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## Perception to Altered Smile Features of Saudi Dental Students at Different Academic Levels

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### Research Article

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#### ABSTRACT

**Purpose/Objectives:** The aim of this study was to evaluate the perception of dental students towards altered smile esthetic parameters and the effect of abnormal deviations of these parameters.

**Materials and Methods:** A sample of 300 dental students was divided by gender into 150 males and 150 females. The sample was further subdivided based on the academic level from 1st year to 5th year. Twenty-four photographs with altered smile features were used. Altered features included gingival show upon smiling (GS), central incisor crown length (CL), midline shift (MS), and midline diastema (D). The photos were randomly presented to the participants. A form containing the visual analogue scale (VAS) was distributed to the students and used to rate the smile esthetics.

**Results:** Perceptions of dental students in different academic levels to GS alterations showed that Level 5 denoted a more unattractive rating than level 2 students ( $p$ -value $<0.05$ ). There was no significant difference between levels when the CL discrepancy was 1.5-2 mm. In the remaining discrepancies level 4 students was the most critical group. There was a significant difference between levels when the MS was 5 mm ( $p$ -value $<0.05$ ). There was no significant difference among the levels when the D discrepancy was  $>0$  mm.

**Conclusions:** Students at level four and five have been exposed to undergraduate orthodontic courses in their academic curriculum, which shifts their perception towards being more critical in their evaluation of altered smile features and approximating the general dentists and orthodontists groups.

### INTRODUCTION

Having pleasant dental esthetics is a concern of dental patients and a treatment goal for dentists and orthodontists. The face plays a fundamental role in determining the aesthetic perception of a person during interpersonal communication. Vital contributors to facial beauty are the eyes and mouth [1-3]. Understanding smile attractiveness is vital because aesthetics is the parameter that laypeople use to judge the success of a treatment. [4,5]. Smile analysis is a key in diagnosis and treatment planning [6]. The perception of a smile is different from one person to another and is affected by many factors, such as personal experience and the social

environment<sup>[7]</sup>. One should understand that the standards of beauty are constantly changing with time, culture, and education<sup>[4,5]</sup>.

A smile is influenced by many factors and parameters, such as tooth color and shape, dental midline shift, midline diastema, gingival display upon smiling, and crown length. These factors play an essential role in the dynamics of a smile, resulting in the perception and judgment of whether the smile is considered attractive or not attractive. An ideal smile might be considered a myth, but the objective of achieving an attractive smile is through a harmonious balance<sup>[7,8]</sup>. Facial and dental midline coordination are vital in the establishment of facial harmony and balance<sup>[9]</sup>. However, precise alignment of the facial and dental midline is difficult to achieve, and a midline discrepancy of less than 2 mm is considered acceptable<sup>[10,11]</sup>.

An area of concern for most specialists is gingival display upon smiling, or in other words, a “gummy smile.” Orthodontists and surgeons tend to see gummy smiles as unattractive. A smile that demonstrates minimal gingival display is considered to be more attractive than a smile with excessive gingival display<sup>[12]</sup>. Kokich et al. concluded that gingival display is only considered unattractive by lay people if it exceeds 4 mm of display<sup>[13]</sup>.

Concerning the appearance of the central incisors, less than 75% display of the upper incisors is considered unacceptable<sup>[13]</sup>. Regarding midline diastema, cultural background is highly influential in the perception of smile esthetics. For example, the Indian population considers a midline diastema of up to 2 mm as acceptable<sup>[5]</sup>. Asymmetric alterations make the dentition esthetics undesirable to both clinicians and lay people<sup>[14]</sup>. It has also been proven that dental clinicians are more critical concerning smile alterations than lay people<sup>[15]</sup>.

Dental students develop knowledge via the systematic learning process. They are expected to evaluate the patient’s smile and to meet their expectations at a certain level<sup>[4]</sup>. The literature has shown minimal data demonstrating the perception of smile aesthetics among dental students. Portuguese laypersons, dental students and dental professionals had non-significant different perceptions of attractiveness when evaluating modified smile features, except for diastemas<sup>[16]</sup>. Furthermore, it would be beneficial to understand the effect of dental students learning process on their perception of smile aesthetics.

The aim of this study was to evaluate the perception of dental students towards altered smile esthetic parameters and the effect of abnormal deviations of these parameters.

## MATERIALS AND METHODS

### Sample

A sample of 300 dental students at the College of Dentistry, King Saud University in Riyadh, Saudi Arabia was divided by gender into 150 males and 150 females with an age range of 19-25 years. The sample was further subdivided based on the academic level from 1st year to 5th year (30 students per level). Ethical approval was obtained from the College of Dentistry Research Center (CDRC) prior to the start of the research; the participants in the study signed an informed consent. Subjects were randomly selected from each level using the Research Randomizer.

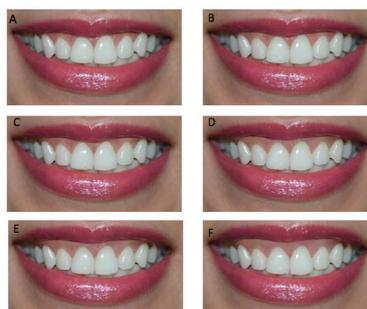
### Variables

Twenty-four photographs with altered smile features were used. Photos were cropped to eliminate other facial features to minimize its influence. Smile features were altered using Adobe Photoshop Software (Adobe Systems incorporated, San Jose, California). Altered features included gingival show upon smiling (GS), central incisor crown length (CL), midline shift (MS), and midline diastema (D). The photos were randomly presented to the participants as slides using Microsoft PowerPoint Software. Each picture was shown for ten seconds, and the participants could not return to the previous image once it had changed. The study was performed in a classroom for every level independently (ten students each time) to ensure clear vision for each participant. The time of the study was fixed at 12:00 pm to minimize variations in the students’ concentration levels.

### Alterations in the smile features were as follows

#### Gingival show:

Gingiva to lip margin level (gingival show) was increased by 1 mm increments to create a gummy smile. Alterations were based on the relationship of the upper lip with the gingival margin of the maxillary incisors (Figure 1).



**Figure 1:** Photographs showing alteration to the vertical height of the gingival margins of the maxillary lateral incisors in relation to the gingival height of the central incisors. (A) No alteration; (B) 1 mm alteration; (C) 2 mm; (D) 3 mm; (E) 4 mm and (F) 5 mm.

**Crown length:**

The crown length of the maxillary central incisors was altered by 0.5 mm increments. The alteration was made to the maxillary central incisors using the incisal edge as a reference point to the highest point of the gingival margin (Figure 2).



**Figure 2:** Photographs showing alteration to the crown length of the central incisors. The alteration was made to the maxillary central incisors, using the incisal edge as a reference point to the highest point of the gingival margin. (A) Central incisor crown length alteration by 0.5 mm increment; (B) 1 mm increment; (C) 1.5 mm increment; (D) 2 mm increment; (E) 2.5 mm and (F) 3 mm increment.

**Midline shift:**

The dental midline shift was made on the maxillary segment, while the lower midline and lip cupid bow were fixed and used as a reference. A 1 mm incremental alteration was performed to shift the upper midline to the left (Figure 3).



**Figure 3:** Photographs showing alterations to maxillary dental midline in relation to the philtrum of the lip. The alterations were done with 1 mm increment. (A) No midline deviation; (B) 1 mm midline deviation to the left; (C) 2 mm deviation; (D) 3 mm deviation; (E) 4 mm deviation and (F) 5 mm deviation.

**Midline diastema:**

A midline diastema was introduced between the maxillary central incisors by a 0.5 mm increment measured from the interproximal contact point of the central incisors (Figure 4).



**Figure 4:** Photographs showing alteration of a midline diastema. The alterations were done by an increment of 0.5 mm. (A) No alteration; (B) 0.5 mm midline diastema; (C) 1 mm diastema; (D) 1.5 mm diastema; (E) 2 mm diastema and (F) 2.5 mm diastema.

### Visual analogue scale

An evaluation form containing the visual analogue scale (VAS) under the photographs was distributed to the students and used to rate the smile esthetics. The VAS scale was 100 mm in length. The left end of the scale was labeled as very unattractive and represented by the number zero. The right end of the scale was labeled as very attractive and represented by a full score of 100. Each judge was asked to place a mark along the VAS for his/her perception of dental esthetics. Each mark on the VAS was measured using a caliper and then recorded.

### Statistical analysis

The data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 18.0 (Chicago: SPSS Inc.) Differences between genders in the perception of altered smile features were statistically analyzed using an independent t-test. One-way analysis of variance (ANOVA) with Tukey Post Hoc test was performed to identify statistically significant differences in the perception of Saudi dental students from different educational levels in each gender of altered smile features. The confidence level was established at  $p < 0.05$ .

To evaluate the reliability of the questionnaires, fifteen students were asked to judge the photographs in a given time, and then repeat the test one week later. It was found that the reliability was consistent in each question with a Cronbach's alpha value of 0.98.

## RESULTS

A comparison of the perceptions of dental students in different academic levels to GS alterations showed that there was no significant difference between ratings when the gingival display was  $< 2$  mm. However, if there was a gingival display of  $\geq 2$  mm, there was a significant difference in the perception between level one and level five. Level five denoted a more unattractive rating than level 2 ( $p$ -value $<0.05$ ). Furthermore, students gave a significantly more unattractive rating (levels 3-5) than levels one and two when the GS was  $\geq 3$  mm ( $p$ -value $<0.05$ ) (**Table 1**).

**Table 1:** Means and standard deviations for the gingival show discrepancies.

Academic level		GS 0 mm		GS 1 mm		GS 2 mm		GS 3 mm		GS 4 mm		GS 5 mm	
		P-Value	Mean (SD)										
Level 1	Level 2	0.997	64.8 (22.3)	0.992	63.9 (23.8)	0.890	63.3 (24.0)	0.408	64.9 (22.4)	0.699	62.0 (25.2)	0.992	60.7 (23.5)
	Level 3	0.092		0.576		0.125		0.003*		0.001**		0.01*	
	Level 4	0.215		1.00		0.102		0.001*		0.000**		0.00**	
	Level 5	0.135		0.282		0.013*		0.000**		0.000**		0.00**	
Level 2	Level 1	0.997	63.2 (25.7)	0.992	60.6 (24.5)	0.890	59.1 (23.3)	0.408	57.2 (23.3)	0.699	56.2 (24.9)	0.992	58.9 (20.0)
	Level 3	0.195		0.834		0.591		0.329		0.043*		0.039*	
	Level 4	0.388		0.992		0.534		0.198		0.013*		0.002*	
	Level 5	0.268		0.540		0.150		0.032		0.002*		0.00**	
Level 3	Level 1	0.092	53.0 (27.5)	0.576	52.6 (28.3)	0.125	52.5 (27.0)	0.003*	48.9 (27.7)	0.001**	43.6 (26.5)	0.010*	47.3 (25.3)
	Level 2	0.195		0.834		0.591		0.329		0.043*		0.039*	
	Level 4	0.995		0.570		1.00		0.999		0.995		0.875	
	Level 5	1.00		0.989		0.921		0.848		0.902		0.329	
Level 4	Level 1	0.215	54.8 (26.6)	1.00	64.0 (79.4)	0.102	52.1 (26.2)	0.001**	47.7 (24.8)	0.000**	41.8 (23.7)	0.000**	43.4 (23.3)
	Level 2	0.388		0.992		0.534		0.198		0.013*		0.002*	
	Level 3	0.995		0.570		1.00		0.999		0.995		0.875	
	Level 5	1.00		0.277		0.947		0.948		0.988		0.887	
Level 5	Level 1	0.135	53.8 (25.7)	0.282	48.9 (21.7)	0.013*	48.7 (23.2)	0.000**	44.4 (22.0)	0.000**	39.6 (22.8)	0.000**	39.6 (19.6)
	Level 2	0.268		0.540		0.150		0.032		0.002*		0.000**	
	Level 3	1.00		0.989		0.921		0.848		0.902		0.329	
	Level 4	1.00		0.277		0.947		0.948		0.988		0.887	

\*  $p < 0.05$ , \*\*  $p < 0.01$

In multiple comparisons between levels, there was no significant difference between levels when the CL discrepancy was 1.5 to 2 mm. However, in the remaining discrepancies, there was a significant difference between level four, which was the most critical group that rated the least attractive VAS rating, while level one rated with the most attractive rating ( $p$ -value $<0.05$ ) (**Table 2**).

In comparison between the different academic levels, there was no significant difference in the perception of students when the MS discrepancy was from 1 mm to 4 mm. There was a significant difference between levels when the MS was 5 mm, with level one demonstrating higher VAS ratings, and levels five and two demonstrating the least attractive ratings (**Table 3**).

**Table 2:** Means and standard deviations for the crown length discrepancies.

Academic level		CL 0.5 mm		CL 1 mm		CL1.5 mm		CL 2 mm		CL 2.5 mm		CL3 mm	
		P-value	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)
Level 1	Level 2	0.748	52.8 (21.5)	1.00	48.4 (22.5)	1.00	51.2 (22.1)	0.994	47.3 (19.2)	0.520	51.6 (20.0)	0.997	45.3 (20.7)
	Level 3	0.401		0.980		0.968		0.996		0.239		0.558	
	Level 4	0.006*		0.057		0.147		0.323		0.010*		0.063	
	Level 5	0.556		0.264		0.814		0.553		0.010*		0.222	
Level 2	Level 1	0.748	48.1 (20.1)	1.00	47.6 (20.4)	1.00	51.4 (21.3)	0.994	45.7 (19.6)	0.520	45.6 (19.3)	0.997	43.9 (20.7)
	Level 3	0.982		0.996		0.956		1.00		0.988		0.778	
	Level 4	0.175		0.096		0.128		0.579		0.424		0.148	
	Level 5	0.998		0.374		0.782		0.809		0.425		0.408	
Level 3	Level 1	0.401	46.0 (21.9)	0.980	46.2 (20.5)	0.968	51.4 (21.5)	0.996	45.9 (19.8)	0.239	43.7 (21.9)	0.558	39.3 (21.7)
	Level 2	0.982		0.996		0.956		1.00		0.988		0.778	
	Level 4	0.454		0.210		0.458		0.555		0.738		0.782	
	Level 5	0.999		0.602		0.992		0.789		0.740		0.977	
Level 4	Level 1	0.006*	39.4 (23.5)	0.057	37.7 (23.4)	0.147	41.8 (24.5)	0.323	40.21 (22.5)	0.010	39.0 (22.2)	0.063	34.8 (21.6)
	Level 2	0.175		0.096		0.128		0.579		0.424		0.148	
	Level 3	0.454		0.210		0.458		0.555		0.738		0.782	
	Level 5	0.304		0.957		0.735		0.995		1.00		0.980	
Level 5	Level 1	0.556	46.9 (19.6)	0.264	40.5 (22.0)	0.814	46.8 (21.6)	0.553	41.6 (21.5)	0.010*	39.0 (21.1)	0.222	37.0 (23.0)
	Level 2	0.998		0.374		0.782		0.809		0.425		0.408	
	Level 3	0.999		0.602		0.992		0.789		0.740		0.977	
	Level 4	0.304		0.957		0.735		0.995		1.000		0.980	

\* p<0.05

**Table 3:** Means and standard deviations for the midline shift discrepancies

Academic level		MS 0 mm		MS 1 mm		MS 2 mm		MS 3 mm		MS 4 mm		MS 5 mm	
		P-value	Mean (SD)										
Level 1	Level 2	0.185	57.6 (17.7)	0.974	50.2 (17.3)	0.922	50.7 (19.1)	1.00	52.5 (18.5)	0.997	50.6 (19.2)	0.033	58.4 (18.3)
	Level 3	0.681		0.998		0.989		0.926		0.844		0.283	
	Level 4	0.260		0.999		0.736		0.969		0.935		0.104	
	Level 5	0.044*		0.441		0.410		0.207		0.587		0.035*	
Level 2	Level 1	0.185	48.8 (21.7)	0.974	47.9 (19.9)	0.922	47.4 (21.4)	1.00	53.1 (19.4)	0.997	52.0 (20.5)	0.033*	46.6 (20.9)
	Level 3	0.905		0.998		0.997		0.865		0.645		0.889	
	Level 4	1.000		0.998		0.995		0.931		0.789		0.992	
	Level 5	0.976		0.817		0.893		0.147		0.368		1.00	
Level 3	Level 1	0.681	52.3 (23.7)	0.998	49.0 (21.7)	0.989	48.8 (24.0)	0.926	49.4 (23.1)	0.844	46.6 (21.4)	0.283	50.4 (23.2)
	Level 2	0.905		0.998		0.997		0.865		0.645		0.889	
	Level 4	0.956		1.00		0.945		1.00		0.999		0.989	
	Level 5	0.581		0.646		0.716		0.678		0.993		0.899	
Level 4	Level 1	0.260	49.5 (24.2)	0.999	49.1 (24.9)	0.736	45.8 (23.6)	0.969	50.1 (20.6)	0.935	47.6 (23.9)	0.104	48.4 (24.1)
	Level 2	1.000		0.998		0.995		0.931		0.789		0.992	
	Level 3	0.956		1.00		0.945		1.00		0.999		0.989	
	Level 5	0.939		0.624		0.986		0.564		0.961		0.994	
Level 5	Level 1	0.044*	46.4 (21.9)	0.441	43.7 (21.6)	0.410	43.7 (21.3)	0.207	44.3 (22.7)	0.587	45.0 (20.5)	0.035*	46.7 (24.5)
	Level 2	0.976		0.817		0.893		0.147		0.368		1.00	
	Level 3	0.581		0.646		0.716		0.678		0.993		0.899	
	Level 4	0.939		0.624		0.986		0.564		0.961		0.994	

\* p<0.05

There was no significant difference among the levels when the D discrepancy was >0 mm. However, a significant difference occurred between levels one and five when the D was 0 mm, where level five gave lower ratings than level one (p-value<0.05) (Table 4).

There was a significant difference between male and female perception of gingival show (GS) upon smiling, particularly when the gingival display was ≥ 4 mm. Female dental students gave less attractive scores compared to male students (p-value<0.05) (Table 5 and Figure 5).

**Table 4:** Means and standard deviations for the midline diastema discrepancies.

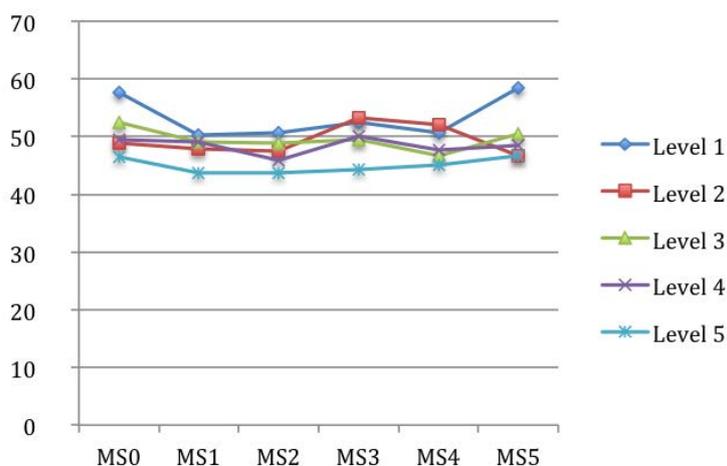
Academic level		D 0 mm		D 0.5 mm		D 1 mm		D 1.5 mm		D 2 mm		D 2.5 mm	
		P-value	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)	P	Mean (SD)	P-value	Mean (SD)	P-value	Mean (SD)
Level 1	Level 2	0.108	65.1 (19.9)	0.997	49.5 (21.1)	0.928	46.7 (21.0)	0.848	35.2 (18.6)	0.996	36.8 (19.6)	0.769	27.0 (20.0)
	Level 3	0.725		0.983		0.929		0.979		0.993		0.982	
	Level 4	0.066		0.942		0.890		0.327		0.951		0.911	
	Level 5	0.008*		0.692		0.959		0.697		0.848		0.718	
Level 2	Level 1	0.108	54.8 (23.8)	0.997	48.1 (20.4)	0.928	52.8 (82.6)	0.848	31.6 (18.4)	0.996	38.1 (16.5)	0.769	31.2 (18.5)
	Level 3	0.755		1.00		.490		0.992		.937		0.972	
	Level 4	1.000		0.994		0.419		0.908		0.816		0.254	
	Level 5	0.892		0.877		0.563		0.999		0.644		0.110	
Level 3	Level 1	0.725	59.9 (22.9)	0.983	47.3 (22.6)	0.929	40.7 (20.5)	0.979	33.2 (21.1)	0.993	35.3 (22.9)	0.982	29.0 (21.4)
	Level 2	0.755		1.00		0.490		0.992		0.937		0.972	
	Level 4	0.631		1.00		1.00		0.683		0.998		0.621	
	Level 5	0.218		0.944		1.00		0.953		0.976		0.371	
Level 4	Level 1	0.066	53.9 (24.0)	0.942	46.5 (24.4)	0.890	39.8 (20.0)	0.327	28.4 (19.4)	0.951	34.2 (19.6)	0.911	23.9 (18.3)
	Level 2	1.000		0.994		0.419		0.908		0.816		0.254	
	Level 3	0.631		1.00		1.00		0.683		0.998		0.621	
	Level 5	0.954		0.983		0.999		0.975		0.998		0.995	
Level 5	Level 1	0.008*	50.9 (25.9)	0.692	44.3 (21.7)	0.959	41.6 (20.6)	0.697	30.6 (20.5)	0.848	33.2 (19.3)	0.718	22.5 (20.0)
	Level 2	0.892		0.877		0.563		0.999		0.644		0.110	
	Level 3	0.218		0.944		1.00		0.953		0.976		0.371	
	Level 4	0.954		0.983		0.999		0.975		0.998		0.995	

\* p<0.05

**Table 5:** Means and standard deviations of VAS rating by males and females to gingival show discrepancy (GS: gingival show in mm).

Discrepancy	Male	Female	t-test	P-value
	Means (SD)	Means (SD)		
GS 0	59.2 (24.7)	56.6 (27.1)	0.855	0.393
GS 1	62.5 (52.9)	53.4 (26.1)	1.87	0.062
GS 2	57.2 (25.1)	53.0 (25.1)	1.43	0.154
GS 3	57.9 (23.5)	47.3 (25.5)	3.73	0.000**
GS 4	53.8 (25.7)	43.4 (25.4)	3.52	0.000**
GS 5	53.9 (22.9)	45.9 (24.2)	2.94	0.004*

\* p<0.05. \*\* p<0.01



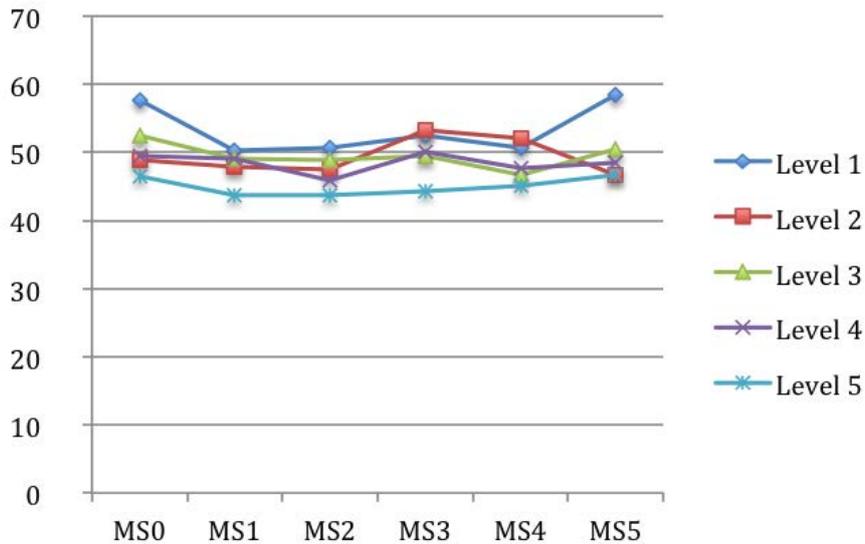
**Figure 5:** Line graph showing the mean ratings of GS discrepancy between different levels in general.

In the perception towards CL discrepancy, there was no significant difference between males and females when the CL discrepancy was between 1-1.5 mm. However, females gave significantly lower VAS ratings to CL discrepancy  $\geq 2$  mm (p-value<0.05) (Table 6 and Figure 6). In general, the perception towards midline shift (MS) discrepancy showed no significant difference between male and female students (Table 7 and Figure 7).

**Table 6:** Means and standard deviations of VAS rating by males and females crown length discrepancy (CL: crown length in mm).

Discrepancy	Male	Female Means (SD)	t-test	P-value
	Means (SD)			
CL_05	50.0 (20.8)	43.3 (22.0)	2.719	0.007*
CL1	45.1 (21.3)	43.0 (22.8)	.835	0.405
CL1_5	50.2 (21.7)	45.7 (22.8)	1.772	0.077
CL2	47.3 (19.3)	41.0 (21.5)	2.657	0.008*
CL2_5	47.2 (20.1)	40.3 (22.0)	2.845	0.005*
CL3	43.7 (21.6)	36.4 (21.4)	2.938	0.004*

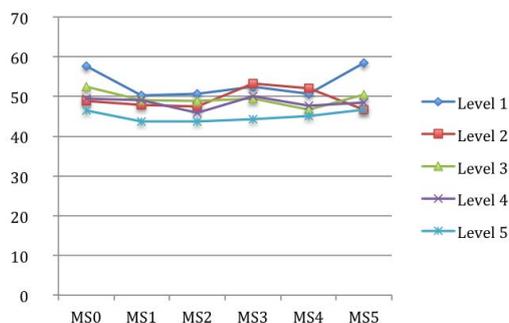
\* p<0.05



**Figure 6:** Line graph showing the mean ratings of CL discrepancy between different levels in general.

**Table 7:** Means and standard deviations of VAS rating by males and females to midline shift (MS: midline shift in mm).

Discrepancy	Male	Female	t-test	P-value
	Means (SD)	Means (SD)		
MS 0	49.8 (21.4)	52.0 (22.8)	-0.859	0.391
MS1	49.2 (20.4)	46.7 (22.0)	0.999	0.319
MS 2	48.4 (21.6)	46.1 (22.3)	0.938	0.349
MS 3	50.3 (21.3)	49.4 (20.9)	0.38	0.704
MS 4	49.6 (21.9)	47.1 (20.4)	1.023	0.307
MS 5	49.9 (23.0)	50.3 (22.3)	-0.143	0.886



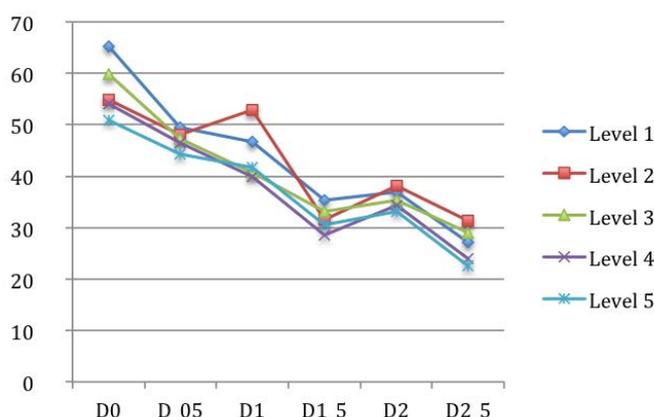
**Figure 7:** Line graph showing the mean ratings of MS discrepancy between different levels in general.

Female dental students gave lower ratings than male dental students for the presence of midline diastema (D) for most of the discrepancies. With increased diastema distance, ratings from both genders decreased towards being unattractive (**Table 8 and Figure 8**).

**Table 8:** Means and standard deviations of VAS rating by males and females to midline diastema (D: midline diastema in mm).

Discrepancy	Male	Female	t-test	P-value
	Means (SD)	Means (SD)		
D 0	54.5 (23.0)	59.3 (24.0)	-1.742	0.083
D 0.5	50.8 (21.1)	43.5 (22.2)	2.907	0.004*
D 1	48.0 (53.9)	40.6 (21.6)	1.575	0.116
D 1.5	34.7 (20.1)	28.9 (18.7)	2.584	0.010*
D 2	38.6 (19.7)	32.4 (19.2)	2.759	0.006*
D 2.5	29.7 (19.7)	23.7 (19.5)	2.627	0.009*

\* p<0.05



**Figure 8:** Line graph showing the mean ratings of D discrepancy between different levels in general.

## DISCUSSION

The perception of a smile is affected by a number of factors, such as personal experience and the social environment<sup>[7]</sup>. One should understand that the standards of beauty are constantly changing with time, culture, and education<sup>[4,5]</sup>.

Comparing the results of the perception of male students towards GS upon smiling showed that there was no significant difference between the academic levels when GS was less than 2 mm. However, when GS was  $\geq 2$  mm, the criticism increased according to the progression of levels; for example, level five gave a more critical judgment than level one ( $p$ -value $<0.05$ ). These findings were consistent with previous results that showed that Saudi dentists and lay people perceived a change in attractiveness when the gingival to lip distance was  $\geq 2$  mm<sup>[15]</sup>. However, female students showed no significant difference in their responses when the gingival show was less than 3 mm. However, with a gingival display of 3 mm, there was a surprising observation in which level three was the most critical group, giving the least attractive scores ( $p$ -value $<0.05$ ). Lastly, with a gingival display of  $\geq 4$  mm, the criticism increased with an increase in the progression of the levels; for example, level five was the most critical group and level one was the least critical group ( $p$ -value $<0.05$ ). This could be attributed to the progression of knowledge about smile features and enrollment of two undergraduate orthodontic courses. The Saudi female students' perception of GS is very similar to those of American dentists and lay people<sup>[13]</sup>.

There was no significant difference in the perception of CL discrepancy between male students. When comparing all female students at different academic levels, there was no significant difference between level five and the other four groups ( $p$ -value $>0.05$ ). There was a significant difference between level one, two, three and four ( $p$ -value $<0.05$ ). Level four female students rated the lowest VAS scores to all discrepancy magnitudes. Level one rated the highest VAS scores when the CL discrepancy was 0.5 mm, 2.5 and 3 mm. Level two rated the highest VAS scores when the CL discrepancy was 1.5 mm, while level three gave the highest rating when the CL discrepancy was 1 mm and 2 mm. These findings are comparable to previous findings that evaluated the perceptions of dental professionals and laypeople towards bilateral crown length alterations<sup>[14,15]</sup>. In these studies, the threshold for unattractiveness was 2.0 mm for lay people. Thus, the female students at level one; two and three had a similar perception as lay people. Students at level four had enrolled in an undergraduate orthodontic course in their academic curriculum, which may have influenced their behavior with a shift towards being more critical in their evaluation of altered smile features and approximating the general dentists and orthodontist groups.

There was no significant difference in the perception of MS discrepancy between male students at different academic levels. There was a significant difference between the academic levels only when the MS was 3 mm, in which level two gave the higher VAS ratings, while level five gave the less attractive VAS ratings. These findings may be attributed to the maturation and increased dental knowledge of the constitution of normal or abnormal smile features. The perception towards MS discrepancy showed no significant difference between male and female students in general.

There was a significant difference between male and female students in level four when the MS was 4 mm. Females gave a significantly less VAS rating compared to males. This result was consistent with previous findings, which showed that Saudi dentists are more sensitive to midline deviation than their American colleagues. In addition, the differences in perception observed between genders were inconsistent with previous studies <sup>[15]</sup>.

There was no significant difference among male students at different academic levels when the D discrepancy was more than 0 mm. There was no significant difference among female students at different levels when the D < 2.5 mm. Furthermore, a difference was observed between level two and five when the D was 2.5 mm. Level five female students gave lower ratings than level two students (p-value < 0.05). Thus, both groups considered a space between the maxillary incisors as unattractive, which is consistent with previous findings <sup>[15]</sup>. However, the threshold for a space between maxillary incisors was much lower for female students at higher academic levels.

There was no significant difference between male and female students in level one and two in their perception towards D. In the absence of the D, level three male students significantly rated the smile less attractive than female students (p-value < 0.05). However, in the presence of a 0.5 mm diastema, level four female students gave a significantly lower rating than male students. Finally, a D that measured 2.5 mm received a significantly lower rating by level five female students than male students. Level five students are near graduation and are considered to have a similar perception to general dentists.

A limitation to our study was the lack of literature that evaluates the perception of Saudi dental students towards altered smile features.

## **CONCLUSION**

1. The threshold of perception of female and male students towards GS upon smiling decreases according to their academic progression, in which level five provides a more critical judgment than level one.
2. There was no significant difference in the perception of CL discrepancy between male students. Level four female students rated the lowest VAS scores to all discrepancy magnitudes.
3. There was no significant difference in the perception of MS discrepancy between male students at different academic levels. The perception towards MS discrepancy showed no significant difference between male and female students in general.
4. The threshold for a space between maxillary incisors was much lower for female students at higher academic levels.
5. There were differences in the perception of all variables examined except for the midline shift between genders.
6. Students at level four and five have been exposed to undergraduate orthodontic courses in their academic curriculum, which shifts their perception towards being more critical in their evaluation of altered smile features and approximating the general dentists and orthodontist groups.

## **CONFLICT OF INTEREST**

The authors have no conflict of interest to declare.

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