



Original Article

# Photographic Evaluation, Analysis and Comparison of Aesthetically Pleasing Smiles: A Prospective Study

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Cite this article as: Janu A, Azam A, Tandon R, Chandra P, Kulshrestha R, Umale V. Photographic Evaluation, Analysis, and Comparison of Aesthetically Pleasing Smiles: A Prospective Study. Turk J Orthod 2020; 33(3): 177-82.

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## ABSTRACT

**Objective:** To evaluate the differences in aesthetically pleasing smiles and compare the smile arc parameters in males and females by dental specialists using photographs.

**Methods:** The study was conducted on 500 North Indian subjects (Indo-Aryan race; 212 males and 288 females) aged 17-25 years (mean age, males=21.1 years; females=23.4 years), with reasonably pleasing smiles. The facial photographs were taken using a DSLR camera. The standardized photographs were shown to 30 judges for evaluation and rated using the visual analog scale. The smiles were categorized into attractive, fair, and average. The quantification of the smile characteristics was done by using an objective method that involved identifying consonant and non-consonant smiles.

**Results:** The association between smile arc and smile attractiveness was significant ( $p=0.018$ ) in females. The buccal corridor width was higher among those with fair to attractive smiles as compared with those with an average smile ( $p=0.018$ ). Most subjects with an attractive smile had a smile arc parallel to the upper lip as compared with most subjects with a fair or average smile who did not have the smile arc in parallel ( $p=0.006$ ).

**Conclusion:** Most females were in the fair to attractive category whereas most males were in the average to fair category. The buccal corridor width was found to be higher among those with a fair to attractive smile as compared with those with an average smile. There was an association between smile arc and smile attractiveness in females.

**Keywords:** esthetics, photography, smiling

### Main points:

- The buccal corridor width was higher among those with fair to attractive smiles as compared with those with an average smile.
- Most subjects with an attractive smile had a smile arc parallel to the upper lip.
- Most females were in the fair to attractive category whereas most males were in the average to fair category.
- There was an association between smile arc and smile attractiveness in females.

## INTRODUCTION

The word "aesthetics" is derived from the Greek word for "perception", and relates with magnificent and charming characteristics. It has two aspects: objective and subjective (1). The objective (commendable) charm depends on the thought of the object itself, suggesting that the object has properties that make it without a doubt commendable. The subjective (delightful) grace is a quality that is esteem loaded and is with respect to the tastes of the individual thinking about it (2). An appealing and admirably adjusted smile is the principal aim of the treatment provided in present day orthodontic therapy (3). It is necessary to control the aesthetic results brought about by orthodontic therapy, which is achievable by knowing the rules that deal with the harmony among teeth and their adjacent soft tissue while smiling (4).

As indicated by the standards of visual recognition, a consonant and symmetric organization of teeth, visible gingival, buccal vestibular areas, and lips are a necessity for an aesthetic and gratifying smile. This smile creation is shaped by the lips in such a way that the arrangement of teeth and visible gingiva is customized by the profile of the lips and height of the smile line. The profile of the lips influences the visual establishment, for example, the buccal vestibule, smile arc, smile index, and the quantity of visible incisal edges (5). Furthermore, it was recently stated that the basic components in the self-impression of the smile allure are the visible teeth, buccal vestibular space, smile arc, and position of the upper lip (6-8). A comprehensive way to deal with orthodontic practice would not just be to treat the malocclusion present in the teeth, but also to manage the profiles of people that impact the individuals' bearing and prosperity. The early hypothesis of aesthetics encircled around the patient's facial contour and it was thought that once the perfect tooth jaw positions were attained, the soft tissues would also align (9). In recent times, the frontal assessment as well as the profile evaluation has been given equal value. Smile analysis is one of the chief elements of a frontal facial evaluation.

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There are two forms of smiles, the happiness or Duchene smile and the presented/posed or social smile (10). The posed smiles have acquired significance in dentistry and orthodontics fundamentally on the grounds that they are replicated easily after some time. Ample consideration has been given to the clinical examination of the visible zone of smile, which is decided by the inter-commissural width, smile arc, inter labial distance, smile index, and visible gingival. Examining the smile and acquiring the midpoints for different smile portions give a recommendation regarding the standard of a normal pattern to fill in as a rule for the production of an aesthetically pleasant smile. A study conducted by Hulsey et al. (11), in which he evaluated the smile arc and aftereffects of his examination, demonstrated that the patients who were treated orthodontically had a low smile quotient than the untreated patients. Rigsbee et al. (12) reasoned that in an alluring smile, the upper lip was raised to uncover 10 mm of the maxillary incisors, the mouth expanded to 30% of its actual width, and the lips were separated by approximately 12 mm. Very little literature is available on the gender differences in smiling and the variability of smiling morphology in humans. Hence, to bring clarity on this topic, this study was done to evaluate the smile characteristics of males and females using frontal view photographs of smiles and also to compare the smile arc for consonant and non-consonant smiles.

## METHODS

The study was carried out on 500 patients taken from the Department of Orthodontics and Dentofacial Orthopedics (212 males and 288 females after performing a power analysis) between the ages of 17 and 25 years (mean age for males=21.1 years; females=23.4 years) with reasonably pleasing smiles. The pleasing smile was considered for incisor crowding, incisor display, gummy smile, and lip contours. The patients who had normal values of the abovementioned parameters were enrolled in the study. The study was approved by the Institutional Ethics Committee; the patients were educated before the study, and informed consent

forms were signed and obtained. All the subjects were selected with the following inclusion criteria: no previous orthodontic treatment; Decayed Missed Filled Teeth (DMFT) Index by Klein, Palmer, and Knutson of zero; ideal overjet and overbite; complete permanent dentition with or without a third molar; good oral hygiene; and no canting of the maxillary occlusal plane. The patients who fit in the above inclusion criteria were included in the study. The rest were excluded. The facial photographs of 500 subjects were taken using a Nikon SLR 3200D digital camera in the photography room of the college (Figure 1). The records of the subjects were taken in the form of posed smile photographs (in the light of the fact that the presented posed smiles are the most repeatable) after seating them in a cephalostat with a natural head position. The photos of presented smiles were recorded in the same domain with an identical background. The camera along with a tripod was fixed at a location, and all the snapshots were recorded in color. The photos were moved to the computer software (Adobe Photoshop, version 7, Adobe Systems, San Jose, California, USA) where they were cut short upright and horizontally by taking into consideration the nose tip and soft tissue pogonion and a perpendicular drawn down from the zygomatic prominence respectively as limits. All images were taken at a real smile (1:1 ratio) life size; hence, there was no magnification error. The ruler and pointer in the software were utilized to get all the estimations for this examination.

The index related to the smile put forward by Ackerman and Ackerman (7) is measured by dividing the inter-commissural width/breadth by the inter-labial width/height (Figure 2). We utilized an improved form of the smile index, called the measured smile index, as a portion of the refinement to incorporate the lips and calculated the inter-vermilion extent/distance at the midline for height and inter-commissural distance for width.

Modified Smile Index=Inter-commissural width/Inter-labial gap X 100

The buccal corridor width was also measured by joining the lines from the buccal aspect of the posterior teeth to the angle of the mouth in the photos. The amount of incisor display was calcu-



Figure 1. a, b. Unattractive smile photos (a) and, attractive smile photos (b)

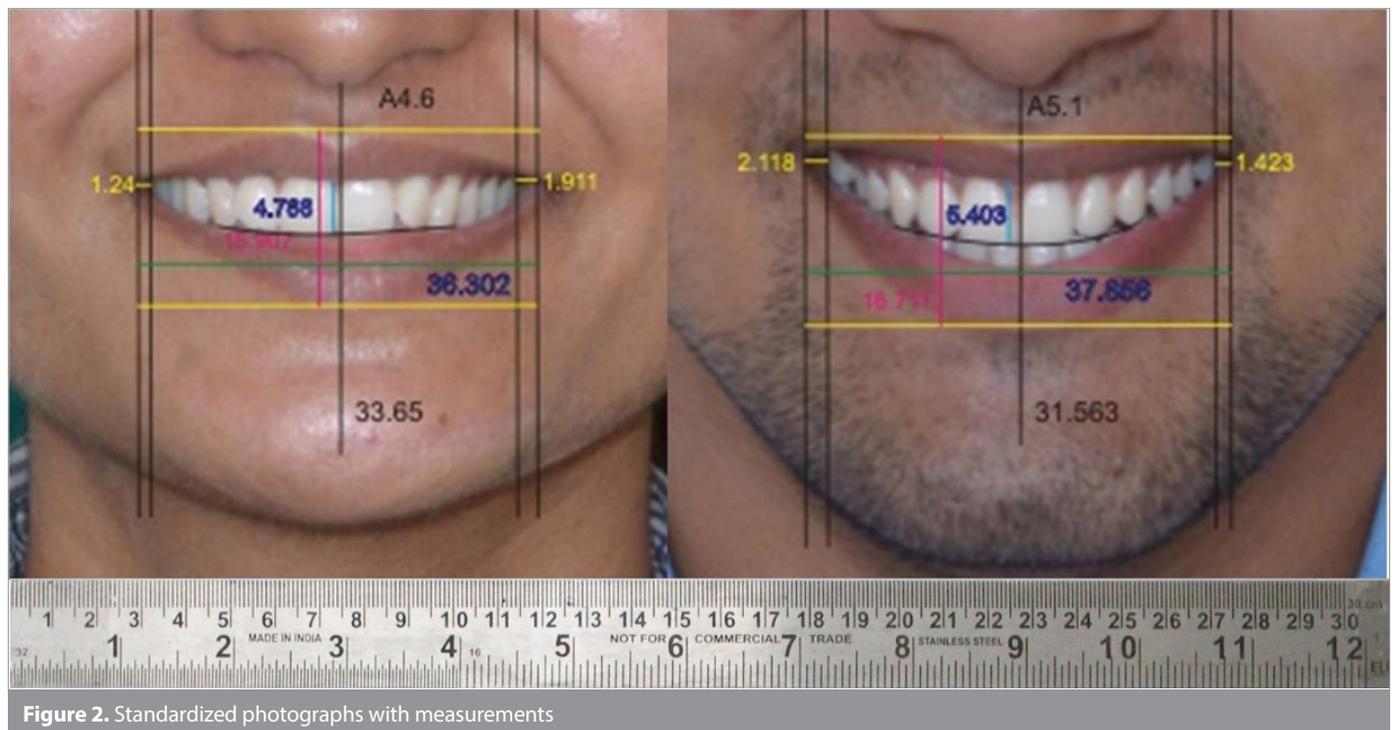


Figure 2. Standardized photographs with measurements

lated by drawing a line from the center of the upper lip perpendicularly downward to the midpoint of the incisal edges of the maxillary incisors. A consonant smile is described as that when the smile arc of the maxillary anterior teeth at the incisal edges are inline or equal to the curvature of the upper lip line. All 500 standardized photographs were shown to a panel of judges for evaluation via a projector for 20 seconds each in several different sessions. The panel comprised 6 orthodontists, 6 oral and maxillofacial surgeons, 6 prosthodontists, 6 beauticians, and 6 lay persons (mean age=35.5 years; 3 males and 3 females in each group). No communication between the panelists was allowed during the evaluation. The panelists were given a blueprint with a visual analog scale (VAS) varying from 1 to 10 (1=worst; 10=very good) to assess these smiles. The VAS was briefly elucidated using a few words to the panel members, with many demonstrations before starting. The smiles were categorized into attractive, fair, and average smiles based on the VAS scores, <3=average; 4-6=fair; >7=attractive. The grouping was done to simplify the categories as the sample size was large to calculate each one individually. A prospective power analysis using the Power and Precision software (version 2.0, Power and Precision, 2000, developed by Borenstein) was done to find the interrelationship for comparing the modified smile index and if the other indexes were correct. For this reason, the  $p$  value was positioned at 0.05 (2 tailed). To check for an error in the assessment of photos, 20 photos were showed to each judge again after a period of 10 days to check for reliability. No difference was seen in the assessment given by the judges for both the photos.

### Statistical Analysis

The statistical analysis was performed with the Statistical Package for Social Sciences, version 16.0 software (SPSS Inc.; Chicago, IL, USA). The gender-wise comparison of the VAS scores was done to find the statistical significance between males and females.

An analysis of variance (ANOVA) analysis with a post hoc evaluation was performed between different parameters of males and females. A group comparison of different parameters of both genders was done using the measures of dispersion mean and standard deviation along with the test of significance to obtain the desired results. For the group-wise perception of the evaluators, the number of evaluators was too small to get any significant difference ( $n=6$ ). The perception of the smile based on the gender of the evaluators was compared using a Student paired  $t$  test, and a statistically significant difference was seen.

### RESULTS

Most females had VAS scores in the fair to attractive category whereas most males had VAS scores in the average to fair category (Figure 3). Statistically, this difference was significant ( $p=0.012$ ) (Table 1). The buccal vestibular width (left side) was established to be more including those with a fair to charismatic smile as compared with those with an average smile ( $p=0.018$ ) (Table 1). Most females with a parallel smile arc had an attractive smile while most females who did not have a parallel arc had an average to fair smile; this association between smile arc and smile attractiveness was significant ( $p=0.018$ ). In males, the proportion of attractive smiles was higher for the parallel smile arc as compared with those not having a parallel smile arc, but this association was not statistically significant. Most subjects with an attractive smile had a parallel smile arc as compared with most subjects with a fair and average smile who did not have a parallel smile arc ( $p=0.006$ ).

### DISCUSSION

The reappearance of the soft tissue pattern in clinical orthodontics has made smile analysis a chief component in detection and therapy (13, 14). In our study, we assessed different qualities of a smile using two techniques. Most females had VAS scores in the

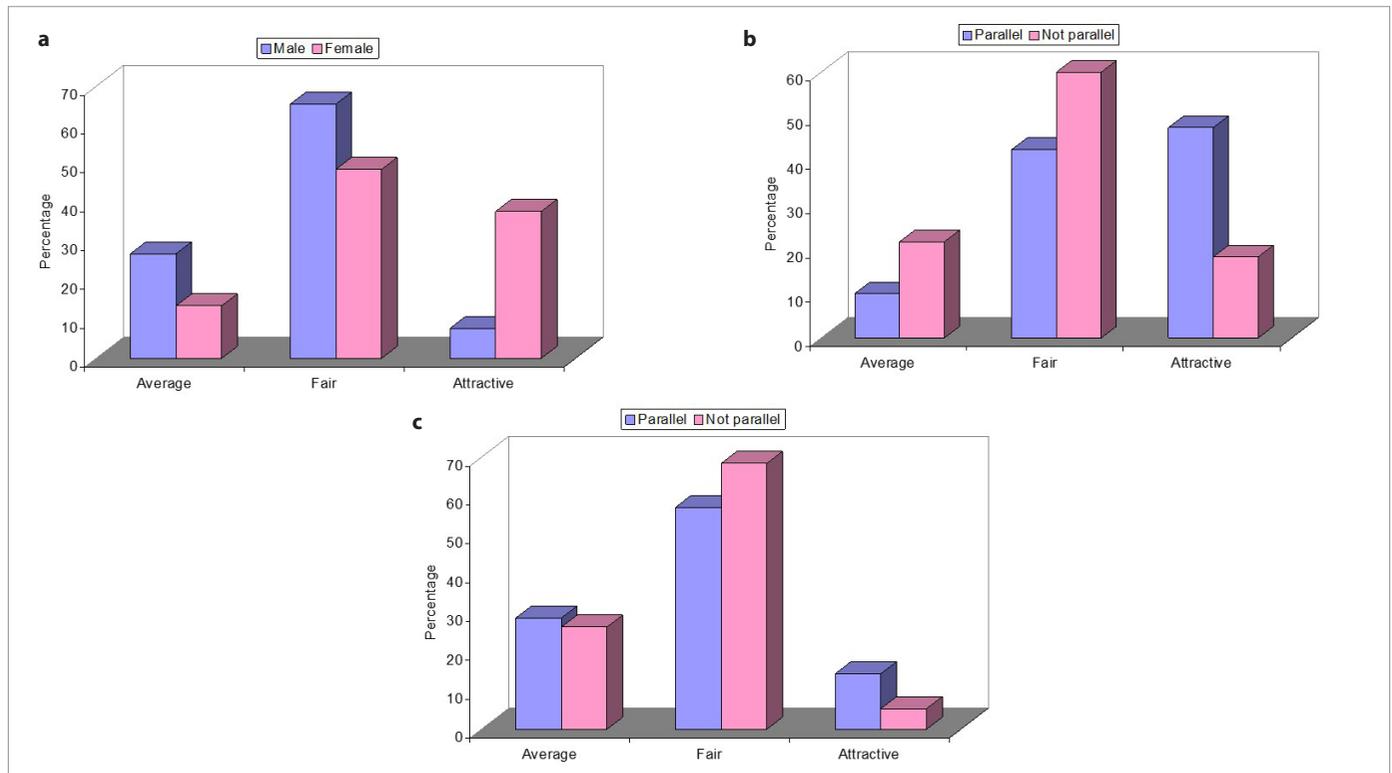


Figure 3. a-c. Gender-wise comparison of the VAS scores (a), smile arc and VAS scores (females) (b), and smile arc and VAS scores (males) (c).

Table 1. Comparison of different parameters among different categories of the VAS Scores (both genders)

Parameter	Average (n=140)		Fair (n=230)		Attractive (n=130)		ANOVA	
	Mean	SD	Mean	SD	Mean	SD	F	p
Incisal exposure	7.12	2.07	7.57	2.07	7.60	1.78	0.381	0.684
BCR	4.01	0.82	4.50	1.31	4.30	1.35	1.033	0.360
BCL	3.52	0.94	4.34	1.26	4.52	1.16	4.160	0.018*
Average BC	3.77	0.79	4.42	1.22	4.41	1.17	2.285	0.107
Inter-labial width	24.92	2.46	25.75	3.21	24.47	2.43	2.006	0.140
Inter-commissural width	56.74	7.25	58.56	6.19	58.36	5.26	0.587	0.558
Smile index	44.44	6.04	44.20	5.51	42.15	4.71	1.628	0.202

BCR: buccal corridor width (right); BCL: buccal corridor width (left); BC: buccal corridor  
 \*Significant at p<0.05

fair to attractive category whereas most males had VAS scores in the average to fair category. Our outcomes concur with those of Krishnan et al. (15), who expressed that the female smile appears to be extra appealing and in harmony than the male smile. Similarly, Geron and Atalia (16) determined that the gender of the imitation smile photo influences the smile allure as they used females as the only model image. We inferred that the perception of attractiveness is biased by the gender of an individual. Smile in a gender perspective is perceived differently as has been elucidated by Dong et al. (17), who found the difference in the perception of attractiveness and personality judgment of the two genders. Similar perception differences based on the gender were also observed in several other studies (18, 19). In a study by Maulik and Nanda (20), smile components were compared between the genders and they found a rationally notable distinction between them in every smile element examined. A greater anterior smile line was seen in females by Peck and Peck (21), and our findings

were in accordance with theirs. Females demonstrated a greater rate of an inverse smile arc. In addition, we noted that females show a smaller buccal vestibule than males.

In an examination by Parekh et al. (22), the gender of the model possibly showed significance when the smile arc was similar, and the buccal vestibule was desirable. Under these circumstances, the male buccal corridor width was unappealing due to greater visibility of the buccal vestibule than that noticed in females. In this study, we assessed accordance and discordance in the smile arc association. The word accordance explains the parallel correlation between the contour of the maxillary incisal edge and contour of the lower lip while smiling. In discordance or a flat smile, the same correlation was noted straight upon smiling. In a study conducted by Tjan et al. (23), the authors stated that adults show a greater (85%) maxillary incisal smile curve parallel to the inner curvature of the lower lip. Around 14% of cases presented a

flat line instead of a curved line and only 1% of cases showed an inverse smile curve. It is familiar that an in-accordance smile arc appears stunning rather than a straight/flat smile (15). A greater number of women showed an appealing smile than men. Most subjects with an attractive smile had a parallel smile arc as compared with most subjects with a fair and average smile who did not have a parallel smile arc.

In our study, the majority of females with a parallel smile arc had attractive smiles while most females who did not have a parallel smile arc had average to fair smiles. Our findings are in agreement with those of Krishnan et al. (15) who established that the female smile is more in harmony and attractive than the male smile. Ackerman and Ackerman (7) revealed that through orthodontic or restorative therapy, the arc of maxillary incisal edges can be modified. Several researchers have also laid emphasis on consonance as the key feature of an aesthetic smile (24, 25). To evaluate the frontal smile by visualizing, Ackerman and Ackerman (7) established a proportion, called the smile index, which portrays the zone encircled by the vermilion borders of the lips during the social smile.

Nowadays many studies are being done by researchers to find the effects of the buccal vestibule on smile aesthetics. All reports demonstrate that buccal vestibules have no impact on the aesthetic assessments of smiles. Parekh et al. (22) discovered that the width of the buccal vestibule had a critical effect just when the smile arc was perfect for men. Whereas in females, all buccal vestibule width with a perfect and intemperate smile arc was observed to be in the upper levels of the attractiveness range. This was valid for men with the exception of when the buccal vestibule areas ended up being intemperate. In a study, Oshagh et al. (26) found that the impact of features such as the buccal corridor width is perceived differently for male and female subjects. In this study, in spite of the fact that we could not locate a noteworthy relationship between the charm and buccal corridor widths for the two genders independently, an overall significant association between the left buccal corridor width and attractiveness was observed, favoring the proposed relationship that the larger buccal corridor was related to an attractive appearance. In females, these trends were quite clear, though not significant statistically.

In our study, among all the criteria, only the buccal vestibule width was observed to be statistically noteworthy. In a study performed by Krishnan et al. (15), when the smiles of both the sexes were juxtaposed for their buccal vestibular values, they observed a high relationship, which could not help but contradict their VAS measurements. The values demonstrated a remarkable contrast between the apparent smiles of men and women. Consequently, we can presume that the buccal vestibular space plays an insignificant role in the aesthetic assessment of a smile and the apparent distinction could be because of different reasons, for example, smile arc, alignment of teeth, shades of tooth, gingival structure, visible gingiva, and density of lips.

Graber et al. (27) stated that the factors that may influence the measurement of the buccal corridor space are the background

light specifics in which the photos were taken. As the teeth are situated more posteriorly in the buccal vestibule, the light ends up diminished, which leads to continuous obscuring and subsequently less perception of these posterior teeth. Less light is focused on the photo, and thus, the negative space is greater as fewer teeth would be noticed. Hence, there may have been dissimilarities in the calibration of the light conditions. The other factors that may impact can be the kind of smile examined, in particular, a constrained smile, which is in our study easily reproducible, and a genuine smile as portrayed in the investigation by Johnson and Smith (28), which is a lot harder to recreate. The limitation of this study was that it was performed on a specified population. Further studies can be done on the general population and with a larger sample size.

## CONCLUSION

- Most females were in the fair to attractive category whereas most males were in the average to fair category. Statistically, this difference was significant.
- In both males and females, an increased buccal corridor width was found in attractive smiles.
- There was an association between smile arc and smile attractiveness in females. More females had consonant smiles than males.

**Ethics Committee Approval:** The study was approved by the Institutional Ethics Committee of Saraswati Dental College and Hospital Lucknow UP.

**Informed Consent:** Written informed consent was obtained from the patients who agreed to take part in the study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Conception – A.J., A.A.; Design – A.A.; Supervision – R.T., P.C.; Data Collection and/or Processing – P.C., R.K.; Analysis and/or Interpretation – R.K.; Writing Manuscript – V.U.; Critical Review – R.K.; Literature Search – A.J.

**Conflict of Interest:** The author has no conflict of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

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