

A Photographic Appraisal for the Comparison of Different Traits of Smile Among Students Studying in a Dental Institute: A Cross-Sectional Study

¹Dr. Pooja Shettigar, MDS Prosthodontics, Department of Prosthodontics and Ex-Post Graduate Student, Nair Hospital Dental College, Mumbai-08, Maharashtra, India

²Dr. Monika Lokhande, MDS Prosthodontics, Department of Prosthodontics and Ex-Post Graduate Student, Nair Hospital Dental College, Mumbai-08, Maharashtra, India

Corresponding Author: Dr. Pooja Shettigar, MDS Prosthodontics, Department of Prosthodontics and Ex-Post Graduate Student, Nair Hospital Dental College, Mumbai-08, Maharashtra, India

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Abstract: Understanding the aesthetic criteria of the smile is fundamental for the present-day dental students, considering the growing demand for aesthetic treatment. However, there is a limited literature that aims to understand the insight among the dental students as they are a part of the dental workforce and should be able to make clinical decisions pertaining to dental aesthetics and when to intervene or refer. The study included 2 constraints:

A) **To calculate Prevalence:** Standardized frontal photographs of 250 dental students were taken with a Camera and were then transferred to an image measurement program software. Each subject’s smile was then analysed carefully by the visual judgment of 2 evaluators.

B) **To calculate Perception:** A standard frontal photograph was selected among the previously collected

photographs and was modified using Photoshop to produce 10 modified smiles which were presented to the evaluators in the form of a questionnaire. Followed by which the data were statistically analysed.

A) **For Prevalence Estimation:** Upper lip position was in the order of average> low> high; while the smile arc was in the order of: Parallel > Straight> Reverse with insignificant difference among the genders. The prevalence of upper lip curvature was Upward>straight > downward; Among the tooth display. type: Tooth>Papillary>Gingival>Mucosal. The number of teeth displayed in smile, suggested greater teeth display to be more esthetic

B) **For Perception Estimation:** The ratings concluded that a Parallel Smile arc, Papillary type and with a greater number of teeth display showed the maximum acceptance among the evaluators as attractive.

The study was conclusive that an average upper lip position, upper curvature of upper lip, parallel smile arc, papillary type of gingival display and maximum number of teeth display were found to be the most prevalent and most accepted among the dental students as aesthetic smile traits.

Keywords: Esthetics, Prevalence, Perception, Upper lip Curvature, Smile Arc, Gingival Display

Introduction

Aesthetics have become increasingly important in the practice of modern restorative dentistry and synonymous with a natural harmonious appearance. The term "aesthetics" is borrowed from the Greek word "aesthesia", which means sensation or sensibility. It can be defined as "belonging to the appreciation of the beautiful"¹. In 1936, Pilkington defined dental esthetics as "the science of copying or harmonizing our work with that of nature, making our art inconspicuous"². In current esthetic conscious world, a smile is considered as an important component of overall appearance and well-being.³ Aesthetics, more than any other area in dentistry, is based on individual perception. Aesthetic judgement is not an entirely objective criterion; the dentist must also consider the subjective concerns of the individual patient when designing a natural smile.¹ Thus it is the collaboration of the patient's perception of "visually pleasing or satisfying" and the clinician's experience in assessment of acceptable anatomic architecture coupled with proper function of the masticatory system.

A beautiful and attractive smile is among the important targets of dental treatment and is provided with an ideal smile line. To achieve the best esthetic results in dentistry, we also should use "frames", "from the inside out": the line angles and axial inclinations that frame a single tooth, the gingival edge that frames the teeth, the lips that frame the teeth and gingiva, and, finally, the

face that frames all these components and acts as the master of the original frame in which all the components interact in a natural or optimally restored dentition to present a pleasing and esthetic smile.¹ Such an esthetic smile is affected by multiple factors in addition to ideal smile line, such as buccal corridors, gingival display, arch width, tooth shapes, asymmetries, and age. Upper lip position refers to the position of the inferior border of the upper lip during smile formation and thereby determines the display of tooth or gingiva at this hard and soft tissue interface. Three types have been identified for the smile line, namely, low, average and high according to the amount of upper anterior teeth exposure during smiling. Low smile line is the one when there is no more than 75% exposure of anterior teeth, average smile line is that when there is 75-100 % exposure of anterior teeth and interproximal papillae, whereas high smile line is that when there is complete exposure of anterior teeth along with gingival display. Under ideal conditions, the gingival margin and the lip line should be congruent or there can be a 1–2 mm display of the gingival tissue. Showing 3–4 mm or more of the gingiva (gummy smile) often requires cosmetic periodontal recontouring to achieve an ideal result.⁴

The smile arc is the relationship of the maxillary incisal edge curvature to the curvature of the lower lip upon smile; the term consonant is used to describe a parallel relationship. A no consonant, or flat, smile arc is characterized by the maxillary incisal curvature being flatter than the curvature of the lower lip on smile or it can be reverse.^{5,6}

The upper lip curvature can be classified as upward, straight or downward, Upward curvature means the corner of mouth is higher than the centre of lower border of upper lip. When they fall in straight line, it is called

‘straight’, and downward when corner of the mouth is lower than centre of lower border of upper lip.⁷

The number of teeth displayed in a social smile can range from canine, to premolar or upto molar display while the type of smile display can be studied under tooth type, papillary type, gingival type and mucosal type.^{7,8}

This study analysed the den to-labial-gingival aesthetic components of the smile based on position of lip, curvature of upper lip, the parallelism of incisal line to upper edge of lower lip to evaluate the prevalence of various types of smiles and the differences of these elements among men and women.

The purpose of the present study was to evaluate the prevalence and the gender-based variations for different smile traits and their perception regarding attractiveness among students studying in a dental institute. The primary research hypothesis states that there are no variations based on prevalence and gender for upper lip position, smile arc, upper lip curvature, smile display type and number of teeth displayed in a smile among students studying in a dental institute. The secondary research hypothesis states that there are no differences in perception for attractiveness of either smile arc, smile display type and number of teeth displayed in a smile among students studying in a dental institute.

Material and methods

A) To Calculate Prevalence

A cross-sectional study was conducted for the comparison of different traits of smile among students studying in Nair Hospital Dental College, Mumbai, Maharashtra. The information sheet and the consent form were provided in English language for better understanding and were signed after full comprehension by the participant. The ethical approval of this study was obtained from Institutional Ethics Committee of Nair

Hospital Dental College, Mumbai, Maharashtra. The individual participant recruitment was done among B.D.S & M.D.S students by convenient sampling. The sample consisted of 250 students; among them 52.4% were females and 47.6% were males. Students who were >18 years of age with no previous history of orthodontic, prosthodontic and restorative treatment with no spacing / crowding in the anterior teeth and no remarkable malformation were included in the study design. Participants with missing teeth, unpleasant gingival colour or contours, unpleasant fracture of teeth, or structural deformity of teeth and the ones who were not willing to participate in the study were excluded.

Parameters evaluated in the study were upper lip position, smile arc, upper lip curvature, tooth display type and number of teeth displayed. Frontal photographs were taken with Canon EOS 3000D with a DSLR Camera equipped with an 18-55mm f/2.8 Macro lens and Tripod stand (Taconic TX10). The photographs were taken with subject’s head in a Natural Head Position (NHP) with the subject sitting upright, with eyes looking at a distant point as she or he would pose with a social smile displaying maxillary anterior teeth as well as gingiva. The photographs were made in neutral background and at 90° to the participant’s face in a properly illuminated room with natural light. The photographs were then copied to the Lenovo IdeaPad 110 Laptop (with LCD screen of 1366 X 768 resolution and 32-bit colour) and were saved in image measurement program software. Each subject’s smile was compared and evaluated carefully by visual judgment of two evaluators. (PS& ML). To evaluate the association between different parameters of smile and gender, Chi-square test was applied. Level of significance was kept at 0.05.

B) To Calculate Perception

1 Frontal Photograph was selected from the previously collected photographs fulfilling the criteria of an ideal smile arc, ideal gingival display type and ideal number of teeth displayed. This image was then modified by using ADOBE PHOTOSHOP CC 2020® to create combination of three smile arc variance (parallel, straight, reverse) three types of number of teeth display (up to Canine, up to Premolar, up to Molar) and four smile display type (Tooth, Papillary, Gingival, Mucosal smile) respectively, thus, producing ten images. These 10 modified smiles were arranged in the form of a questionnaire which were presented to evaluators. A total of 43 dental students were recruited as evaluators and we're not informed about the alterations made in the images and were then asked to score the attractiveness of each image on a Linear Numerical Rating scale of 0 to 5, with 0 being the least attractive and 5 the most attractive. After the recordings were made, the data were statistically analysed using chi square test. Normality of numerical data was calculated using Shapiro–Wilk test

or Kolmogorov-Smirnov test while Inter group comparison (2 group) was determined using t test / Mann Whitney U test while Inter group comparison (>2 groups): ANOVA test / Kruskal Wallis ANOVA test.

Results & discussion

In recent times, due to ever advancing technology, ways to achieve an ideal and alluring smile has undergone paradigm shift. It can alleviate stress and help you give a better first impression. Indeed, in a poll conducted by the American Academy of Cosmetic Dentistry, more than nine out of ten (92%) of adults agreed that an attractive smile is an important social asset, while 85% said that an unattractive smile makes someone less appealing. The purpose of the present study was to evaluate the prevalence of the different smile characteristics and to identify the perception among the evaluators regarding the attractiveness of these smile traits.

A) For Prevalence Estimation

The final sample consisted of 250 photographs of dental students. Among them 52.4% were females and 47.6% were males. (Table 1)

Characteristics		Female % (n=131)	Male % (n=119)	Total % (n=250)	Chi-square statistics
Upper Lip Position	Low Smile Line	37(28.2)	41(34.4)	78(31.0)	20.010 ^a (p=.000) [†]
	Average Smile Line	81(61.81)	44(17.6)	125(50)	
	High Smile Line	13(9.92)	34(28.57)	47(18.8)	
Upper Lip Curvature	Upward	86(65.6)	46(18.4)	132(52.8)	18.751 ^a (p=.000) [†]
	Straight	24(18.32)	44(17.6)	68(27.2)	
	Downward	21(16.03)	29(11.6)	50(20)	
Smile Arc	Parallel	73(55.72)	61(51.26)	134(53.60)	1.204 ^a (p=.548)
	Straight	56(42.74)	54(45.38)	110(44)	
	Reverse	2(1.53)	4(3.36)	6(2.4)	
Type of Smile Display	Tooth	53(40.46)	57(47.90)	110(44)	6.829 ^a (p=.078)
	Papillary	61(46.56)	38(31.93)	99(39.6)	
	Gingival	17(12.98)	23(19.33)	40(16)	
	Mucosal	0	1(0.84)	1(0.4)	
Number of teeth displayed	Upto canine	12(9.16)	13(10.92)	25(10)	23.146 ^a (p=.000) [†]
	Upto 1 st Premolar	39(29.77)	14(11.76)	53(21.2)	
	Upto 2 nd Premolar	55(41.98)	40(33.61)	95(38)	
	Molar Display	25(19.08)	52(43.7)	77(30.8)	

The average smile was found in 50% of the participants which was the highest amongst the three (61.81% of females and 17.6% of male). Notably, low smile was found in 31% participants (28.2% females and only 34.4% males) whereas high smile was found in 18.8% of participants (9.92% in female and 28.57% in males). (Fig.1) There was a statistically highly significant difference seen between the groups ($p < 0.01$) with higher frequency for Average smile with female participants. This was in agreement with the literature⁷⁻¹⁴. In the present study, followed by average smile line, there was a higher prevalence for low as compared to high smile line. Tjan and Miller¹² also reported that high smile line was least common in their study, which is in agreement with the present study. Contrary to this, some studies revealed low smile line to be least common among their participants.^{7,9,13,16}. Considering the gender variation, it was observed that females had a higher prevalence for greater gingival display; with 35.29% females presenting with high smile line while males reported a lower frequency of high smile line. This was in agreement with the study done on smiling photographs of celebrities¹⁵.

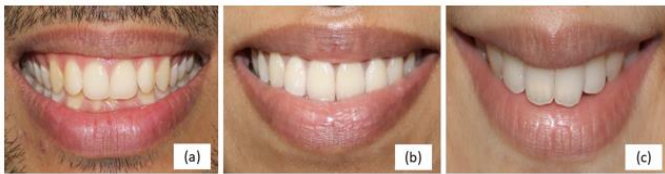


Fig 1: A Photograph of The Participant During the Posed Smile Demonstrating an Example of High (a), Average (b) and Low Smile (c)

Prevalence of upward upper lip curvature was 52.8% (65.6% in females and 18.4 % in males) followed by straight curvature i.e 27.2% (18.32% female and 17.6% male). The least prevalent type was downward i.e. 20% (16.03% in females and 11.6% in males). There was a statistically highly significant difference seen between the groups ($p < 0.01$) with higher frequency for upward

with females (Fig.2) This was found to be harmonious with other studies^{17,18}. Contrary to this Bishal Babu observed a higher prevalence for straight and downward curvature to upward curvature⁷. Similarly another study conducted among Indian population observed a higher prevalence for downward lip curvature as compared to upward lip curvature⁹.

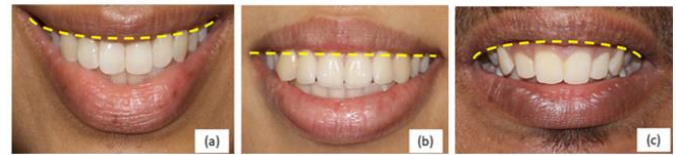


Fig. 2: A Photograph of The Participant During The Posed Smile Demonstrating An Example Of Upward (a), Straight (b) and Downward Upper Lip Curvature (c) Prevalence of the variation in smile arc demonstrated that, 53.6 % of the total sample (55.72% female and 51.26% male) had incisal edge of maxillary anterior teeth parallel to upper border of lower lip, while they were in a straight line in 44% of the total sample population (42.74% female and 45.38 % male). In the given sample there were a total of 2.4% population (1.53% female and 3.36% male) with reverse smile arc. There was a statistically non-significant difference seen between the groups ($p > 0.05$) (Fig. 3) This was in accordance with Parekh wherein orthodontists and laypersons preferred parallel (ideal) smile arc as compared to flat smile arc.¹⁹ Another study conducted by Hulsey concluded, the flat smile arc to be less attractive among the participants.²⁰ Similarly, other studies found higher esthetic scores for ideal smile arcs.^{7,9,21}



Fig 3. A Photograph of The Participant During The Posed Smile Demonstrating An Example Of Parallel (a), Flat (b) and Reverse Smile Arc (c)

d) Accounting for the type of display, most of the sample demonstrated an equivalent prevalence of tooth as well as papillary display of smile. Tooth type demonstrated highest of 44% prevalence (40.46% female and 47.90% male). While papillary display accounted for 39.6% (46.56% female and 31.93% male). As compared to the former two types, the gingival & the mucosal display demonstrated the least prevalence accounting for 16% (12.98% female and 19.33% male) and 0.4% (0% female and 0.84% male) respectively. There was a statistically non-significant difference seen for the frequencies between the groups ($p > 0.05$) (Fig. 4). Thus, it is conclusive that females demonstrate more of papillary type of smile display and less of the excess gingival display type.¹⁵

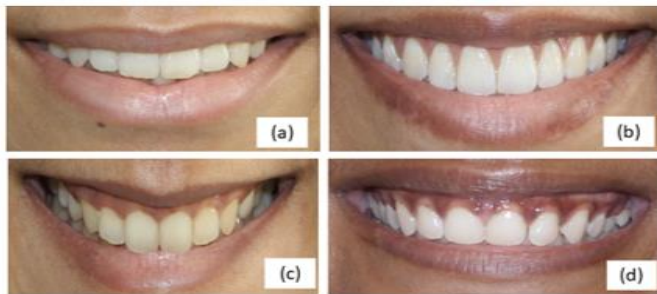


Fig 4: A Photograph Of The Participant During The Posed Smile Tooth(a), Papillary(b), Gingival (c) and Mucosal Type Of Smile Display (d).

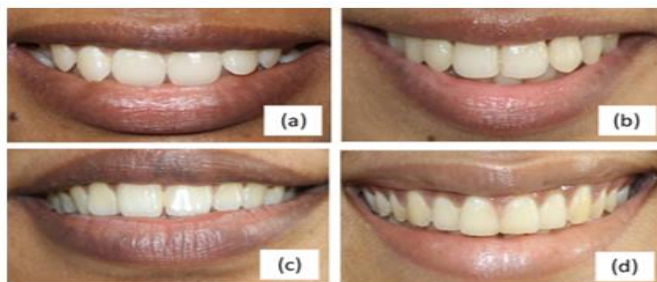


Fig 5: A Photograph Of The Participant Demonstrating The Number Of Teeth Displayed In Smile: Up to Canine (a), Up to 1st Premolar (b), Up to 2nd Premolar (c), And Up to Molar (d)

e) The number of teeth displayed in smile was divided into categories based on the terminal tooth displayed.

This included up to canine, up to 1st Premolar, up to 2nd Premolar and Molar display. (Fig. 5) In the present study, up to canine type of smile was found in 10% of the sample (9.16% in females & 10.92% in males); 21.2% (29.77% in females & 11.76% in males) showed 1st premolar type of display while 38% with 2nd Premolar type (41.98% in females and 33.61% in males) and 13.33% with Molar type display (6.9 % in females & 29.41% in males). There was a statistically highly significant difference seen between the groups ($p < 0.01$) with higher frequency for 2premolar with females. Thus, in a higher proportion, second premolars and molars type of smile display is prevalent which is in agreement to other studies^{9,15}. But some studies found exposure up to first premolars.^{10,23}

B) For Perception Evaluation

To evaluate the perception regarding the attractiveness of different smile traits, a close ended questionnaire of 10 questions were presented to a total of 43 dental students who were recruited as evaluators for the study. The questionnaire comprised of 3 subheadings: Rate the photographs in terms of attractiveness of:

1. The type of smile displayed /gingival display:

Tooth/papillary/gingival/mucosal

2. With respect to its smile arc:

Parallel/ flat/reverse

3. The number of teeth displayed in the smile:

Molar /premolar/ canine smile

These traits were then scored using a Linear Numerical Rating scale of 0 to 5, with 0 being the least attractive and 5 the most attractive. (Table 2,) It was observed that the evaluators rated the papillary type of smile display type as the most attractive –Score 5 (39.5%), followed by gingiva type – Score 3 (25.6%), tooth type – Score 2 (32.6%) and mucosal type – Score 0 (51.2 %) which was found to be the least attractive among the participants. A

study conducted by L. Ousehal et al. to compare the perception of altered smile esthetics among Moroccan professionals and lay people.²⁵ They observed that as compared to the lay people, the professional group evaluated this smile esthetic discrepancy to be unaesthetic when the gingival exposition increase was 4 mm or greater. Similar study was conducted by Kokich²⁶ Al Taki²¹ ,concluded that, orthodontists rated 0mm of display as the most attractive, however a display beyond 4 mm was found to be unattractive even among the dentists and the layperson.

Likewise, raters appreciated the parallel smile arc to be the most attractive – Score 5 (37.2%), followed by flat

smile arc – Score 2 (32.6%) and reverse smile arc - Score 1 (55.8%) as the least attractive. Al Taki study revealed similar results wherein, he observed that dentists rated ideal smile arc(parallel) to be most attractive as compared to flat smile arc.²¹

For the number of teeth displayed in a smile, molar smile was rated as the most attractive – Score 5 (30.2), followed by premolar smile – Score 4 (34.9%) and canine smile – Score 2&1 (37.2% & 27.9% respectively). This was in agreement to the literature that supported the prevalence of premolar and molar smile display as most attractive as compared of canine type of smile display.^{9,10,15,23}

Table 2: Frequency of Different Characteristics of Smile Based On Perception of Dental Students

Rating Scale Score	Smile Display Type				Smile Arc			Number of Tooth Display		
	Tooth	Papillary	Gingival	Mucosal	Parallel	Flat	Reverse	canine	Premolar	Molar
0	7.0	0.0	7.0	51.2	0.0	4.7	27.9	7.0	2.3	2.3
1	4.7	7.0	23.3	27.9	0.0	25.6	55.8	27.9	4.7	0.0
2	32.6	9.3	16.3	16.3	7.0	32.6	9.3	37.2	23.3	14.0
3	25.6	18.6	25.6	4.7	14.0	27.9	4.7	20.9	27.9	18.6
4	20.9	25.6	20.9	0.0	41.9	9.3	2.3	7.0	34.9	34.9
5	9.3	39.5	7.0	0.0	37.2	0.0	0.0	0.0	7.0	30.2

Conclusion

The understanding of smile analysis is the need of the hour in the present world where aesthetics is always given an upper hand by the patients. Within the limitations of the present study, the primary research hypothesis can be negated. Thus, variations based on prevalence for upper lip position, smile arc, upper lip curvature, smile display type and number of teeth do exist as displayed in the smile among students studying in a dental institute. However the gender based variations were not found to be statistically significant for the prevalence study. Additionally, there are differences in perception for attractiveness with a parallel smile arc, papillary smile display type and molar type of teeth

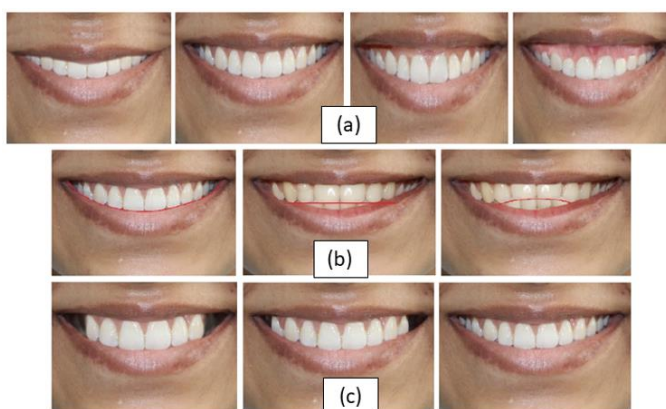


Fig 6. Modified Photograph Presented to Rate the Attractiveness Among 4 Variances of a)Gingival Display: Tooth, Papillary, Gingival and Mucosal (b) Smile Arc: Parallel, Flat and Reverse. (c)No. of Teeth Display: Canine, Premolar and Molar Smile.

display among the dental students. The results of this study have shown that dentists detect specific dental esthetic discrepancies at varying levels of deviation. Therefore, it is the responsibility of dentists initially to inform the patient of the noticeable deviations and then allow the patient to make his or her own decisions as to the overall esthetic significance of each discrepancy.

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