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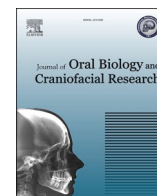


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Evaluating smile aesthetic satisfaction and related smile characteristics in dental students

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ABSTRACT

Aim: This study aimed to assess the association between self-rated smile satisfaction and the smile dimensions among dental students.

Method: An analytical cross-sectional study was conducted on 216 Vietnamese dental students. A standardized photograph was taken of each student with their frontal social smiles to assess aesthetic dimensions. A single-session self-administered questionnaire containing five questions about smile aesthetic satisfaction related to various aspects was administered to all students. Differences in smile characteristics and satisfaction scores between the two genders were evaluated. The impact of smile characteristics on satisfaction scores was assessed using multiple linear regression models.

Results: Most dental students had a high smile line, parallel smile arcs, an upward upper lip curvature, a non-touching labiodental relationship, a dental midline that coincided with the midline of the face, and eight teeth displayed during smile. Most participants were satisfied with their smiles, and the self-rated satisfaction score was 67 out of 100. Self-perceived overall smile satisfaction was associated with the "smile arc", the "upper lip curvature", the "number of teeth displayed during smile", and the "dental midline". Female students had a statistically significant correlation between self-perception and smile characteristics, such as upper lip curvature, dental midline shift, and smile line.

Conclusions: The smile arc, upper lip curvature, and dental midline shift affected self-perceived satisfaction among dental students. Female students showed an association between the smile parameters and self-perceived satisfaction.

1. Introduction

Smile is a key component of facial attractiveness and is therefore crucial to human social interactions.¹ The idea that people with attractive smiles are judged to be more intelligent, treated more favorably, and exhibit more socially desirable behaviors and traits than unattractive people, is supported by previous studies.^{2,3} As a result, one of the main reasons patients seek orthodontic treatment is to improve their smile aesthetics.⁴ To help the orthodontist create an accurate treatment plan, it is necessary to identify the factors that influence overall dental aesthetics and smile aesthetics.^{5,6} Various smile characteristics affect the perception of smile attractiveness, including the position, shape, size, and shade of the teeth; the position, texture, color, and lines of the gingiva and lips; and the shape of the jaws.⁷

People's satisfaction with their oral appearance is known to be

influenced by age, gender, and level of education.^{8,9} Dentists probably have a significant impact on the patients' decisions and the options they choose when receiving aesthetic care.¹⁰ However, previous studies revealed a certain discrepancy between subjects' perceptions and professional assessment of the need for aesthetic treatment.^{11,12} Several studies have found that dentists have a much higher standard of aesthetics than patients or laypeople do in general.^{11,13}

Compared to other dental professionals, the aesthetic perceptions of dental students have a degree of variability due to the level of dental education they acquired on different aspects of dentistry.¹⁴ As future dentists, dental students have a responsibility to understand the needs and expectations of patients and make clinical judgments regarding dental aesthetic issues.¹⁵ Several studies have been conducted to determine how dental students perceive the aesthetics of smiles. However, the majority of these studies relied on photographs—often taken

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using software imaging programs—to evaluate participants’ perceptions of the factors that significantly affect dental appearance and overall smile aesthetics, such as the level of anterior gingival exposure during smile, the smile arc, the relationship between the dental and facial midlines, tooth proportion, and tooth shade.^{16,17} Information in the literature about how dental students perceive their smile aesthetics and which factors affect their aesthetic satisfaction is very scarce. Furthermore, to the best of our knowledge, no research has been done in Vietnam on how dental students perceive their smiles. Therefore, we conducted this study to assess the smile satisfaction of Vietnamese dental students and to examine the association between smile satisfaction and smile characteristics.

2. Materials and methods

2.1. Study design and sampling

This cross-sectional study was conducted from November 2021 to February 2022 at *** University of Medicine and Pharmacy, Vietnam. The study protocol was approved by the Institutional Ethics Committee of *** University of Medicine and Pharmacy, *** University (Approval number: H2022/494), and written informed consent was obtained from all participants.

The sample size was calculated based on a previous study of smile assessment on Vietnamese adults in 2021 with a prevalence of parallel smile arc of 52.17 % in males.¹⁸ Taking power of 80 % at a 5 % level of significance, and adjusting by 10 % for the non-response rate, a minimum of 96 participants were required for each gender. We rounded up 108 to distribute the number of students evenly among the six academic years, and the sample size for the study was 216 individuals (108 male students: and 108 female students). A total of 216 Vietnamese dental students, aged 19–25 years, were included in this study, using the stratified random sampling technique.

The inclusion criteria were that all participants have 28 permanent teeth (the except for third molars) with overjet and overbite of 2–5 mm.

The participants also do not have super-numerary teeth or any facial deformities.

The exclusion criteria included.

- i) previous history of orthodontic treatment or maxillofacial surgery.
- ii) craniofacial anomalies, inflammation, active periodontal disease, and periodontal treatment (except for routine scaling and polishing), or maxillofacial trauma.
- iii) psychologically illnesses.

2.2. Data collection

The characteristics of dental students’ smiles were assessed using standardized photographs. The photograph was taken with frontal social smiles using the "say cheese" method in natural head positions.^{19,20} All photographs were taken under the same lighting conditions using a Nikon D5500 with AF-S 18–55, Japan (ISO 100, f 1/8, exposure time 1/80). The camera was fixed in position with a tripod, placed 1 m away from the subject, and photographs were taken in color. The photos were then analyzed using Photoshop CS6 to assess the following parameters (Fig. 1).

- **Smile line:** described as (1) very high, (2) high, (3) average, and (4) low. A “very high smile” shows more than 2 mm of the gingival margin. “High smile” displays a 0–2 mm gingival margin. An “average smile” shows only the gingiva in the interdental space can be seen, and a “low smile has no gingiva displayed.
- **Smile arc:** (1) “parallel smile arc” is defined as when the line of the incisal edges of the maxillary anterior teeth and upper border of the lower lip follow the same curvature. Whereas, if the two are not parallel, it can either be demonstrated as (2) “flat” (when flatter curvature of the teeth in relation to the lower lip) or (3) “reverse” (when maxillary teeth form a reverse curve in relation to the lower lip).²¹



Fig. 1. Smile characteristics of participants.

- **Upper lip curvature:** is recorded as three basic types: (1) upward (the corners of the mouth lie above the horizontal line), (2) straight (the corners of the mouth at the level of the horizontal line), and (3) downward (the corners of the mouth lie below the horizontal line).²²
- **Labiodental relationship of the lower lip and maxillary anterior teeth:** is divided into the lower lip (1) “slightly touching” the incisal curve of the maxillary anterior teeth, (2) “not touching” the anterior teeth, or (3) “covering” the anterior teeth.²²
- **Number of teeth displayed:** is classified as displaying teeth up to (1) the canines (6 teeth), (2) first premolars (8 teeth), (3) second premolars (10 teeth), or (4) first molars (12 teeth).²³
- **Dental midline:** is divided into two types (1) coincides or (2) non-coincides with the facial midline.²⁴

The self-rating of smile satisfaction was evaluated using a single-session self-administered questionnaire adapted from the questionnaire used in the study of Alamassi et al.²⁵ The questionnaire contained five questions: satisfaction with the overall smile (Q1), number of teeth displayed during smile (Q2), teeth arrangement (Q3), lip shape during smile (Q4), and gingiva during smile (Q5). All the questions were scored with a 100-mm visual analog scale (VAS) bar; the left anchor was labeled not satisfied, and the right anchor was labeled very satisfied. During this study, the dental students were asked to evaluate their smile aesthetics from memory, without viewing their smiles in the mirror.²⁵ No names or identifiers were written on the questionnaire, and anonymity and confidentiality were assured.

2.3. Statistical analysis

Descriptive statistics were applied for the smile characteristics and self-rated smile satisfaction variables stratified by gender. We used the chi-squared test and two-sided *t*-test for independent samples to analyze the differences in smile characteristics and self-rated satisfaction scores between males and females.

Five multiple linear regression models were used to assess the impact of smile characteristics on the five items related to dental appearance satisfaction. The variables’ age and ‘academic years’ were also included in these models as covariates. Each model was used for the total sample and each gender. All analyses were conducted using StataMP version 14.1 (StataCorp), with the level of statistical significance set at $p < 0.05$.

3. Results

In this study, we recruited 216 dental students (50 % male, 50 % female) from all six academic years, aged 19–25, with a mean age of 21.4 ± 1.8 . Table 1 summarizes the smile characteristics assessed in the photographs of the participants, with their distribution stratified by sex. Of the 216 subjects, the highest percentage of subjects had a “high smile line” (34.26 %), “parallel smile arc” (49.07 %), “upward upper lip curvature” (47.22 %), “maxillary anterior teeth do not touch lower lip” (60.19 %), “8 teeth displayed during smile” (51.39 %), and “dental midline coincide with the face’s midline” (60.65 %). Mostly, there were no significant differences in smile characteristics between genders and academic years. Table 2 presents the mean self-rated satisfaction scores for smiles according to sex. Overall, all questions related to self-rated satisfaction with smile characteristics had mean scores of over 67 out of 100. The highest score was self-rating satisfaction on “the number of teeth displayed during smile” (Q2) (70.0/100), and the lowest score was satisfaction on “the teeth arrangement” (Q3) (67.04/100). There was no difference in the self-rating score between genders and academic years for any of the questions ($p > 0.05$).

Table 3 and Fig. 2 show the estimation results of the linear regression models used to predict self-rating satisfaction according to smile characteristics. Table 3 shows that, of total subjects, the self-rating overall smile satisfaction was associated with the “smile arc,” the “upper lip curvature,” the “number of teeth displayed during smile,” and the “dental

Table 1

Distribution of smile characteristics assessed on the photographs of participants ($n = 216$).

Smile characteristics	Total n (%)	Male n (%)	Female n (%)	p- value ^a
Total	216 (100 %)	108 (50 %)	108 (50 %)	
Smile line				
Very high	20 (9.26 %)	10 (9.26 %)	10 (9.26 %)	0.198
High	74 (34.26 %)	32 (29.63 %)	42 (38.89 %)	
Medium	69 (31.94 %)	33 (30.56 %)	36 (33.33 %)	
Low	53 (24.54 %)	33 (30.56 %)	20 (18.52 %)	
Smile arc				
Parallel	106 (49.07 %)	49 (45.37 %)	57 (52.78 %)	0.480
Straight	95 (43.98 %)	50 (46.3 %)	45 (41.67 %)	
Reverse	15 (6.94 %)	9 (8.33 %)	6 (5.56 %)	
Upper lip curvature				
Upward	102 (47.22 %)	51 (47.22 %)	51 (47.22 %)	0.621
Straight	73 (33.8 %)	34 (31.48 %)	39 (36.11 %)	
Downward	41 (18.98 %)	23 (21.3 %)	18 (16.67 %)	
Lower lip-maxillary anterior teeth relationship				
Slightly touch	76 (35.19 %)	32 (29.63 %)	44 (40.74 %)	0.223
Not touch	130 (60.19 %)	71 (65.74 %)	59 (54.63 %)	
Covered	10 (4.63 %)	5 (4.63 %)	5 (4.63 %)	
Number of teeth displayed during smile				
6 teeth	7 (3.24 %)	5 (4.63 %)	2 (1.85 %)	0.384
8 teeth	111 (51.39 %)	55 (50.93 %)	56 (51.85 %)	
10 teeth	86 (39.81 %)	40 (37.04 %)	46 (42.59 %)	
12 teeth	12 (5.56 %)	8 (7.41 %)	4 (3.7 %)	
Dental midline				
Coincide with the face’s midline	131 (60.65 %)	65 (60.19 %)	66 (61.11 %)	0.889
Not coincide with the face’s midline	85 (39.35 %)	43 (39.81 %)	42 (38.89 %)	

^a Chi-square test.

Table 2

The self-rated score of smile aesthetic satisfaction of smile according to sex ($n = 216$).

Self-rated score of smile aesthetic satisfaction	Total mean (SD)	Male mean (SD)	Female mean (SD)	p- value ^a
Q1. Overall score	67.8 (16.7)	67.8 (17.7)	67.8 (15.8)	1.000
Q2. Number of teeth displayed during smile	70.0 (16.3)	70.5 (16.6)	69.5 (16.0)	0.677
Q3. Teeth arrangement	67.0 (18.2)	66.1 (19.1)	68.0 (17.2)	0.455
Q4. Lip shape	67.6 (17.6)	67.6 (17.9)	67.7 (17.4)	0.969
Q5. Gingiva exposed during smile	67.5 (17.6)	67.4 (18.4)	67.6 (16.4)	0.939

SD: standard deviation.

^a Two-sample *t*-test.

Table 3

Coefficient of linear regression for the association between self-rated overall smile satisfaction and related smile characteristics, stratified by sex (n = 216).

Smile characteristics	Total (n = 216)		Male (n = 10)		Female (n = 108)	
	β (SE)	p-value	β (SE)	p-value	β (SE)	p-value
Smile line						
Very high	−1.64 (4.15)	0.692	1.06 (6.57)	0.872	−1.35 (5.19)	0.796
High	1.58 (2.74)	0.564	−2.95 (4.45)	0.509	7.24 (3.41)	0.037
Medium	Ref.		Ref.		Ref.	
Low	−2.83 (3.03)	0.351	−2.95 (4.57)	0.520	−1.41 (4.14)	0.734
Smile arc						
Parallel	Ref.		Ref.		Ref.	
Straight	−3.61 (2.47)	0.146	−6.215 (4.11)	0.138	−1.82 (2.91)	0.593
Reverse	−15.25 (4.72)	0.001	−13.43 (7.33)	0.070	−13.12 (6.12)	0.035
Upper lip curvature						
Upward	Ref.		Ref.		Ref.	
Straight	−5.32 (2.54)	0.037	−0.98 (4.36)	0.823	−8.86 (3.21)	0.007
Downward	−3.33 (3.08)	0.282	4.69 (5.00)	0.350	−11.62 (3.87)	0.003
Lower lip-maxillary anterior teeth relationship						
Slightly touch	Ref.		Ref.		Ref.	
Not touch	1.10 (2.62)	0.676	0.29 (4.37)	0.948	5.09 (3.16)	0.111
Covered	2.14 (5.48)	0.697	2.79 (8.39)	0.740	−0.55 (7.29)	0.940
Number of teeth displayed during smile						
6 teeth	Ref.		Ref.		Ref.	
8 teeth	10.99 (6.29)	0.082	14.29 (8.22)	0.086	4.90 (11.00)	0.657
10 teeth	10.88 (6.62)	0.102	15.47 (8.98)	0.088	3.76 (11.24)	0.739
12 teeth	17.69 (8.18)	0.032	34.87 (11.44)	0.003	−8.91 (13.33)	0.505
Dental midline						
Coincide with the face's midline	Ref.		Ref.		Ref.	
Not coincide with the face's midline	−5.13 (2.26)	0.024	−3.57 (3.65)	0.330	−3.98 (2.76)	0.153

All models were adjusted for age and study grades.

midline." In females, self-perceived overall smile attractiveness was significantly associated with a high smile line. Female students with reverse arc, straight, or downward upper lip curvature rated the satisfaction score of the overall smile as lower. Among male students, those with 12 teeth displayed during smile had 34.87 points higher self-rated satisfaction scores on the overall smile than those with 6 teeth displayed during smile.

Regarding the number of teeth displayed during smile, the male students with 12 teeth displayed during smile rated a higher score compared to those with fewer teeth displayed, while females showed a reverse answer, with the lowest self-rating for displaying 12 teeth during smile (Fig. 2A).

Fig. 2B shows a significant effect of the dental midline on self-perceived smile attractiveness ($p = 0.012$), and both male and female students who had dental midlines that did not coincide with the face's midline rated lower satisfaction scores on "teeth arrangement" than those who had dental midline that coincided with the face's midline. In Fig. 2C, we found that female students with straight or downward upper lip curvature rated lower satisfaction scores than upward upper lip curvature, while male students only rated lower scores with downward upper lip curvature. In Fig. 2D, we found only a significant association

between the smile line and the satisfaction score among female students.

We did not find significant results between smile characteristics and satisfaction scores when examining students in each academic year because the number of students were limited ($n = 36$ students each year).

4. Discussion

In the future, dental students will be in charge of developing treatment plans for patients. As a result, it is crucial to comprehend their perspective on smiles. To the best of our knowledge, this is the first study to evaluate the relationship between the smile dimensions and satisfaction with their smiles. In the current study, we discovered that most participants were satisfied with their smiles. The smile arc, upper lip curvature, number of teeth visible during smile, and dental midline shift were the factors that influenced their self-perceived smile. Female students' satisfaction scores with their smiles were more in line with the clinical characteristics than male students' scores.

The majority of participants in the current study had a high smile line, consonant smile arcs, an upward upper lip curvature, a non-touching labiodental relationship, a dental midline that coincided with the face's midline, and eight teeth displayed when smile. Except for a high smile line, these findings are consistent with those of Tjan and Khan.^{21,23} We conducted this study on dental students aged 19 to 24, who typically have a higher smile line than people aged 50 and up; therefore, this could result in a higher proportion of high smile lines compared to studies on the general population.¹⁰

In the current study, the self-rated satisfaction score of smiles was 67 out of 100, higher than that of the participants in the study by Jorung, lower than that of adolescents in studies by Boeira and Ellakany, but equivalent to that of dental students in studies by Zardawi.^{10,26–28} Patients appear to come to the clinic with dental concerns, which may cause them to feel more dissatisfied with their appearance than healthy ones. On the other hand, dental students already have knowledge about dental aesthetics; therefore, they might have undergone a more rigorous evaluation of their smile aesthetics and rated lower scores than adolescents did. Similar to the results of Boeira's study, we found no significant gender differences in the self-rated satisfaction score of smiles or any part of the lip, gum, or teeth.²⁶ The reason might be due to the similarity in the smile morphology of male and female participants in this study. In addition, the recruited dental students were from the same university; therefore, they had a similar educational background and, most likely, similar aesthetic demands.

Regarding the correlation between smile parameters and smile satisfaction, the current findings were in line with previous studies, which showed a higher satisfaction rating score among students with a consonant smile arc, upward upper lip curvature, and coincident dental midline with facial midline.^{29,30} Shah's systemic review also found that smile arc and dental midline shift were the most common factors influencing smile attractiveness in many studies.³¹ Although there was no significant difference in self-rated satisfaction between the two genders, we examined the correlation between smile parameters and satisfaction in males and females separately since gender differences in biology and social impact are well-established in the literature.³² We found that female students with favorable smile characteristics rated higher satisfaction levels than others. However, the male rating pattern for self-perceived satisfaction did not correspond to the common perception of an attractive smile. This suggests that smile characteristics primarily influence female perceptions of smile attractiveness. According to many studies, females are more concerned about aesthetics than males.^{27,33} They might be more aware that a friendly smile can make them appear more trustworthy, and they also tend to smile more than males in a variety of social situations.^{32,34} Thus, we assume that females pay more attention to an aesthetic smile than males when self-evaluating their smile. Given the number of teeth exposed during smile, there is a significant difference in how the two genders perceive their smiles.

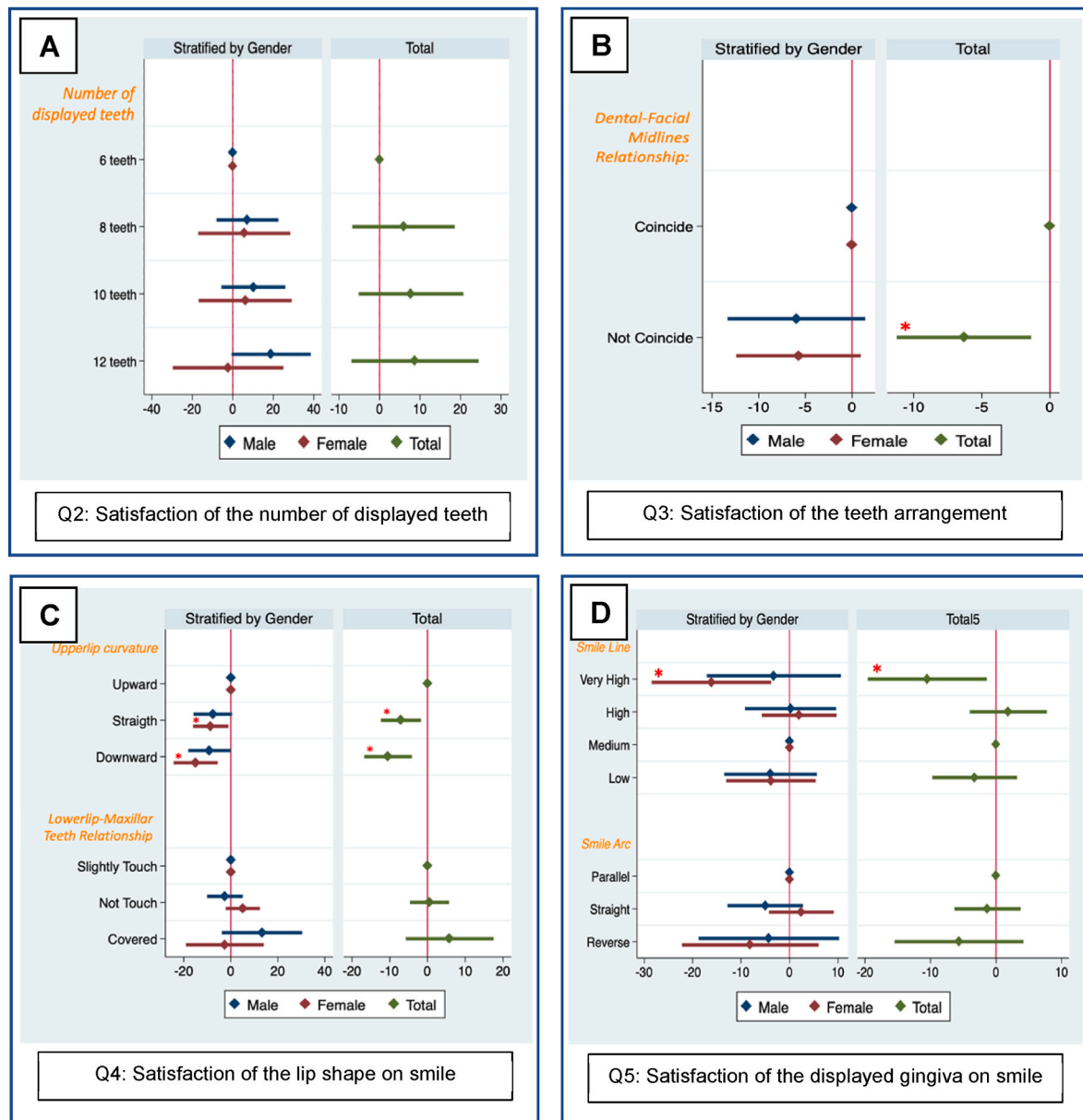


Fig. 2. The coefficients of linear regressions for the association between self-rated satisfaction of the number of displayed teeth (A), the teeth arrangement (B), lip shape on smile (C), the displayed gingiva on smile (D) and related smile characteristics.

Females rated a smile with 12 teeth exposed as unsatisfactory, while males rated the highest level of satisfaction. Greater width smiles in males have been widely recognized in the literature; thus, they may consider a wide smile as an ordinary image.³⁵ Another theory that could explain this disparity is the Vietnamese cultural perspective, which believes that a broad smile is a sign of a successful man but an unpleasant woman.

In addition, we investigated students' self-perceived satisfaction with their lips, gums, and teeth separately, and their relationship with related smile features. Aside from the number of teeth displayed during smile, dental students' perceptions of lip, teeth, and gum satisfaction were associated with smile characteristics, such as upper lip curvature, dental midline shift, and smile line. Among the female participants, we observed a statistically significant correlation between the satisfaction score of the lip shape during smile and the direction of the upper lip curvature. Female who had a very high smile line also reported significantly less satisfaction with the gingiva display on their smiles. However, we did not detect any connection between smile parameters and

satisfaction ratings for the lips, gums, or teeth among males. Females were more likely to have a better self-perception of smile parameters than male students. This finding is consistent with Althagafi's study, which found that at every level of study, female dental students appeared to have higher perceptions of smile aesthetics than male dental students.¹⁶ Our result suggested the possibility that male dental students underrated smile characteristics in personal aesthetic evaluation or that they did not understand what people consider an appealing smile. Although several authors have stated that males may have an inherent unwillingness to smile or may not consider it an important feature of their social image, male dentists need to understand what a beautiful smile is for planning aesthetic treatment.^{36,37} The orthodontic treatment needs of patients are influenced by the assessment of a dental practitioner, typically an orthodontist.³⁸ Therefore, our findings suggest that more effort should be placed into teaching students how to assess aesthetic smiles and encourage students—especially male students—to discuss more understanding of smile aesthetics while considering patients' treatments.

In the *** University of Medicine and Pharmacy's 4th-year dental curriculum, dental students were taught about smile aesthetics, and the required study hours linked to this topic may be insufficient. Therefore, we propose that dental students be introduced to smile aesthetics and smile design early in the academic year so that students have a better understanding of smile aesthetics and can utilize smile design in treatment more effectively later.

There are several limitations to this study. First, because we only recruited dental students from one university with a small sample size, our findings cannot be generalized to all dental students in Vietnam. Second, since this is a cross-sectional study, no causalities can be inferred. Thirdly, there might be errors in measurement since the instruments for collecting data have not been validated before. However, the self-rated satisfaction questions appear relatively accurate, as our findings were consistent with previous studies.^{29,39,40} Fourth, we did not collect data on tooth color and shape to investigate factors that influence people's satisfaction, even though tooth shape and color significantly impact self-perceived satisfaction with facial aesthetic.^{27,41} We were concerned that the lighting conditions during photography would lead to inaccuracies in tooth color evaluation.

Our research has some strengths as well. The present study is one of the few studies investigating the relationship between the smile parameters and self-perception of the smile. Compared to previous studies, we included more clinical characteristics of the smile in examining their relationship to self-perceived smiles.^{35,41} Furthermore, we assessed not only self-reported satisfaction with the smile, but also satisfaction with the lip, gum, and teeth separately in their relationship to the lip, gum, and teeth characteristics in detail. To the best of our knowledge, this design has not been conducted on dental students before. Hence, our findings may provide a better understanding of how dental students perceive their smiles.

5. Conclusion

Within the limits of this study, the current study discovered that smile arc, upper lip curvature, and dental midline shift were factors affecting self-perceived satisfaction among dental students. We found appropriate associations between smile parameters and self-perceived satisfaction among female students, whereas no such links were detected for male students.

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None.

Declaration of competing interest

None.

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