



ORIGINAL ARTICLE

Smile Attractiveness: Differences among the Perceptions of Dental Professionals and Laypersons

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Cite this article as: Öz AA, Akdeniz BS, Canlı E, Çelik S. Differences among the perceptions of dental professionals and laypersons. Turkish J Orthod 2017; 30: 50-5.

ABSTRACT

Objective: The aim of this study was to analyze the acceptable values of female and male smile attractiveness based on different amounts of gingival display and buccal corridor widths, as judged by dental professionals and laypersons.

Methods: The frontal smile photographs of a male and female model were modified to create seven different smile photographs of the same individual with different amounts of gingival display and buccal corridor widths. Overall, 249 evaluators in four groups (Group 1=orthodontists, Group 2=prosthodontists, Group 3=oral surgeons, and Group 4=laypersons) evaluated 28 images of different smiles with a visual analogue scale. Significant statistical differences were found among the evaluator's scores ($p<0.05$).

Results: For female smiles, the highest scores were obtained for 12% and 0% buccal corridor width. For male smiles, the highest scores were obtained for 4%, 0%, 12%, and 16% buccal corridor width for Groups 1, 2, 3, and 4 respectively. The highest scores were obtained for +2 mm and -3 mm of gingival display for female smiles.

Conclusion: The amount of gingival display, the buccal corridor width, and the knowledge in the field affects the perceptions of smile attractiveness. Thus, 3 mm of gingival display and buccal corridor width larger than 16% should be avoided for esthetic reasons during dental treatment.

Keywords: Dental esthetics, dentition, gingival display, dental specialties, buccal corridors, smile

INTRODUCTION

A person's smile is a strong determinant of facial attractiveness. Various factors affect smile attractiveness, such as the size and color of the teeth, the amount of gingival display (GD), the width of the buccal corridors (BCs), and the smile arch (curvature of the maxillary incisor edges) (1). The amount of GD, the width of BCs, and the smile arch can all be changed by dental treatment. Thus, clinicians should consider these factors when developing a treatment plan (2-4).

A broad smile may be more attractive than a narrow one (4). Ker et al. (5) asserted that the ideal BC width was 13% of the total width between the two commissures. Nevertheless, the perception of the attractiveness of a smile could change with time and the estimator's perspective. In a study where laypersons judged smile photographs, a broad smile with 2% BC width was rated as the most attractive (2).

Recently, excessively wide BCs have been referred to by some orthodontist as a "negative space," which should be eliminated by transverse expansion of the maxilla. It is well documented in the prosthodontic literature that one of the characteristics of an unrealistic "denture smile" is the lack of BCs (6). Although a recent systematic review found no general consensus about BC width, most previous studies concluded that increased BC widths were considered less attractive (7-10). On the other hand, some studies found no correlation between BC widths and smile esthetics (11,12).

Geron and Atalia (13) asserted that smiles were rated as less attractive when the amount of upper GD increased while smiling. They also found significant differences between the scores of male and female evaluators. According

This paper was presented as a scientific poster in 14th International Congress of Turkish Orthodontic Society, September 2014, Ankara, Turkey.

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Received: 11 March 2017

Accepted: 13 April 2017

Table 1. The mean smile attractiveness visual analog scale scores

			Orthodontist (Group 1)	Oral Surgeons (Group 2)	Prosthodontists (Group 3)	Laypersons (Group 3)
Buccal corridor	Female	0%	34.57±12.58	26.10±12.56	35.73±15.73	59.45±23.08
		4%	30.87±13.00	23.03±9.02	31.53±14.24	58.39±22.73
		8%	30.18±12.81	24.38±6.18	24.35±9.37	57.86±21.98
		12%	39.66±8.46	31.36±8.63	33.66±14.72	55.10±22.41
		16%	26.88±7.45	9.65±8.17	22.83±12.87	50.37±24.06
		20%	24.16±6.71	15.70±7.64	19.13±11.56	55.65±22.72
		24%	26.36±6.13	20.56±9.04	28.98±13.14	49.53±25.21
	Male	0%	35.83±8.11	53.13±13.00	39.36±17.22	38.36±20.57
		4%	40.85±8.61	51.51±12.36	35.90±17.33	41.44±21.85
		8%	36.68±8.24	49.30±10.23	37.26±15.11	39.04±22.08
		12%	37.40±7.83	44.02±10.73	44.90±16.11	40.92±21.86
		16%	38.78±9.52	32.15±11.71	40.91±16.62	44.11±21.85
		20%	32.83±8.38	36.09±10.03	33.24±14.63	40.05±23.43
		24%	25.46±5.31	16.66±9.53	31.44±13.66	40.18±22.35
Gingival display	Female	-3 mm	27.81±7.20	43.86±13.03	40.63±16.02	43.42±21.95
		-2 mm	21.80±7.15	18.16±7.96	23.75±10.63	36.18±20.84
		-1 mm	32.78±10.45	32.71±11.70	33.41±16.56	37.50±20.99
		0 mm	21.68±7.99	14.88±10.52	23.35±13.45	34.95±21.17
		+ 1 mm	30.68±7.06	27.86±6.12	35.21±13.46	38.49±23.09
		+ 2 mm	36.75±8.13	52.96±7.54	44.10±15.62	40.97±22.25
		+3 mm	11.35±6.18	8.86±6.74	10.25±10.51	28.50±20.28
	Male	-3 mm	21.35±7.79	35.53±13.89	24.75±10.94	25.36±19.65
		-2 mm	26.83±8.83	42.91±12.41	38.93±16.27	31.08±21.56
		-1 mm	29.91±6.48	38.60±13.44	46.31±14.38	31.01±21.04
		0 mm	37.60±9.08	29.86±13.18	33.65±16.14	29.69±21.31
		+ 1 mm	28.80±6.45	36.40±11.63	37.83±17.57	32.27±21.35
		+ 2 mm	25.01±6.63	24.78±11.87	31.40±14.61	29.98±20.01
		+3 mm	20.11±5.60	18.20±9.25	22.66±13.12	24.40±19.35

to a study by Ker et al. (5), the minimum amount of an aesthetic GD was 0.8 mm, the maximum amount was 4.5 mm, and the mean ideal amount was 2.3 mm.

Previous studies have used different types of evaluators to investigate smile attractiveness. Some involved only laypersons, whereas others included both orthodontists and laypersons (2,3,5,8,11,14-16). However, only a few previous studies investigated and compared the perceptions of dentists from different specialties (17,18).

Therefore, the aim of this study was to investigate the perceptions of dental professionals and laypersons regarding smile attractiveness and to compare the acceptable values of smile attractiveness with different amounts of GD and BC widths with those reported in previous studies.

METHODS

This study was approved by the regional ethics committee of Ondokuz Mayıs University (number: OMUKAEK 2014/937). Frontal intra-oral and smile photographs of a male and female model were taken. Written consent forms were also taken from the models.

The selection criteria for the models were having Angle's Class I occlusion with no crowding, diastemas, rotations, color changes, fillings, or crowns that might alter the perception of the evaluator. The models also had no apparent signs of scar tissue or color changes in their soft tissue, which could be seen in the photographs. The models' lips and surrounding soft tissues were visible in the photographs. The rest of the facial attributes were also excluded to eliminate the potential effects of these on the evaluators' scores. The smile photographs were taken when the models were in a relaxed position and had a full, natural smile, with a natural head position. Extra-oral and intra-oral photographs were taken from the same distance and with the same magnification ratio. The same camera and light configurations (EOS 600D, Canon macro ring lite MR-14EX flash, 100 mm f:2.8 macro lens; Canon, Tokyo, Japan) were used in every photograph. Informed consent forms were obtained from both the female and male candidates to digitally manipulate the smile photographs used in this study.

One smile photograph and one intra-oral photograph of each model were used for computer-aided superimposition. Adobe Photoshop CS6 Extended (Adobe Systems Incorporated; CA, USA) was used to digitally alter and superimpose the photographs. Intra-oral parts,

excluding the lip line, were removed in each smile photograph. The intra-oral photographs were placed behind this lip frame to replace the dental arch so that the part that contained the teeth could be placed wherever desired without losing its natural appearance. The GD photographs were created by moving the dental arch up and down from its original position. The same intra-oral photographs were divided into three segments to create different BC widths. Incisor teeth and canines were included in the central segment, and posterior teeth were included in two lateral segments. The lateral segments were distorted. The central segment was kept in place to change the BC width, without changing the sizes of the anterior teeth, which could alter the tooth shapes and perception (Figure 1).

Seven different amounts of GD were created in the images by moving the teeth within the lip frame: GD of -3 mm, -2 mm, -1 mm, 0 mm, +1 mm, +2 mm, and +3 mm (Figure 2). Seven different BC widths were produced in each of the seven images: 0%, 4%, 8%, 12%, 16%, 20%, and 24% (Figure 3).

Twenty-eight images of the different smiles were created and placed in a slide show in random order. Overall, 249 evaluators, including laypersons and professionals, were separated into the following groups:

orthodontists, Group 1 (n=60, mean age of 30.5±4.6 years); prosthodontists, Group 2 (n=60, mean age of 32.0±3.8 years); oral surgeons, Group 3 (n=60, mean age of 33.4±5.9 years); and laypersons, Group 4 (n=69, mean age of 22.8±3.7 years). A visual analogue scale (VAS) was used to measure the perception of smile attractiveness. The evaluators were instructed to put a vertical mark on the 10-cm scale for scoring attractiveness. Every image was visualized for 5 s during the slide show, and the evaluators were asked to score the photographs in a range from unattractive to very attractive. The same investigator measured the scores manually with a digital caliper.

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences SPSS for Windows, version 15.0 (SPSS Inc.; Chicago, IL, USA). The means and standard deviations of the groups were calculated. The alterations in the smile esthetics between the groups were evaluated using the analysis of variance. Tukey's post-hoc analysis was used for multiple comparisons. The level of significance was set at p<.05.

Ten randomly selected evaluators from each group were asked to score the smile images 1 week after the initial measurements. Intra-class cor-

Table 2. Statistical differences between the visual analog scale scores

			Group1-2	Group 1-3	Group 1-4	Group 2-3	Group 2-4	Group 3-4
Buccal corridor	Female	0%	.002	NS	<.001	.002	<.001	<.001
		4%	.001	NS	<.001	.001	<.001	<.001
		8%	.013	.031	<.001	NS	<.001	<.001
		12%	<.001	.044	<.001	NS	<.001	<.001
		16%	<.001	NS	<.001	<.001	<.001	<.001
		20%	<.001	.026	<.001	NS	<.001	<.001
		24%	<.001	NS	<.001	.001	<.001	<.001
	Male	0%	<.001	NS	NS	<.001	<.001	NS
		4%	<.001	NS	NS	<.001	.009	NS
		8%	<.001	NS	NS	<.001	.005	NS
		12%	.001	.010	NS	NS	NS	NS
		16%	.006	NS	NS	.007	.001	NS
		20%	NS	NS	NS	NS	NS	NS
		24%	<.001	.014	<.001	<.001	<.001	<.001
Gingival display	Female	-3 mm	<.001	<.001	<.001	NS	NS	NS
		-2 mm	NS	NS	<.001	.009	<.001	<.001
		-1 mm	NS	NS	NS	NS	NS	NS
		0 mm	.001	NS	<.001	.001	<.001	.002
		+ 1 mm	NS	NS	NS	.001	.003	NS
		+ 2 mm	<.001	.010	NS	.001	<.001	NS
		+3 mm	NS	NS	<.001	NS	<.001	<.001
	Male	-3 mm	<.001	NS	NS	<.001	.005	NS
		-2 mm	<.001	<.001	NS	NS	.001	NS
		-1 mm	<.001	<.001	NS	.018	NS	<.001
		0 mm	.002	NS	.036	NS	NS	NS
		+ 1 mm	<.001	.002	NS	NS	NS	NS
		+ 2 mm	NS	.017	NS	.044	NS	NS
		+3 mm	NS	NS	NS	NS	NS	NS

NS: not significant
p<0.05

relation coefficients were calculated to determine the reliability of the evaluators. The correlation coefficients ranged from 0.82 to 0.93.

RESULTS

Table 1 shows the means and standard deviations of the scores for each group. In the female smile photographs, the highest scores were obtained for a BC width of 12% (Groups 1 and 2) and a BC width of 0% (Groups 3 and 4). However, in the male smile pho-

tographs, the highest scores were obtained for a BC width of 4% (Group 1) and a BC width of 0% (Group 2). In contrast, Groups 3 and 4 showed the highest scores for a BC width of 12% and 16%, respectively, in the male smile photographs. In the female smile photographs of GD, the highest scores were obtained for GD of +2 mm (Groups 1, 2, and 3) and GD of -3 mm (Group 4). The highest scores for GD in the male photographs were different for all the groups in this study. The lowest scores were obtained for GD of +3 mm in all groups for both female and male photographs.

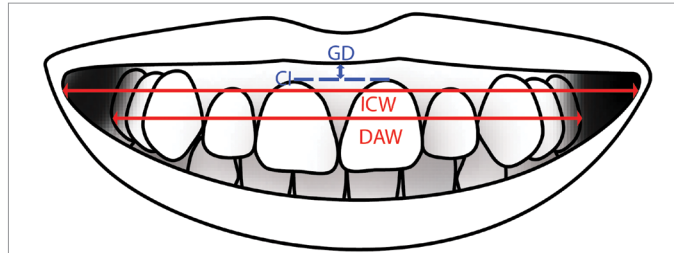


Figure 1. Schematic drawing of the measurements of BC and GD

$$BC \text{ width ratio} = \frac{(\text{Intercommissural width(ICW)} - \text{Dental Arch width(DAW)})}{ICW} \times 100$$

GD was measured from the line that connects the gingival border of the upper central incisors to the lower border of the upper lip

Table 2 shows the statistically significant differences between the evaluator groups in the perception of smile attractiveness. The perceptions differed significantly between the groups, except for GD of -1 mm for female smiles and GD of +3 mm and a BC of 20% for male smiles. The scores of the orthodontists and oral surgeons differed significantly in 22 of 28 smile photographs ($p > 0.05$). In 17 photographs, the scores of the orthodontists and prosthodontists did not differ significantly.

DISCUSSION

Many previous studies have evaluated the effect of BC and GD on smile attractiveness (8-10,14-17). Although these studies consisted of several groups, most included only two evaluator groups in the

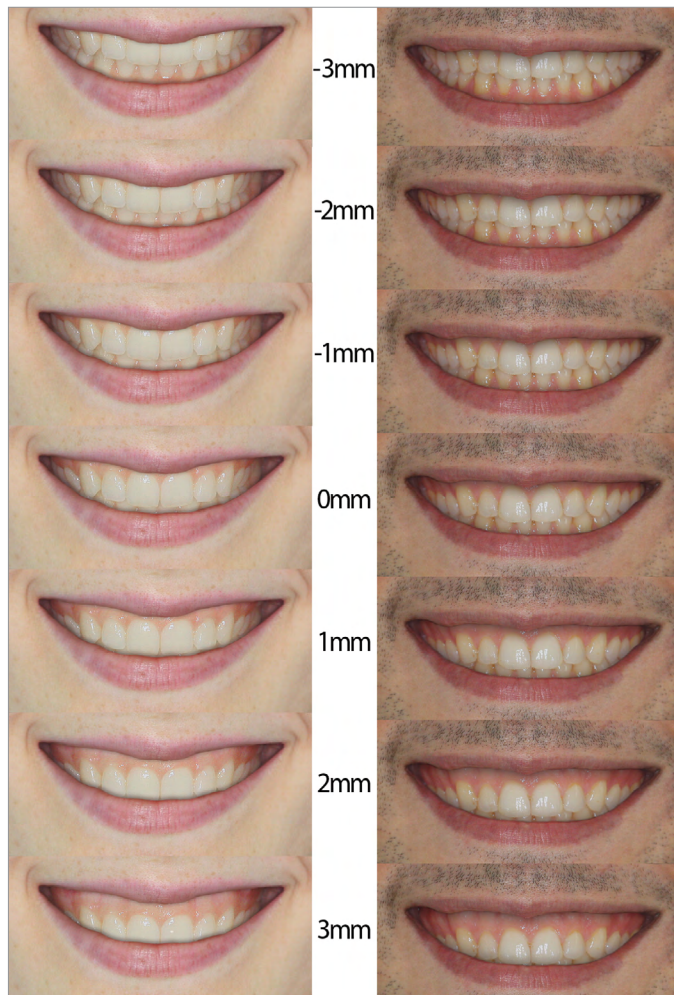


Figure 2. The amount of gingival display in an increasing order from -3 mm (top) to 3 mm (bottom) in photographs of the female (left) and male (right) models

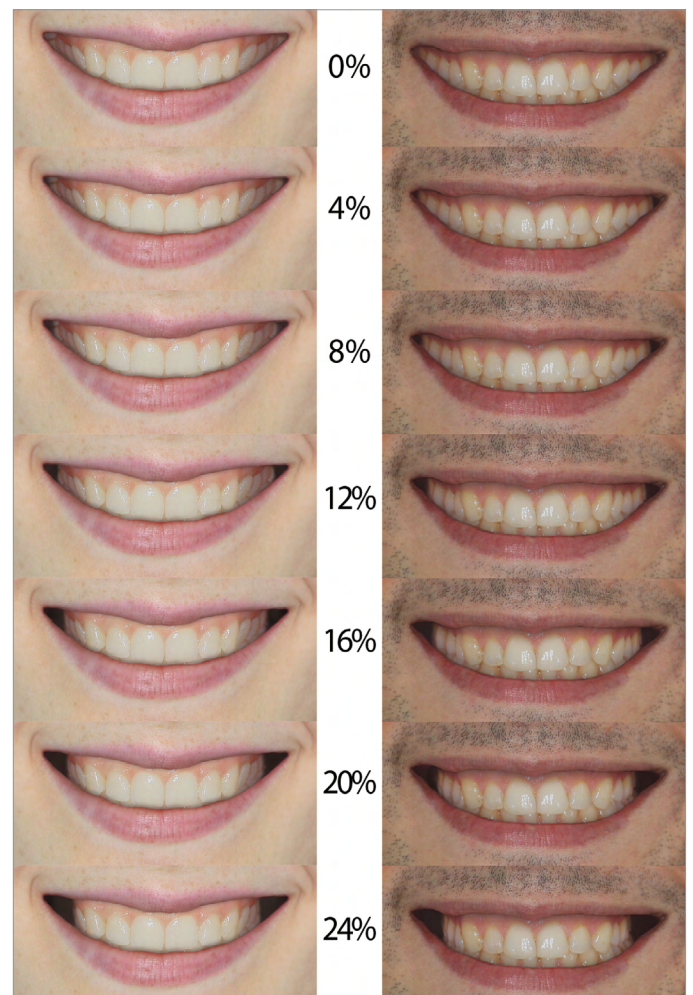


Figure 3. The buccal corridor width in an increasing order from 0% (top) to 24% (bottom) in photographs of the female (left) and male (right) models

final evaluation (8,15,16). There have been no studies on the differences between the esthetic smile perceptions of dental professionals from different specialties and those of laypersons. Therefore, the present study determined whether the type of dental specialty and the education of the specialist affected the perception of smile esthetics, focusing on the effect of the BC width and the amount of GD.

Visual analogue scale is a widely used and reliable assessment tool (3,19-21). In addition to providing a simple and rapid method for collecting data, it does not restrict evaluators to categories. The photographs were shown for a second time to 10 evaluators in each group to determine the reliability of the evaluators, as done in a previous study (3). Similar to other studies on the same subject, the photographs featured only the mouth and the surrounding tissue, with minimum facial exposure, to eliminate the effect of other parts of the face on the evaluation (17,20,22). Van der Geld et al. (1) and Abu Alhaja et al. (22) emphasized that the social acceptance of an individual was strongly influenced by the attractiveness of his or her smile, and it was asserted that the age and gender of individuals did not affect the perception of their attractiveness (3,8,10). In contrast, some studies reported that the gender of an individual in a photograph could affect the evaluator's perceptions of the esthetics of different amounts of GD and BC width (13). However, most of the previous studies evaluated only female smiles (2,10,12,15,18). Only one of the previous studies evaluated male smiles, and the effect of the gender of the model in the photograph on the perception of attractiveness was still not clear throughout the literature (9). Thus, the present study included photographs of both female and male smiles.

Photographic manipulation techniques may play an important role in the perception of smile attractiveness. In the current study, we did not change the shape of the teeth, particularly that of the incisors, or the number of teeth when manipulating the BC width. Previous studies manipulated photographs either by distorting the whole arch or by reducing the number of posterior teeth (22). Several studies asserted that the extraction of teeth did not have a negative effect on smile esthetics (23,24). However, the subjects in those studies had undergone orthodontic treatments. Until the effect of reducing the number of teeth on the esthetic perceptions of smiles is clarified, the number of teeth should not be reduced in photographs.

Effect of the Buccal Corridors Width

Both orthodontists and oral surgeons rated a BC width of 12% as the most esthetically pleasing, whereas prosthodontists and laypersons rated a BC width of 0% as the most esthetically appealing. Although the highest scores awarded by the orthodontists and prosthodontists differed, there were no statistical differences between the scores for BC widths of 0%, 4%, 12%, and 16% for the female smile photographs ($p>0.05$). In a similar study of female smile photographs, loi et al. (10) reported that orthodontists and laypersons rated a BC width of 10% and 5%, respectively, as the most esthetically pleasing.

Orthodontists, surgeons, prosthodontists, and laypersons rated BC widths of 4%, 0%, 12%, and 16%, respectively, as the most esthetically appealing in the male smile photographs. The difference between different specialists and laypersons indicate the dental professional's specialty, and a similar educational background

may have a role in esthetic perceptions. The differences in perceptions were more apparent in the male BC photographs.

In the present study, the evaluators considered wide BCs less attractive in both the female and male photographs. Other studies reported similar findings, reporting that all evaluator groups preferred minimal BCs (8,16,22). However, in two similar studies, Roden-Johnson et al. (12) and Ritter et al. (25) asserted that the amount of BC width was not a significant factor in smile attractiveness. However, there were important differences in the methods of these studies compared to those of the current study. Both studies used photographs of multiple ($n=30$) smiles, but the actual BC width that Johnson et al. used in their study is unclear. Ritter et al. (25) investigated the effect of different BC widths, but their samples were digitally unaltered smile photographs. Moreover, the number of evaluators (two orthodontists and two laypersons) was low compared to that in the current study.

Effect of Gingival Display

The laypersons scored -3 mm of GD as the most esthetically pleasing in the female photographs, whereas all the other groups scored +2 mm of GD as the most esthetically pleasing. This finding is similar to that of an earlier study, which reported that +2 mm of GD was the most appealing in women (26). All the groups ranked GD of +3 mm in the female smile photographs as the least esthetically pleasing.

The orthodontists, oral surgeons, prosthodontists, and laypersons scored GD of 0 mm, -2 mm, -1 mm, and +1 mm, respectively, as the most esthetically pleasing in the male GD photographs. Similar to the female photographs, all the groups ranked GD of +3 mm in the male photographs as the least esthetically pleasing. The dental professionals rated +2 mm of GD as the most esthetically pleasing for women, whereas minimum to no GD was preferred for males. Previous studies reported that women naturally show more of the gingiva than men during a full smile (26,27). Our findings show that what is considered natural is also considered more esthetically pleasing.

Our finding of statistical differences between the perceptions of the evaluator groups ($p<0.05$) demonstrate that the area of specialty could be a factor in the perception of smile esthetics, even among dental professionals. Although the scores of the surgeons and orthodontists were statistically different for most of the photographs, there was no statistical difference between the scores of the prosthodontists and orthodontists in 17 of the 28 photographs. This result could be attributed to the similar education of the orthodontists and prosthodontists in the field of smile esthetics. In contrast, Isiksal et al. found no significant difference in the smile perceptions of orthodontists, plastic surgeons, artists, general dentists, dental professionals, and parents (17). However, Alhaja et al. (22) evaluated the perceptions of orthodontists, general practitioners, and Jordanian laypersons regarding altered smiles and found that the profession of the evaluators affected the attractiveness scores.

Although the highest esthetic score for GD was different in each group, all the groups ranked +3 mm of GD as the least esthetically appealing in both the male and female photographs. This finding suggests that even if the knowledge in the field alters the perception of the most esthetically pleasing smile, the perception of the least esthetically appealing smile is independent of the degree of knowledge. This finding is similar to that of several other studies,

which reported that smile attractiveness decreased with an increased amount of GD (13,28).

The most important limitation of this study was the inconsistent results for male photographs. There were more discrepancies in the scores of different male photographs in our findings. One reason of the discrepancy could be the complex evaluation of male attractiveness. Several previous studies about male attractiveness concluded that unlike women's attractiveness, it was difficult to evaluate male's attractiveness with a single variable and that it was driven by some social and emotional factors as well as physical factors (29). Thus, the factors, which effect the male smile attractiveness, should be studied in more detail in future studies.

CONCLUSION

Dentists' perceptions of smiles are affected by their specialties. The perceptions of orthodontists and prosthodontists regarding different amounts of GD and BC widths were similar overall. This could be attributed to their knowledge of the subject.

The amount of GD that was considered attractive in the male and female smile photographs differed. However, an increased amount of GD decreased the smile attractiveness in both genders. All the groups rated large BCs as less attractive. Thus, 3 mm or more of GD and BC width larger than 16% of the inter-commissural width should be avoided for esthetic reasons during dental treatment.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ondokuz Mayıs University (number: OMUKAEK 2014/937).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - B.S.A., A.A.O.; Design - A.A.O., B.S.A.; Supervision - A.A.O.; Resources - E.C., S.C.; Materials - E.C., S.C.; Data Collection and/or Processing - B.S.A., E.C., S.C.; Analysis and/or Interpretation - B.S.A.; Literature Search - B.S.A., E.C.; Writing Manuscript - A.A.O., B.S.A.; Critical Review - B.S.A., E.C.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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