PERCEPTION OF SMILE AESTHETICS: A CROSS-SECTIONAL COMPARATIVE EVALUATION OF SENIOR DENTAL AND MEDICAL STUDENTS

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ABSTRACT

Objectives: Acquiring the ability to identify deviations in dental aesthetic norms has been considered as an essential skill for the development of a dental professional. The timing and quality of this development of aesthetic perception has not been explicitly discussed in the dental education literature. This study aimed to evaluate the impact of dental training on the development of smile aesthetic perception, and to compare this perception between dental students and medical students in a similar cohort.

Methods: One-hundred dental and medical students were invited to complete a self-administered questionnaire, designed to evaluate eight images; using a visual analogue scale (1 least attractive; 100 most attractive). The students rated the smile aesthetics of one 'model' smile image, and seven digitally modified smiles representing major variations in smile features. Data were analyzed using the independent student's *t*-test.

Results: forty-four male and fifty-five female participants were successfully recruited, with a response rate of 99%. Dental students' ratings of smile aesthetics were significantly lower than medical students for seven of the eight images ($p<0.05$). This difference was greatest for the model smile image, and least for the diminutive lateral incisors image. There were no statistically significant gender-related differences.

Conclusions: Within the limitation of this study, the dental curriculum has a significant impact on developing students' perception of dental aesthetics. Longitudinal studies with larger samples sizes, are needed to examine if progress through the dental curriculum affects students' perception of dental aesthetics.

KEYWORDS: Cross-sectional study; Curriculum; Digital Smile Design; DSD; Dental students; Dental education; Orthodontics; Smile aesthetics

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INTRODUCTION

In order to complete a dental school program, dental students should develop a diverse array of skills and abilities. The set of core competencies necessary, have been clearly established by the General Assembly of the Association for Dental Education in Europe and the Dental Education Association in North America.[1,2] As future dental professionals, dental students and are expected to develop essential skills including the ability to identify deviations in dental aesthetic norms.[3,4,5,6] This skill is considered a prerequisite for cosmetic or aesthetic dentistry; the provision of which has undergone a burgeoning increase over the past couple of decades, with an increasing number of patients opting for elective dental procedures.[6.] An appealing dental appearance plays a significant role in one's social perception, success and psychosocial behavior.[7,8] Thus, understanding the characteristics of what composes an aesthetic smile can further help achieve targeted measures individualized to each patient and improve patients' satisfaction.[8,9] Dental students therefore, must have the capacity to diagnose and meet patients' aesthetic needs and demands, in order to provide them with individualized, evidence-based, culturally appropriate care. The traditional dental education model for reinforcement of these competencies has included a two year preclinical curriculum inclusive of basic biological sciences followed by a two year clinical curriculum in order to develop of clinical skills.[7] During clinical training, dental students are considered the main providers of patient treatment, with faculty serving in supervisory roles. Management of patients' aesthetic concerns typically involves assessment of aesthetic need followed by addressing of such needs by offering aesthetic restorative/orthodontic treatment options. Hence, students become cognizant of dental aesthetics norms as part of their training.

Despite the emphasis placed on aesthetic dentistry as being one of the vital dimensions of clinical dentistry, dental aesthetics is not always explicitly delivered through a dental school curriculum. When and how dental students' aesthetic assessment skills are developed are not explicitly discussed in the dental education literature. Perception of smile aesthetics depends on social and cultural awareness[10], gender, the age of observer. Few studies in the literature have investigated the perception of smile aesthetics among dental students, dentists, specialist orthodontists, and laypeople.[9,10,11,12]. These studies investigated the perception of smile aesthetics in different populations, and a consensus on this amongst dental students and laypeople is lacking. Few recent studies have recently re-evaluated the question whether dental education has a significant effect on one's aesthetic perception.[13,14,15] Whilst each study provided ample data and evaluation, none of these above studies compared dental students to medical students in the same cohort, who would be of similar age, social and cultural norms and gender. These are influential factors for the perception of smile aesthetics.[14]

Several valid objective measures have been developed and used to assess dental aesthetics, such as The Index of Orthodontic Treatment Need Aesthetic Component (IOTN-AC),[16] and the Dental Aesthetic Index (DAI).[17] Such measures, aim to assess the level of normative need for orthodontic treatment. In the literature, using a Visual Analogue Scale (VAS) and frontal dental images or facial images are considered an established method for obtaining judgements on smile aesthetics.[18] Furthermore, the use of a VAS, has been shown to be a reliable and valid tool in obtaining judgements from assessors on smile aesthetics.[19]

The aim of this study was to investigate the perception of smile aesthetics by dental students and compared to medical students of a similar age, cultural values and sex, with the intention of evaluating the impact of dental training on developing smile aesthetics perception. We hypothesized that there is no difference in the

perception of smile aesthetics, whether judged by dental students or medical students.

MATERIALS AND METHODS

Ethics

The study was reviewed and approved by the Research Ethics Committee at the Faculty of Dentistry of King Abdulaziz University in Saudi Arabia (Approval number 004-13).

Subjects

This cross-sectional study was carried out amongst 100 dental students and medical students enrolled at King Abdulaziz University Saudi Arabia between February 2012 – January 2013. One hundred participants and their parents/guardians gave written informed consent. Participant's details (name, email, and mobile number) were obtained from the students' register lists for fourth and fifth academic year. In order to avoid bias, a systematic random sampling technique applying a random number generator was used to select the study sample to one-hundred students from a list containing three-hundred students. The students from Year 4 and year 5 students were selected as per Armalite et al due to their more detailed knowledge of clinical dentistry, prosthodontics, orthodontics and smile aesthetics.[9]

Data collection

Study data were collected using a 2-part questionnaire. The first part of the questionnaire included sociodemographic items, i.e., student gender, age, nationality, and years of study as per Armalite et al. [9] The second part elicited responses to 10 images (Figure 1); using a 100-point VAS each student rated the smile aesthetics (1 least attractive; 100 most attractive). Participants were instructed to rate an image then wait for twenty seconds to move on and rate the next image without being allowed to return to previously rated images, as suggested by Flores and colleagues.[19]

Smile images

All 10 images were developed in collaboration with Dr. Hanan Omar from the prosthodontic department of the International Medical University in Malaysia (Figure 1). An initial image (Figure 1.1) was identified as the "model smile" as based on "Dental Golden proportions". This image was subsequently cropped to remove any confounding factors including the chin, nose, and cheeks which could influence the perception of a smile.[9] Each image therefore was a frontal view of the incisors/canines/premolars teeth, gingivae and lips.

The image (Figure 1.1) was then altered digitally to produce 7 images of varying smile features using Adobe Photoshop Software (Adobe Systems, San Jose, CA, USA) (Figure 1.2-1.8). The degree of alterations and modifications were similar to that proposed by a number of studies.[18,19,20] The varying smile features examined were displayed in Figure 1. Face validity of the developed images were tested in several studies.[11,20-22] To test for intra-examiner reliability, two images were duplicated (Figure 1.1 and Figure 1.3), and included in the questionnaire, hence the questionnaire included a total of ten images initially.

Statistical analysis

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software (IBM SPSS statistics for Mac, version 20.0. IBM corp., Armonk, NY, USA) and the significance level for all tests was set at $p<0.05$. The means, standard deviations (SD), 95% confidence interval (CI) were calculated for continuous variables. The Visual Analogue Scale (VAS) of the paper based questionnaire, consisted of 100 mm long scale; therefore, the obtained responses were rounded to the nearest tenth. The data were analyzed using independent samples t-test. To evaluate the level of agreement and test for reliability, Bland and Altman analysis and paired t-test were used.
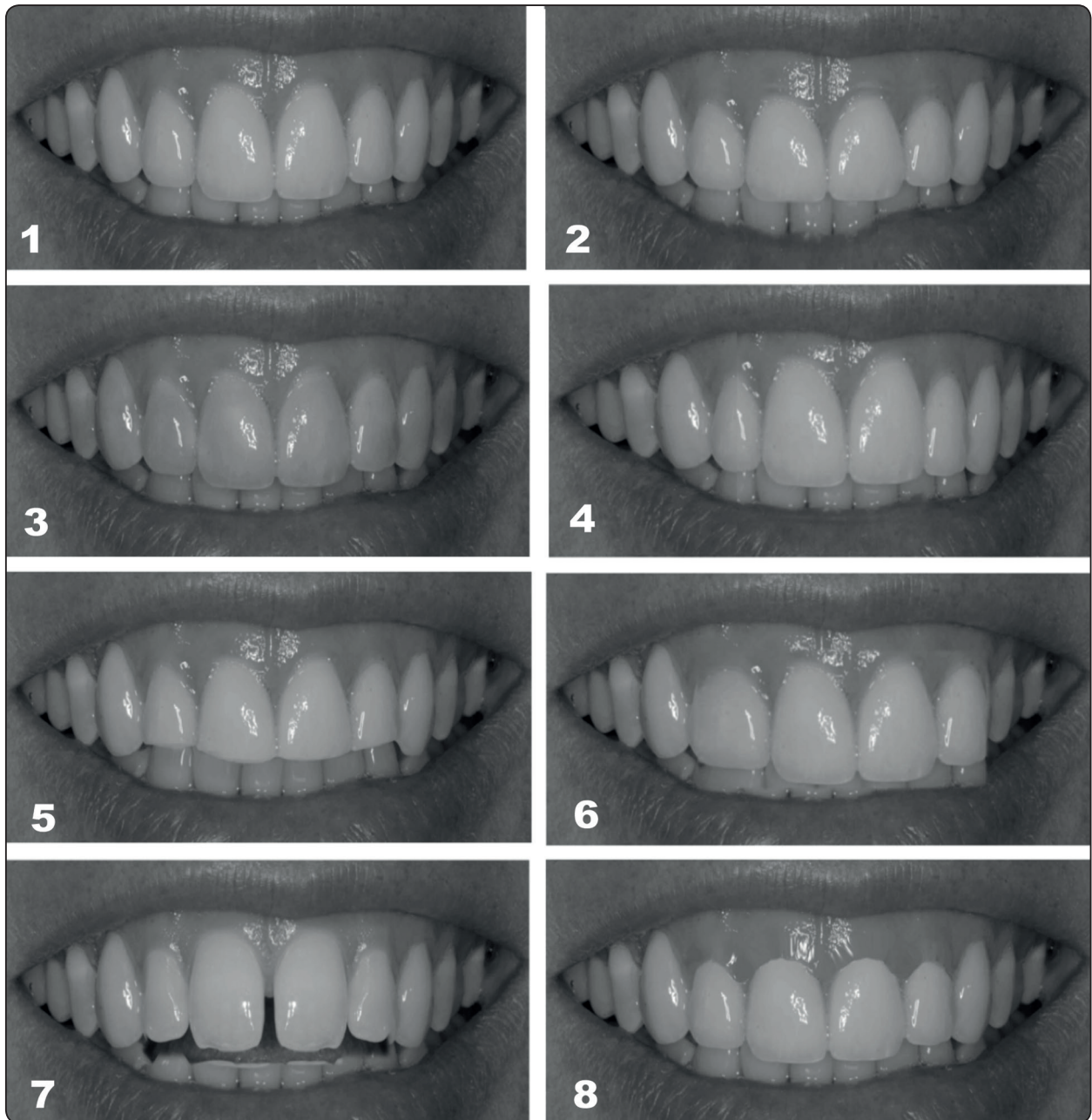
Fig. (1)

RESULTS

Out of the one-hundred participants, 99 questionnaire data were successfully obtained from the dental and the medical students' group with a response rate of 99%. One participant refused to continue with the questionnaire. There were 44 male participants and 55 female participants. The descriptive data of the age group and field of study of the participants are shown in Table 1.

The level of agreement and reliability testing was analyzed using Bland and Altman analysis. The average systematic measurement error was 10 (d-line = -10). Paired t- test comparing the rating of the duplicate images was not statistically significant ($p = 0.09$). Analysis from data collected revealed the following differences in perception.

The means and standard deviation scores for the aesthetic ratings by dental and medical students are shown in Table III. An independent sample *t*-test was conducted, as a result there was a statistically significant difference in relation to the model smile and six of the seven altered smiles ($p<0.05$) therefore, the null hypothesis was rejected (Table III).

When taking gender differences into account, there were no statistically significant gender-related differences (Table 2). Females gave higher ratings to the model smile, while males gave higher ratings for the image with darker crowns shade. These findings were consistent among both groups, apart from females in the medical students' group (Table 2).

TABLE (1) Descriptive data of demographic variables.

Faculty	Gender	Participants no.	Mean age	SD	Minimum	Maximum
Dentistry	Female	27	22.63	1.36	19.00	25.00
	Male	10	23.10	1.73	19.00	25.00
Medicine	Female	17	21.12	2.15	18.00	25.00
	Male	45	21.82	1.89	18.00	26.00
Overall	Female	44	22.05	1.84	18.00	25.00
	Male	55	22.05	1.91	18.00	26.00

SD: Standard Deviation

TABLE (2) Comparison of mean differences of image scores based on gender.

Image type	Gender	Participants no.	Mean	Mean difference	*p* value
Model smile	Female	44	-20.90	-7.81	
	Male	55	-13.09		0.140
Reduced maxillary incisor height	Female	44	-20.23	5.77	0.351
	Male	55	-26.00		
Dark-colored maxillary incisors	Female	44	-9.1	4.90	0.383
	Male	55	-14.0		
Diminutive maxillary lateral incisors	Female	44	-5.5	1.63	0.768
	Male	55	-7.1		
Flattened maxillary incisor edges	Female	44	-27.1	.41	0.941
	Male	55	-28.4		
Upper dental midline deviation	Female	44	-40.0	-8.0	0.178
	Male	55	-32.0		
Midline diastema	Female	44	-4.31	-2.7	0.660
	Male	55	-1.63		
Increased gingival display	Female	44	-11.52	-7.30	0.220
	Male	55	-4.21		

$p<0.05$ indicates a statistically significance result (2-tailed)

TABLE (3) Comparison of dental versus medical students' evaluations of the model smile and the digitally altered smile.

Image type	Dentistry Mean (SD) Min-Max	Medicine Mean (SD) Min-Max	Comparison of dental & medical students' evaluations (*t*-test).				95% CI of the Difference	
			Mean Difference	Standard. Error Difference	*t*	Significance (2-tailed)	Lower	Upper
Model image	48 (19) 17-90	62 (19) 10-100	-13	3	-3.52	.001	-21	-6
Reduced maxillary incisor height	36 (19) 0-80	46 (22) 0-100	-10	4	-2.32	.022	-18	-1
Dark-colored maxillary insiors	53 (23) 10-100	66 (19) 20-100	-10	4	-2.60	.011	-19	-2
Diminutive maxillary lateral incisors	27 (19) 0-77	33 (24) 0-100	-5	4	-1.50	.250	-14	3
Flattened maxillary incisor edges	39 (20) 0-92	50 (23) 6-100	-11	4	-2.40	.016	-20	-2
Upper dental midline deviation	42 (18) 0-79	52 (23) 0-90	-10	4	-2.30	.025	-19	-1
Midline diastema	57 (24) 10-100	67 (21) 0-100	-9	4	-2.10	.038	-19	-1
Increased gingival display	50 (21) 10-89	62 (22) 10-100	-12	4	-2.72	.008	-21	-3

SD: Standard Deviation; CI: Confidence Interval

p<0.05 indicates a statistically significance result (2-tailed)

DISCUSSION

This study demonstrated the differences in the perception of smile aesthetics between dental and medical students. Dental students (mean = 48; SD = 19) rated the attractiveness of the model smile image (figure 1.1) significantly different ($p<0.001$) than medical students (mean = 62; SD = 19) with dental students rating the attractiveness of the model smile image lower than medical students. Dental students exhibited a more critical analysis of in the model smile image than their medical counterpart, perhaps due to the slight increase gingival display in this image, suggesting that dental students are more aware of pink aesthetics than medical students. This corresponds to the findings of Sybaite et al, who demonstrated lay people in contrast to dental professionals, were less conscious of other smile components compared to white aesthetics.[21]

The dental students' perception of the altered smile images were also significantly different from that of lay people (medical students) for all images, except for the with diminutive maxillary lateral incisors (Table 3). In the literature, few studies have investigated the perceptions of smile aesthetics among dental students and laypeople in different populations.[9,12,21,23] Armalite et al concluded that

the least attractive smile features identified by dental students were hypodontia, gummy smile and occlusal cant.[9] However, the authors did not compare their findings with a control group.

In agreement with our findings, Omar and Tai validated that the dental students were more sensitive in assessing a range of smile alterations than a group of laypeople (pharmacy students).[12] Smile features such as darker tooth shades, spacing and midline deviation received the lowest ratings by both groups. However, dental students were more critical and able to detect changes in gingival display, and lateral incisors width and shape, while laypeople were more tolerant in their ratings.[12]

In contrast to other studies, dental students were less tolerant to darker crown shades when compared to medical students in our study. This is inconsistent with the findings of other authors who found both dental students and laypeople to be less tolerant to darker tooth shades. [12,24] As reflected in the ratings, we also found that, medical students were able to discriminate between diminutive laterals (figure 1.4) (mean = 33; SD = 24) and normally shaped laterals incisors (figure 1.1) (mean = 62; SD = 19); however, this contradicted the findings of Witt and colleagues; who found that laypeople are unable to differentiate between various shapes, forms, and sizes of maxillary incisors. [27]

Furthermore, dental students tended to evaluate dental midline shifts slightly less favorably than medical students. In the literature, it is established that a 2mm midline deviation can be deemed aesthetically acceptable by dental professionals, and laypeople.[27] These findings, supports the concept that a small 2-mm midline deviation of the maxillary anterior teeth does not bother laypeople, hence could be left untreated in the case it does not create aesthetic concern patients. In our study, other smile factors have also been investigated. In comparison to a dental midline shift, a gummy smile or increased gingival display was found to be less

attractive by both dental students (mean = 50; SD = 21) and medical students (mean = 62; SD = 22).

On taking gender differences into account, females gave higher ratings to the model smile image, while males evaluated the third smile image (with darker crowns shade) more favorably; although these findings were not significant statistically (Table II). These findings are consistent with Witt et al, who reported no significant gender-related differences.[28]

Sensitizing dental students to smile aesthetics allows for a greater appreciation of patients' perspective and demand. Smile aesthetics is recognized as the prime demand for patients embarking on cosmetic and orthodontic treatment. Most dental schools' curricula include two years of clinical training. In such teaching environment, faculty members contribute to patient care by supervising and guiding dental students, with a focus on restoring dental health and function.

In this study, further analysis based on the years of study might have been advantageous; nevertheless, this was not possible in this study because of the small sample size. Such analysis would aid assessment of any progressive change in dental students' perception of smile aesthetics longitudinally during their academic years. Espana et al, demonstrated that students' ability to detect alterations in smile aesthetics doesn't improve progressively over the course of a dental school program.[25] There is therefore a need for further studies with larger samples and longitudinal follow-up to examine the impact of a dental curriculum on developing students' perception of dental aesthetics. The study design should include collecting baseline data from dental students Also, this could provide a scope to compare the impact of different dental education curricula on dental students' perception of smile aesthetics.

In this study, as in most similar studies, a computer aided software was used in order to manipulate the original image to produce altered images in order to assess one variable at a time. Numerous

studies have used computer altered images to assess dental aesthetics, among the first were Kokich et al (Kokich et al).[10,11] Such method has been shown to be a reliable approach in assessing the perception of smile aesthetics.[12,19,21] The reliability of this method was also confirmed in our study. Our study limited the photographs to mouth only in order to reduce confounding variables such as facial proportion. Havens et al demonstrated that viewing the full face could alter the raters' score and a malocclusion could be found more attractive in a full face view.[26]

Limited conclusions can be drawn from this pilot study due to the small sample size. Furthermore, the results reflect the findings from one dental school only; hence, cannot be generalized. Variance within methodological factors in the literature should be taken into account while interpreting our findings. Such methodological factors include, diverse cultural backgrounds, different data collection methods, and investigation of other smile features.[11,27-33] Although, using a VAS is an established data collection method in studies investigating the perception of smile aesthetics, other methods have been also used. These include, using web-based questionnaires, patient-reported perception (IOTN-AC).[34,35] Hence, our findings can only be compared to those in the literature to a limited extent.

CONCLUSIONS

- A statistically significant difference was found in the perception of smile attractiveness between dental students and medical students.

- This difference was highest for the model smile image, and lowest for the darker crowns shade image.

- Within the limitation of this pilot study, the aesthetic perception is higher in dental students compared to medical students.

- There is a need for further longitudinal studies with larger samples to evaluate the impact of a dental curriculum on developing students' perception of dental aesthetics.

Abbreviations

(IOTN-AC) Index of Orthodontic Treatment Need Aesthetic Component

(DAI) Dental Aesthetic Index

(VAS) Visual Analogue Scale

(SPSS) Statistical Package for Social Sciences

(CI) Confidence Interval

(SD) Standard Deviation

Data Availability

All data included in our manuscript are available.

Conflict of interest

The authors would like to declare that they don't have any competing interests.

Author contributions

All authors meet the ICMJE criteria for authorship. AI, SA and ME substantially contributed to conception and design, ME acquired the data and AI, TT and ME analyzed and interpreted the data. AI, and ME drafted the article and revised it critically for important intellectual content. AI, ME, and TT Finally approved the version to be published.

Ethics

The study was reviewed and approved by the Research Ethics Committee at the Faculty of Dentistry of King Abdulaziz University in Saudi Arabia (004-13). Written informed consent was obtained from all participants and their parents/

guardians. All the procedures have been performed as per the ethical guidelines laid down by Declaration of Helsinki (2013) to be mentioned.

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