
Orthodontists			
Dentists	-0.318	0.299	0.001*
Patients	-0.513	0.301	0.00*
Laypersons	-0.168	0.299	0.001*
Dentists			
Patients	-0.238	0.299	0.91
Laypersons	1.50	0.297	0.95
Patients			
Laypersons	0.388	0.299	0.65

*Statistically significant p <0.05 (Bonferroni correction for multiple comparisons)

Table 3: Shows the differences in incisal step comparisons

Step	Mean Difference	SD	P
0.0			
0.5	5.13	1.277	0.001*
1.0	5.60	1.377	0.085
1.5	5.39	1.431	0.467
2.0	5.22	1.186	0.713
0.5			
1.0	5.59	1.370	0.000*
1.5	5.36	1.447	0.001*

2.0	5.25	1.218	0.779
1.0			
1.5	5.36	1.447	0.00*
2.0	5.25	1.218	0.00*

1.5			
2.0	5.36	1.447	0.01*

*Statistically significant p <0.05 (Bonferroni correction for multiple comparisons)

Table 4: Estimated Marginal Means From SPANOVA

		Orthodontist		Dentist		Patient		Laypersons
Factor	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex								
Male	41.76	0.24	41.02	0.21	44.71	0.25	41.60	0.25
Female	36.15	0.26	42.30	0.16	48.44	0.19	39.06	0.29
Gingival Exposure								
No Exposure	54.78	9.96	53.91	13.98	52.64	15.43	55.31	13.58
Exposed	57.34	9.73	56.05	14.39	52.58	16.52	56.13	13.50
Step (mm)								
0.0	17.2	4.374	20.7	5.23	20.39	6.324	20.07	5.805
0.5	19.3	3.5	21.79	5.264	21.24	6.348	23.49	5.369
1.0	26.48	3.624	22.86	6.163	21.34	6.639	24.12	5.722
1.5	26.17	4.139	22.63	6.633	21.7	6.11	22.47	5.145
2.0	22.97	4.055	21.98	5.114	20.55	6.541	21.29	5.047
Sex + Gingival Exposure								
MN	24.84	5.245	26.66	6.518	26.4	6.246	25.72	7.09
ME	31.45	4.907	28.13	7.406	31.56	8.497	29.87	6.397
FN	29.94	4.715	27.39	7.471	26.24	8.191	29.59	6.493
FE	25.89	4.825	27.92	6.992	26.13	8.028	26.21	7.108
Sex + Step								
M0.0	17.46	4.251	21.5	6.164	20.15	5.611	20.27	5.793
M0.5	20.09	3.254	21.4	4.852	22.06	6.309	23.64	5.583
M1.0	26.87	3.573	21.8	5.832	22.36	6.511	23.6	5.764
M1.5	26.5	4.208	22.5	6.057	21.24	5.813	21.72	4.992
M2.0	23.38	3.695	21.9	5.137	20.06	7.842	21.63	4.918
F0.0	16.8	4.6	20.44	4.86	20.56	6.729	19.83	5.85
F0.5	18.07	3.428	21.9	5.364	20.65	6.265	23.28	4.922
F1.0	25.86	3.658	23.19	6.212	20.56	6.641	24.77	5.625

F1.5	25.66	4.111	22.91	6.816	22.05	6.225	23.38	4.664
F2.0	22.33	4.525	21.99	5.065	20.93	6.595	20.88	4.671
Gingival Exposure + Step								
N0.0	8.38	2.532	9.84	2.474	9.94	2.792	9.17	2.915
N0.5	9.33	1.713	10.71	2.61	10.66	3.05	11.38	2.713
N1.0	13.33	1.735	11.34	3.029	10.56	3.334	12.22	2.688
N1.5	12.43	2.124	11.29	3.396	11.2	3.147	11.47	2.52
N2.0	11.31	1.856	10.73	2.48	10.28	3.114	11.07	2.745
E0.0	8.82	1.842	10.86	2.756	10.45	3.532	10.9	2.89
E0.5	9.97	1.787	11.08	2.654	10.58	3.298	12.11	2.656
E1.0	13.15	1.889	11.52	3.134	10.78	3.305	11.9	3.034
E1.5	13.74	2.015	11.34	3.237	10.5	2.963	11	2.623
E2.0	11.66	2.199	11.25	2.617	10.27	3.427	10.22	2.302
Sex + Gingival Exposure + Step								
MN0.0	4.28	1.413	4.60	1.194	4.79	1.281	4.45	1.413
MN0.5	4.56	0.754	5.32	1.234	5.20	1.305	5.48	1.519
MN1.0	5.64	0.903	5.63	1.337	5.58	1.678	5.52	1.485
MN1.5	5.28	1.191	5.46	1.567	5.60	1.614	5.10	1.374
MN2.0	5.08	0.984	5.51	1.186	5.23	1.368	5.17	1.299
ME0.0	4.79	1.031	5.54	1.502	5.10	1.630	5.42	1.338
ME0.5	5.59	0.910	5.88	1.327	5.53	1.867	6.43	1.130
ME1.0	7.38	0.877	5.93	1.738	5.40	1.661	6.40	1.588
ME1.5	7.41	1.117	5.51	1.535	5.35	1.594	6.15	1.331
ME2.0	6.28	0.972	5.27	1.304	5.07	1.745	5.57	1.010
FN0.0	4.10	1.119	5.24	1.280	5.15	1.511	4.72	1.502
FN0.5	4.77	0.959	5.39	1.376	5.46	1.745	5.90	1.194
FN1.0	7.69	0.832	5.71	1.692	4.98	1.656	6.70	1.203
FN1.5	7.15	0.933	5.83	1.829	5.60	1.533	6.37	1.148
FN2.0	6.23	0.872	5.22	1.294	5.05	1.746	5.90	1.446
FE0.0	4.03	0.811	5.32	1.254	5.35	1.902	5.48	1.552
FE0.5	4.38	0.877	5.20	1.327	5.05	1.431	5.68	1.526
FE1.0	5.77	1.012	5.59	1.396	5.38	1.644	5.60	1.446
FE1.5	6.33	0.898	5.83	1.702	5.15	1.369	4.85	1.292
FE2.0	5.38	1.227	5.98	1.313	5.20	1.682	4.65	1.292

M = Male; F = Female; N = No Exposure; E = Exposed; 00 = O mm; 05 = 0.5mm; 10 = 1.0mm; 15 = 1.5mm; 20 = 2.0mm

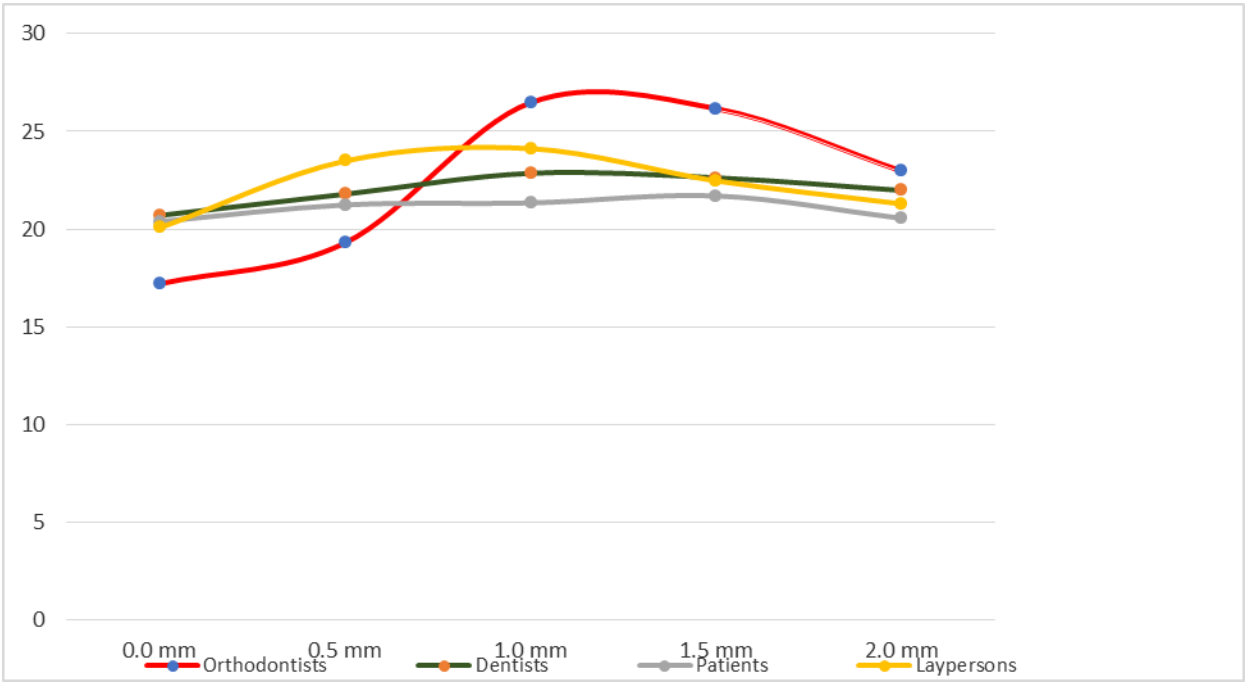

Fig 1: Shows the estimated marginal means of the steps according to each evaluator group

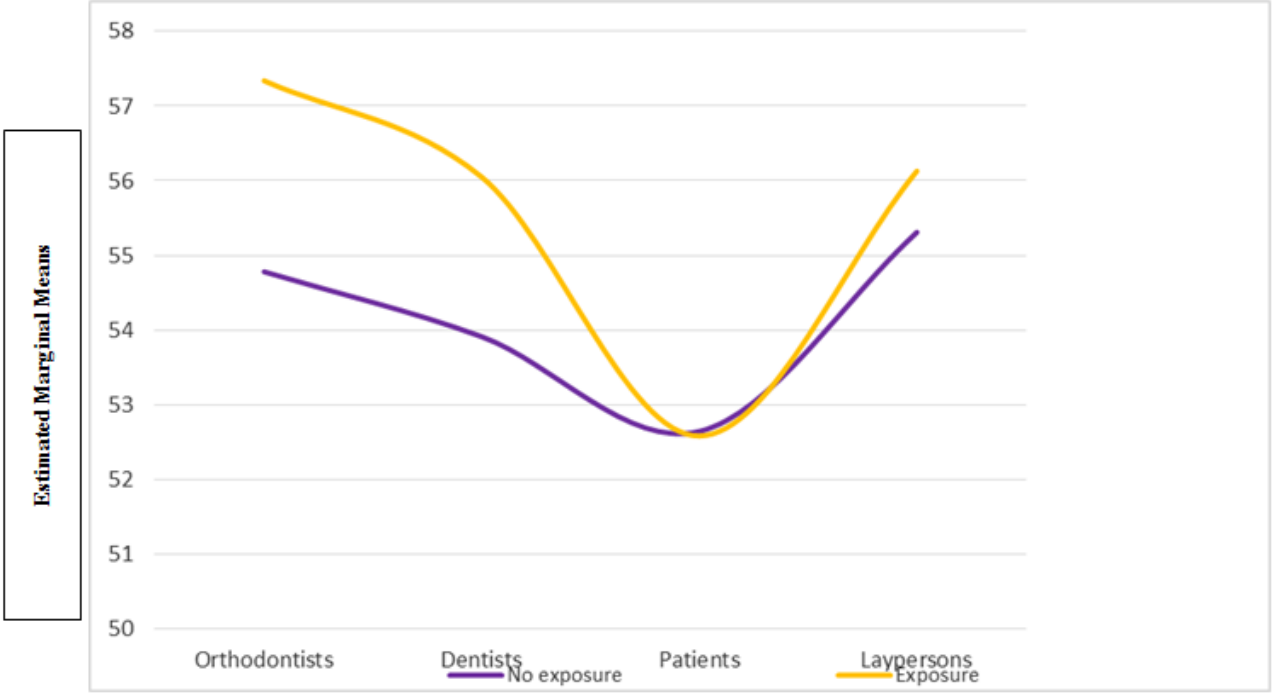

Fig 2: shows the estimated marginal means per evaluator group, according to the gingival exposure

DISCUSSION

Smile esthetics is important for the self esteem of the patient as it gives a better quality of life and social well being. The key role of the anterior teeth in smile esthetics should be important, encouraging professionals to be mindful of the finishing procedures in a treatment.[2]

In evaluating smile esthetics, the upper central incisors are the key teeth, so their vertical positioning is an aspect of chief importance.[3,4]

We conducted this study with photographs of smiles to increase the focus on local alterations which reduces the distraction of other facial characteristics.[5,6]

The photographs were taken with the mouth partially opened, resembling speech and spontaneous smiling.

The VAS is a reliable and commonly used scoring method in health research to generate parametric data from subjective notions.[7,8]

Our findings were obtained in a defined population, so their extrapolations to other situation should be done carefully, because of ethnic and sociocultural variations.[9]

In our study, both vertical height of central incisor and gingival display had statistically significant influence on the perception of smile attractiveness, independent of age, rater group and sex.[10, 11, 12,13]

The orthodontist group was the only one with statistically significant difference compared with the others (Table 2) and provided the highest scores among the groups. This is a critical finding as the perception of smile attractiveness among people with different levels of dental and orthodontic knowledge vary considerably.[9]

It was also shown that the means for dentists and patients were similar, because both groups focused , on the more general characteristics of the smile.

Crossing step information with gingival exposure, we notice that for the extreme values (0.0 and 2.0mm), gingival exposure causes variations. This alteration is unesthetic because it breaks the harmony of smile lines.[14,15,16]

Maxillary gingival exposure and the position of the maxillary front teeth have definitive effects on the esthetic perception of a smile.[17] The smiles with gingival exposure received better scores, especially of the female model. Other studies showed that smiles with gingival exposure were considered more attractive and young.[18]

The highest means for the smiles of the man and the woman without gingival exposure corresponded to the 1.0-mm step, but for the smiles with gingival exposure, the highest means corresponded to the 0.5-mm step for the man and the 1-mm step for the woman (Table 4). Our findings reinforce the hypothesis that flat smiles are more accepted for men, and convex smile arches better characterize attractive smiles for women.[19]

The orthodontists showed more homogeneity, preferring the 1.5-mm step in every variation of sex and gingival exposure tested.

For dentists, smiles of the woman with and without gingival exposure had a 1.5-mm step, whereas for the man, the higher means went to the 1-mm step with gingival exposure and the 1-mm step without gingival exposure.

Orthodontic patients selected the 1.5-mm step in every situation, without gingival exposure.

Laypersons preferred a smile for a man with 0.5-mm step with gingival exposure. The smile of the woman with a 1.0-mm step without gingival exposure was rated more.

In general, the smiles of the man got higher scores than that of the woman.

One limitation of this study is that it was carried out on participants of North Indian origin only. In addition, upper central incisor positioning is influenced by many variables, including age, sex, tooth anatomy, etc.[20]

CONCLUSION

1. The most accepted vertical relationship of incisor borders was the 1.0-mm step.
2. There was a statistically significant difference in the esthetic perception from orthodontists when compared with dentists, laypersons, and orthodontic patients.
3. The gingival display altered significantly the esthetic perception of the smiles evaluated.
4. There were statistically significant differences between the evaluation of the smiles of men and women.

REFERENCES

1. Machado RM, Duarte MEA, Motta AFJ, Mucha JN, Motta AT. Variations between maxillary central and lateral incisal edges and smile attractiveness. Am J Orthod Dentofacial Orthop. 2016; 150:425-35.
2. Duarte MEA, Machado RM, Motta AFJ, Mucha JN, Motta AT. Morphological simulation of different incisal embrasures: Perception of laypersons, orthodontic patients, general dentists and orthodontists. J Esthet Restor Dent. 2016; 00(00):1-11.
3. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. J Prosthet Dent. 1973; 29(4):358-82.
4. Anthony HL, Tjan, Miller GD, Josephine GP. Some esthetic factors in a smile. J Prosthet Dent. 1984; 51(1):24-28.
5. 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, and modified smile index. Am J Orthod Dentofacial Orthop. 2008; 133(4):515-23.
6. Duarte MEA, Machado RM, Motta AFJ, Mucha JN, Motta AT. Morphological simulation of different incisal embrasures: Perception of laypersons, orthodontic patients, general dentists and orthodontists. J Esthet Restor Dent. 2016; 00(00):1-11.
7. Burc, Kayaa, Uyarb R. Influence on smile attractiveness of the smile arc in conjunction with gingival display. Am J Orthod Dentofacial Orthop. 2013; 144(4):541-7.
8. Witt M, Flores-Mir C. Laypeople's preferences regarding frontal dentofacial esthetics: tooth-related factors. J Am Dent Assoc. 2011; 142:635-45.
9. Machado RM, Duarte MEA, Motta AFJ, Mucha JN, Motta AT. Variations between maxillary central and lateral incisal edges and smile attractiveness. Am J Orthod Dentofacial Orthop. 2016; 150:425-35.
10. Hunt O, Johnston C, Hepper P, Burden D, Stevenson M. The influence of maxillary gingival exposure on dental attractiveness ratings. Eur J Orthod. 2002; 24:199-204.
11. Geron S, Atalia W. Influence of sex on the perception of oral and smile esthetics with different gingival display and incisal plane iclination. Angle Orthod. 2005; 75:778-84.
12. Ioi H, Nakata S, Counts AL. I nfluence of gingival display on smile esthetics in Japanese. Eur J Orthod. 2010; 32(6):633-7.
13. Parekh MS, Fields HW, Beck M, Rosenstiel S. Attractiveness of variation in the smile arc and buccal corridor space as judged by orthodontists and laymen. Angle Orthod. 2006; 76(4):557-63.
14. Camara CA. Estetica em ortodontia: seis linhas horizontais do sorriso. Dental Press J Orthod. 2010; 15:118-31.
15. Machado AW, Moon W, Gandlin LG. Influence of maxillary incisor edge asymmetries on the perception of smile esthetics among orthodontists and laypersons. Am J Orthod Dentofacial Orthop. 2013; 143(4):658-64.

16. King KL, Evans CA, Viana G, BeGole E, Obrez A. Preferences for vertical position of the maxillary lateral incisors. World J Orthod. 2008; 9:147-54.
17. Akyalcin S, Frels LK, English JD, Laman S. Analysis of smile esthetics in American Board of Orthodontics patients. Angle Orthod. 2014; 84:486-91.
18. Machado AW. 10 commandments of smile esthetics. Dental Press J Orthod. 2014; 19:136-57.
19. Tjan. Esthetic factors involved in anterior tooth display and the smile: Vertical dimension. J Clin Orthod. 1998; 35(7):432-55.
20. Machado AW, Mccomb RW, Moon W, Gandini LG. Influence of the vertical position of maxillary central incisors on the perception of smile esthetics among orthodontists and laypersons. J Esthet Restor Dent. 2013; 25(6):392-401.