

The Influence of the Vertical Position of the Canine on Smile Esthetic Perceptions by Orthodontists, Restorative Dentists, and Laypersons

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Abstract

Esthetic perception is a subjective experience. The canine position is a major player in smile esthetics. This study aimed to evaluate the impact of modifying the vertical position and the amount of gingival display of the maxillary canines on the smile esthetic perceptions of orthodontists, restorative dentists, and laypersons.

A cross-sectional study was used to compare the smile esthetic perception of orthodontists, restorative dentists, and laypersons in Riyadh, Saudi Arabia. An electronic questionnaire that included 10 photographs with digital alteration of the vertical position of the canines and gingival display was used. The images were evaluated by the participants, for the level of attractiveness of each smile on a visual analog scale. The overall VAS score, accounting for the type of the smile (with and without gingival display) and the level of canine misalignment (0, -1mm, -.5mm, +1mm, +.5mm) was compared between the groups.

Descriptive statistics, one-way analysis of variance, and multiple linear regression were used for the statistical analysis ($P \leq 0.05$).

The highest scores for the smiles with the gingival display were given to the smile with a 0.5-mm intrusion (75.28 ± 20.65) by the orthodontists and to the smile with a 1-mm intrusion (79.22 ± 20.17 , 79.18 ± 18.60 respectively) by both the restorative dentists and laypersons. For the smiles without gingival display, the restorative dentists and orthodontists gave the highest scores to the smile with 1 mm intrusion (80.09 ± 16.25 and 67.13 ± 21.25), and the laypersons gave the highest score to the smile with a 0.5-mm intrusion (72.42 ± 18.06). The lowest scores for all three groups were given to the smiles with a 1-mm extrusion. Orthodontists were more critical in their assessments.

The results indicated no significant difference in the perception of the professionals and laypersons regarding smile esthetics concerning the vertical position and the amount of the gingival display of the maxillary canines.

Within the limitations of this study, the background knowledge of an individual did not affect the smile esthetic perception. Saudi Arabian laypeople and dental health professionals had similar perceptions of smile esthetics. Clinicians can rely on the judgment of laypersons in esthetic dental treatment.

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Introduction

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The smile is the most important aspect of facial animation²⁸, defined as a highly pleasant facial expression, and typically portrayed with the corners of the mouth turned up and the front teeth exposed²². Several components play a role

in the creation of an esthetically pleasing smile, including a proper smile arc, the status of the buccal corridors³³, the golden ratio, the proportionality and symmetry of the smile component³¹, minimal gingival display²⁵, anterior teeth with adequate gingival margins²⁻²⁰, which should be carefully considered by dentists during diagnosis and treatment planning³².

Designing an aesthetic smile that suits the personality of an individual requires appropriate case selection and careful treatment planning which encompasses comprehensive dental examinations, smile analysis as well as a good understanding of the patient's expectations that are critical in achieving a successful outcome²². The eye of the artist, therefore, becomes very helpful to attain a successful final aesthetic outcome.

In the past, the parameters reported in literature which were used to determine the level of attractiveness of a given smile were based solely on the author's expert opinion. The perception of beauty, today, is even more subjective and is significantly influenced by several factors such as evidence-based literature, cultural differences, and civilization¹. In addition, esthetic criteria and perception of beauty vary from one person to another and are influenced by the social characteristics as well as the professions of the individuals¹¹⁻¹².

It appears that laypersons are also capable of recognizing the characteristics of an ideal smile⁸⁻¹⁹. A dentist should make an effort to explore and understand the esthetic view of a layperson regarding the elements of smile esthetics to prevent unnecessary treatment of small changes that often go unrecognized by the patient. Making the effort is important as such treatment often requires a multidisciplinary team from different specialists, time commitment and money. This mutual understanding would facilitate improving the communication and support the determination of a common treatment objective²⁷.

Regarding the canine position, a cornerstone in the mouth and a major player in smile esthetics, several studies indicated that the gingival margins of the maxillary canines should be located on the same vertical level as the central incisor and slightly above the margins of the lateral incisors⁷⁻¹⁰⁻¹⁴. Literature suggests that the lateral incisors' gingival margins should be positioned slightly lower compared to the

adjacent teeth¹⁷⁻²⁴. Literature reports limited evidence regarding the influence of the changes in the vertical position of the maxillary canine on the perceptions of smile esthetics of laypersons and professionals¹⁰⁻¹⁴. The study aimed to evaluate the impact of modifying the vertical position and the amount of gingival display of the maxillary canines on the smile esthetic perceptions of orthodontists, restorative dentists, and laypersons.

Materials and methods

A cross-sectional design was used to compare the smile esthetic perception of orthodontists, restorative dentists, and laypersons in Riyadh, Saudi Arabia. Convenient sampling was used to select a sample of 87 participants. To detect an effect of $\eta^2_p = .10$ with 80% power in a one-way between-subjects ANOVA (three groups, alpha = .05), G*Power suggested 29 participants in each group (N = 87). The participants were asked to evaluate 10 different variations of the same smile photograph in a PowerPoint presentation using an electronic survey consisting of 10 visual analog scales, one for each slide.

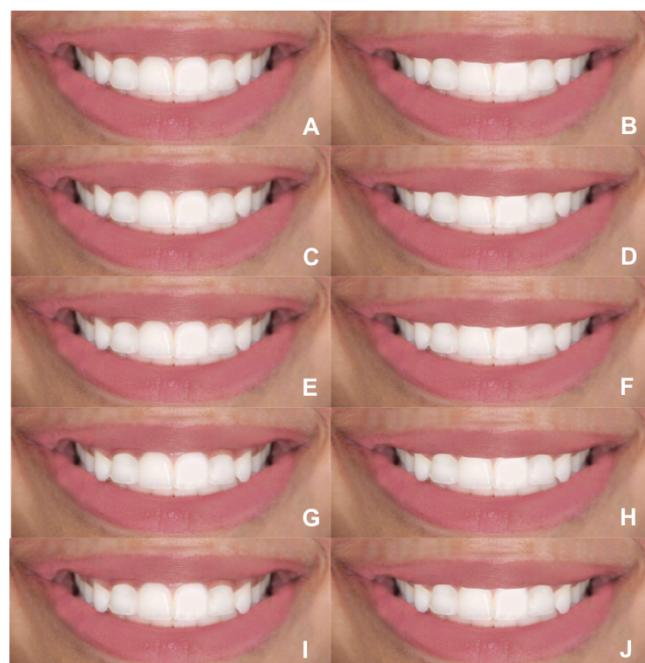


Figure 1. Smiles after manipulation of canine vertical positions. Left column(full smile):smile shows excessive amount of gingival tissue between the upper lip and apical margin of upper teeth. Right column(without gingival display):smile with upper lip contacting the most apical margin of upper teeth. A

and B, 1.0 mm of intrusion; C and D, 0.5 mm of intrusion; E and F, standard smile; G and H, 0.5 mm of extrusion; I and J, 1.0 mm of extrusion. (E is used with permission).

The photograph used in this research was taken from an article after obtaining the author's permission⁴. The photograph was digitally manipulated with adobe photoshop CC 2019 to eliminate stains and adjust color changes. In the final image, one side was mirrored to ensure smile symmetry and was labeled as the standard smile, where the gingival margins of the maxillary central incisors and canines were at the same level, and the gingival margins of the maxillary lateral incisors were 0.5 mm below the central incisors and canines. The canine tips were positioned 0.5 mm above a straight line touching the incisal edges of the maxillary central and lateral incisors, the smile is considered as harmonious about the smile curve. This standard smile was similar to that used by Machado and Paiva et al.¹⁰⁻¹⁸.

The photograph of the standard smile (Fig E and F) was digitally manipulated by symmetrically altering the canines' vertical position, making them more intruded or extruded in increments of 0.5 mm relative to the line tangent to the central incisors' edges. Variations were made by movements of one canine in the cervico-occlusal direction relative to this line, without modifying the length or the proportion between height and width. In addition, this photograph was mirrored to guarantee symmetrical changes would be accomplished.

For the vertical position graduation, the maxillary central incisors were measured with a digital caliper and the dimensions were used as a reference for the calibration of a ruler in the image editing software. There are four images in addition to the standard smile: 0.5 mm of extrusion (Fig G and H), 1 mm of extrusion (Fig I and J), 0.5 mm of intrusion (Fig C and D), and 1 mm of intrusion (Fig A and B).

After the first slide, the photographs were displayed in separate slides in a random distribution, each slide was displayed for 15 seconds before automatically transitioning to the next. The participants were not allowed to re-evaluate previous slides and the gender of the model was not disclosed.

A visual analog scale was used to evaluate the attractiveness of each smile. For every slide, the scale was ranked from 0 to 100 on a continuous

scroll bar, with 0 considered being the least attractive and 100 the most attractive. They were instructed to score these slides by making a perpendicular line on the scale at any point, considering 0 as unattractive and 100 as very attractive. They were not aware of the question of the research. A digital caliper was used to measure the scores.

All statistical analysis was performed with NCSS software (version 2020). All significant results were based on two-sided test statistics and a type I error of 5%. The primary objective of the current study was to compare the VAS of the study groups as a proxy for the individual perception of the smile quality. The overall VAS score, accounting for the type of the smile (with and without gingival display) and the level of canine misalignment (0, -1mm, -.5mm, +1mm, +.5mm) was compared between the groups using ANOVA.

Results

The sample of assessors consisted of 32 orthodontists (18 women, 14 men), 32 restorative dentists (19 men, 13 women) and 33 laypersons (18 women, 15 men). The descriptive statistics are displayed in Table 1.

The analysis of the smiles with gingival display indicated that the highest scores by the orthodontists were given to the smile with a 0.5-mm intrusion (75.28 ± 20.65) and the highest scores for both the restorative dentists and laypersons were given to the smile with a 1-mm intrusion (79.22 ± 20.17 , 79.18 ± 18.60 respectively). The lowest scores for all three groups (orthodontists, restorative dentists, and laypersons) were given to the smiles with a 1-mm extrusion (means, 62.44 ± 21.40 , 65.53 ± 24.55 , and 69.58 ± 20.66 respectively). The orthodontists gave the lowest scores for all categories compared to the restorative dentists and laypersons (Table 2).

For the smiles without a gingival display, the restorative dentists and orthodontists gave the highest scores to the smile with 1 mm intrusion (80.09 ± 16.25 and 67.13 ± 21.25), and the laypersons gave the highest score to the smile with a 0.5-mm intrusion (72.42 ± 18.06) (Table 2). The lowest scores for all three groups were given to the smiles with a 1-mm extrusion (61.47 ± 19.51 , 61.28 ± 20.89 , and 57.76 ± 24.15 respectively) (Table 2).

Demographics	n(%)
Gender	
Male	48(49)
Female	49(51)
Age	
25-34	50(52)
35-44	19(20)
45-54	22(23)
>55	06(06)
Years of experience (Orthodontists and Restorative dentists)	
1-5	25(39)
6-9	12(19)
10 and above	27(42)
Post-graduate education (Orthodontists and Restorative dentists)	
Saudi Arabia	(60)
Other European countries	(40)

Table 1. Demographic distribution of the patients.

		Orthodontists N=32	Restorative Dentists N=32	Laypersons N=33	F	Sig.
		Mean±SD	Mean±SD	Mean±SD	p-value	
Full smile	1 mm intrusion	73.09±20.38	79.22±20.17	79.18±18.60	F(2, 94) = 1.028	0.361
	0.5 mm intrusion	75.28±20.65	77.94±17.35	78.48±16.56	F(2, 94) = 0.265	0.768
	standard smile	68.09±20.05	72.25±24.54	77.42±19.32	F(2, 94) = 1.551	0.217
	1 mm extrusion	62.44±21.40	65.53±24.55	69.58±20.66	F(2, 94) = 1.028	0.361
	0.5 mm extrusion	69.03±20.13	71.09±22.26	74.00±21.04	F(2, 94) = 0.453	0.637
Smile without gingival display	1 mm intrusion	67.13±21.25	80.09±16.25	69.67±16.68	F(2, 94) = 0.250	0.779
	0.5 mm intrusion	67.13±21.62	65.78±19.32	72.42±18.06	F(2, 94) = 1.037	0.359
	standard smile	65.19±19.97	64.88±18.24	66.21±18.43	F(2, 94) = 0.045	0.956
	1 mm extrusion	61.47±19.51	61.28±20.89	57.76±24.15	F(2, 94) = 0.305	0.738
	0.5 mm extrusion	62.16±19.38	63.72±19.49	59.52±21.11	F(2, 94) = 0.367	0.694

Table 2. Detailed analysis of the comparisons.

Regarding the difference between the specialist groups and laypersons in the perception of the different types of smile following the modification in the vertical position of the maxillary canines and the amount of gingival display of the maxillary canines, a one-way between-subjects ANOVA was conducted to compare the effect of background knowledge on smile esthetic perceptions scores for the orthodontists, restorative dentists, and laypersons. When the scores were compared between the three groups, statistically no significant difference were observed for all the photographs. There was no significant effect of the background knowledge on the smile esthetics perception at the $p<.05$ level for the three different groups. Also, the scores given by the orthodontists were lower than the other two groups (Table 2).

Discussion

The findings suggest that the background knowledge of an individual did not affect the smile esthetic perception. The current study aimed to assess to what extent dental professionals can rely on the esthetic judgment of laypersons as they request the esthetic treatment provided by dental professionals. The results indicated no significant difference in the perception of the professionals and laypersons regarding smile esthetics with regard to the vertical position and the amount of the gingival display of the maxillary canines.

Esthetic perception is a subjective experience and may change based on the common beliefs and standards of a community. Based on the results of the current study, no significant difference was observed between the perspectives of the laypeople of Saudi Arabia and dental professionals for any of the images, supporting current literature⁶⁻¹⁶⁻²³⁻³⁰. Barros et al,⁶ evaluated the tooth and gingival display when smiling and assessed the difference in the opinions of the professionals and laypersons concerning smile esthetics. Kokich et al,¹⁶ evaluated altered dental esthetics (symmetry and asymmetry). Saffarpour et al³⁰ evaluated and compared the perception of laypersons and dental professionals in the overall smile esthetics, gingival display, and alignment of teeth. None of the studies reported a significant difference in this regard, which confirms our findings. However, a few studies reported that orthodontists, general practitioners, and laypersons have different opinions when it comes to their perception of smile attractiveness¹⁴⁻²⁹. The general public was less sensitive to minimal deviations from the ideal parameters¹⁸.

In our study, we opted for close-up photographs of the smile instead of a full-face photograph as previous studies have shown no differences in the scores for a full-face and close-up photographs of smiles⁹⁻²¹⁻³⁴. Other studies suggested that the perception of smile details may be considered more relevant when close-up images are used rather than full-face images,⁵⁻¹². Our study indicated that extrusion alterations received the lowest scores, considering it to be extremely unpleasant. For both groups, the smiles with intrusion received the highest scores, followed by the standard smiles, similar to the findings of Correa et al⁹ who stated that changes

up to 0.5 mm and 1.0 mm in the gingival margins of canines are not harmful to the aesthetics of smiles assessed by orthodontists and laypersons. We observed a trend toward greater rejection of extruded canines compared with intruded canines, similar to current literature⁹⁻¹⁰. Our study showed that, in general, extrusion variations were considered more unaesthetic, as the smile with 1-mm extrusion received the lowest scores for all groups in smile types, corroborating the findings of de Paiva et al¹⁰. However, it was contradictory to Pinho et al,²⁶ who reported that extrusion up to 2 mm in the cusps of the canines was not perceptible to orthodontists and laypersons.

Another interesting finding from our study was that smiles with intruded canines received the highest scores for all groups in all smile types, which was in contrast to the findings of de Paiva et al¹⁰, and Corea et al⁹. Their study indicated that standard smiles were given the highest scores of all smile types and all groups, followed by a smile with 0.5 mm intrusion and 1 mm intrusion was viewed negatively. In the current study, specifically the orthodontists favored the smile with 0.5 mm and the restorative dentists and laypersons favored the 1 mm intrusion over the standard smile images in all smile types.

According to literature, a slight gingival display makes the smile more attractive¹³, which is consistent with our study's findings with full smile images receiving higher scores in all groups. Overall, the scores of the images with a full smile were significantly different ($p=0.013$) from their equivalents with a lower lip position, proposing an influence of gingival display in the esthetic assessment. These results varied from previous studies. Machado et al expected lower scores for a full smile since they acknowledge visualizing both the gingival margins and the incisal edges at the same time could potentially be unpleasant to the assessors. Although our study did not show a statistically significant difference between the types of the smile in the three groups, laypersons gave higher scores to full smile images than dental professionals and this finding conforms with Pinzan-Vercelino et al's²⁷ findings that dental professionals were more sensitive to alterations in gingival display than laypeople.

The laypersons gave the highest score to most of the variation images, followed by the restorative dentists, and the orthodontists gave the lowest scores, which correspond to multiple studies indicating that orthodontists had a more critical view of smile aesthetics and specifically the canine position¹⁰⁻¹⁴.

Literature showed that Saudi laypersons had more positive perceptions to smile aesthetics than Saudi dental professionals, especially when rating gingival display in smile aesthetics³⁵. However, this was not on par with our findings. It should be noted that there was no previous literature discussing the influence of the canine vertical position in smile esthetics perception in a Saudi sample.

The limitations of the current study include the large effect size. The data must be interpreted carefully considering the fact that the study was not large enough. The lack of statistical significance does not mean there is no effect. There is some evidence of an effect, but the result were not statistically significant. Another major limitation due to the small sample size is a possible overestimation of the magnitude of an association. Assessors in comparative studies tend to give central scores when they do not know what the next photograph will be¹⁰⁻¹⁵. A preview slide containing all images was not provided to the evaluators to minimize this bias. In addition, the reliability of our study method was not tested. Although every effort was made to standardize the smile, there may have some deficiencies in some elements such as lateral incisors crown size and gingival margins, the width of the buccal corridors in full smiles, and factors such as the shape of the lips and more.

In summary, smile design is a multifactorial decision-making process that allows treating patients using a personalized approach, taking into account that aesthetic perception is variable between individuals and that a professional opinion concerning facial esthetics may not coincide with the perceptions and expectations of patients or laypersons. Understanding the differences in the perception of smile attractiveness in orthodontists, restorative dentists and laypersons will be beneficial in the diagnosis, setting treatment objectives, and treatment planning³. Diagnosis and treatment planning is improved when multidisciplinary practice is implemented, underpinning the reason why our study focused on comparing different dental specialists perceptions. The laypeople had the same esthetic perception as the professionals and correctly detected the reason behind an unaesthetic smile to some extent. It appears that in esthetic dental treatment, laypeople's judgment can be reliable.

Conclusions

Within the limitations of this study, Saudi Arabian laypeople and dental health professionals

had similar perceptions of smile esthetics. The laypeople reliably identified the components of a beautiful smile. Clinicians can rely on the judgment of laypersons in esthetic dental treatment.

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Declaration of Interest

The authors report no conflict of interest.

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