Perception and Characterization of Posed Smile: A Photographic Study

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Abstract

Aims of the Study: The aims of the study are: (a) to compare the perceptions of dental specialists and laypeople regarding smile esthetics; (b) to compare male and female smile parameters; (c) to find influence of smile parameters on esthetics of smile.

Materials and Methods: The study was conducted on 60 subjects (30 males and 30 females) of age 18 to 25 years. Frontal posed photographs of all subjects were taken using a digital camera and rated on a visual analog scale by 10 dental specialists and 10 laypersons. Measurements made on photographs were used to analyze various parameters of smile, such as buccal corridor space, smile arc, modified smile index, anterior height of smile, most posterior maxillary tooth visible, and midline relationship of central incisors to philtrum.

Results: Visual analog scale values showed that 6 photographs were rated as very good (3 males, 3 females), 29 as good (11 males, 18 females), 21 as average (13 males, 8 females), and 4 photographs were rated as bad (3 males, 1 female). A high correlation was observed between ratings of dental specialists and layperson's ratings for both male and female smiles. Most of the subjects had non-consonant smile arc, and a high correlation was found between buccal corridor space on right and left sides in both males and females. Most of the male and female smiles had an average anterior height of smile; permanent maxillary first molar was the last tooth visible during smile (73.3% females, 66.7 males); and 55% subjects had coincident midline relationship of central incisors to philtrum.

Conclusion: There was no significant difference in perception of dental specialists and laypersons regarding esthetics of smile. Smile arc and anterior height of smile influenced the esthetics of smile. No significant difference was found between male and female smile parameters except modified smile index.

Keywords
Posed smile, buccal corridor space, esthetics, smile arc

Introduction

The perception of smile esthetics is subjective, influenced by personal experience and social environment.5 Diamond6 reported that what a person finds attractive has much to do with the qualities of surrounding population and other environmental factors. For the same reasons, there can be differences of opinion regarding esthetics of smile between laypeople and professionals. Some studies concluded that dental professionals and general population have different preferences for smile esthetics.7,8 Mc Leod also observed that cultural differences related to smile perception do exist. Canadian laypersons are more discriminating to deviations from ideal and have a narrower range of acceptability as compared to the people of USA.9 US Caucasians, US American Asian Indians, and Indians living in India have different preferences for smile esthetics.10 Therefore, there

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is a need of regional studies on perceptions of different populations regarding smile esthetics.

Most orthodontic patients seek orthodontic treatment to improve their smile. Therefore, smile analysis becomes an integral component of orthodontic diagnosis and treatment planning for a patient, and the expectations of the patient must be considered because of subjective variation in perception. Smile analysis is the assessment of some variables such as smile arc, buccal corridor space, gingival display, tooth proportions, dental and facial midlines, and tooth color. Esthetics of smile depends on these variables. Also some studies found gender difference for various parameters of smile, which was different for different populations. Therefore, it is essential to understand components of an esthetically attractive smile to satisfy patient’s expectation as well as to achieve successful treatment results, and knowledge of sexual dimorphism regarding smile components is also necessary.

The purpose of this study was: (a) To compare the perceptions of dental specialists and laypeople regarding smile esthetics; (b) to compare male and female smile parameters; and (c) to find the influence of smile parameters on esthetics of smile.

Materials and Methods

In this study, a sample of 60 subjects including 30 males and 30 females, aged between 18 and 25 years were selected.

Inclusion Criteria

1. All subjects had full complement of permanent teeth with no supernumerary teeth, and the presence or absence of third molars does not affect our inclusion criteria.
2. All subjects fulfilled the criteria till grade 3 of the esthetic component of Index of Orthodontic Treatment Need (IOTN) (Figure 1). The first three grades of esthetic component of IOTN include subjects having well-aligned teeth without any tooth malformation or fracture.
3. None of the subjects had any history of orthodontic treatment or maxillofacial surgery, periodontal disease, and treatment except for routine scaling and polishing.
4. The subjects did not have any craniofacial anomalies or other pathologies.
5. Subjects with short upper lip were not included in study sample.

Informed consent was obtained from each subject before taking the photographs, and ethical clearance was obtained from Ethical Committee of Desh Bhagat Dental College and Hospital for conducting the study. Sample size was calculated using statistical analysis based on pilot study. Intraobserver and interobserver errors were calculated statistically using Dahlberg’s formula and dependent t tests at significance level of 5%.

The subjects were photographed with posed smile after positioning them in a cephalostat. A mirror was hung on the wall facing the cephalostat at a distance of 5 feet from the subject. The subject was asked to look into the reflection of his/her own eyes in the mirror to obtain natural head position. Photographs were taken in the same environment with same lighting conditions using a digital camera which was fixed in position with a tripod stand at a distance of 4 feet from subject. The camera lens was adjusted parallel to the apparent occlusal plane. Colored photographs were taken and transferred to computer software and cropped in vertical and transverse direction to a standardized (4” × 6”) image size. A panel of 20 evaluators was selected, which included 10 dental specialists and 10 laypersons. Dental specialists were dental academicians in different departments except department of orthodontics as orthodontists observe smile parameters more critically due to their special training and detailed knowledge of smile analysis and smile esthetics. Laypersons are educated people with minimum qualification of graduation. The age range for all evaluators was 30 to 50 years. Photographs were projected in front of evaluators as a slide show on a projector. For evaluation, each photograph was projected for 25 seconds. Evaluators were not familiarized with any of the smile parameters in questionnaire form. The evaluators were given a chart with a visual analog scale for rating the overall appearance of smiles based on whatever factors they feel important. Photographs were grouped according to rating of visual analog scale as follows: <3 very good, 3 to 4.9 good, 5 to 6.9 average, >7 bad.

All photographs were developed in standardized size (4” × 6”), and these parameters were measured: smile arc, buccal...
corridor space, modified smile index (MSI), anterior height of smile, most posterior maxillary tooth visible, and midline relationship of central incisors to philtrum.

**Smile arc:** Smile arc is the relationship between the curvature of the incisal edges of the maxillary anterior teeth and the curvature of upper border of the lower lip. When these two are parallel to each other, smile arc is consonant (Figure 2A), and if these are not parallel to each other, smile arc is non-consonant (Figure 2B).

**Buccal corridor space:** It is measured from mesial line angle of maxillary first premolar to the inner portion of commissures of lips (Figure 3). To calculate buccal corridor space, two vertical lines were drawn, one along the mesial line angle of maxillary first premolar and the other along the inner commissure of lip on both sides. The horizontal distance between these two vertical lines was measured as buccal corridor space.

**Modified smile index:** MSI is a ratio calculated by dividing intervermilion distance at midline by intercommissural distance (Figure 4).

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\text{MSI} = \frac{\text{Intervermilion distance}}{\text{Intercommissural distance}} \times 100
\]

**Anterior height of smile:** It represents display of maxillary incisors while smiling. In average anterior height of smile 75% to 100% of crowns of maxillary incisors are visible. In high anterior height of smile, a continuous band of gingiva above the maxillary incisors is visible on smiling (Figure 5a-5c).

**Most posterior maxillary tooth visible:** The most posterior maxillary tooth visible on posed smile was taken into account. In case of discrepancy between the two sides, the most posterior tooth among the two sides was taken.

**Midline relationship of central incisors to philtrum:** It was assessed by a line passing through philtrum and the center of two incisors (Figures 6A and 6B).

**Results and Observations**

The average visual analog scale value for each smile was calculated and rated from good to bad. According to visual analog scale values, 6 photographs were rated as very good (3 males, 3 females), 29 as good (11 males, 18 females), 21 as average (13 males, 8 females), and 4 photographs were rated as bad (3 males, 1 female) (Figure 7).
Spearman’s correlation coefficient rho was calculated to find the correlation between dental specialists’ and layperson’s ratings (Table 1).

Frequency distribution of various smile parameters was calculated for the total sample given in Table 2, and parameter distribution in smile groups was also calculated according to visual analog scale (Table 3). Parameters were also compared in male and female smiles (Tables 4 and 5).

### Table 2. Frequency Distribution of Parameters in Total Sample

| S. No. | Smile Arc | Anterior Height of Smile | Most Posterior Maxillary Tooth Visible | Midline Relationship of Central Incision to Philtrum |
|--------|-----------|--------------------------|---------------------------------------|-----------------------------------------------|
|        |           |                          | 1st Premolar | 2nd Premolar | 1st Molar | 2nd Molar | Coincident | Not Coincident |
| n      | Consonant | Non-consonant | Average | Low | High | 1 | 16 | 42 | 1 | 33 | 27 |
| 60     | 17 (28.3%) | 43 (71.7%) | 53 (88.3%) | 4 (6.7%) | 3 (5%) | 1 (1.7%) | 16 (26.7%) | 42 (70%) | 1 (1.7%) | 33 (55%) | 27 (45%) |

Source: Taken from statistical analysis of study data.

### Table 1. Correlation of Ratings of Dental Specialists and Laypersons

| Smiles | r Value |
|--------|---------|
| Male smiles | 0.580* |
| Female smiles | 0.811*** |
| Overall | 0.728** |

Source: Taken from statistical analysis of study data.

Notes: * $r > 0.5$—significant correlation value, ** $r > 0.7$—high significant correlation value.
Table 3. Distribution of Parameters in Groups According to Visual Analog Scale

| Parameters                        | Very Good (<3) n = 6 | Good (3–4.9) n = 29 | Average (5–6.9) n = 21 | Bad (>7) n = 4 | P-value |
|-----------------------------------|----------------------|---------------------|------------------------|----------------|---------|
| Smile arc                         | Consonant            | 66.7%               | 34.5%                  | 14.3%          | 0       |
|                                  | Non-consonant        | 33.3%               | 65.5%                  | 85.7%          | 100%    |
| Buccal corridor space            | Right side          | 16.08               | 15.50                  | 14.57          | 16.12   |
|                                  | Left side           | 17.00               | 15.75                  | 15.42          | 15.75   |
| Modified smile index             | 43.34                | 44.04               | 45.36                  | 36.91          | .081 (NS) |
| Anterior height of smile         | Average              | 100%                | 89.75%                 | 90.5%          | 50%     |
|                                  | Low                  | 0                   | 3.4%                   | 4.8%           | 50%     |
|                                  | High                 | 0                   | 6.9%                   | 4.8%           | 0       |
| Most posterior maxillary tooth visible | 1st molar       | 83.3%               | 62.1%                  | 71.4%          | 100%    |
|                                  | 2nd premolar        | 0                   | 3.4%                   | 0              | 0       |
|                                  | 1st molar           | 0                   | 3.4%                   | 0              | 0       |
|                                  | 2nd molar           | 16.7%               | 31.0%                  | 28.6%          | 0       |
| Midline relationship of central incisors to philtrum | Coincident | 66.7%               | 62.1%                  | 42.9%          | 50%     |
|                                  | Not coincident      | 33.3%               | 37.9%                  | 57.1           | 50%     |

Source: Taken from statistical analysis of study data.

Notes: NS—Non-significant. P ≤ .05—significant (*).

Table 4. Buccal Corridor Space and Modified Smile Index Measurements

| Right Side (mm) | Left Side (mm) | Modified Smile Index |
|-----------------|----------------|----------------------|
|                 | Males          | Females              | Males  | females | Males  | Females |
| Mean            | 11.48          | 12.20                | 11.23  | 12.23   | 45.68  | 44.26   |
| Standard deviation | 2.14          | 2.42                 | 2.04   | 2.04    | 6.21   | 5.53    |
| P-value         | .221 (NS)      | .01 (S)              | .25 (NS)|         |        |         |

Source: Taken from statistical analysis of study data.

Note: NS—Non-significant.

Table 5. Comparison of Parameters in Males and Females

| S. No. | Smile Arc | Anterior Height of Smile | Most Posterior Maxillary Tooth Visible | Midline Relationship of Central Incisor to Philtrum |
|--------|-----------|--------------------------|--------------------------------------|---------------------------------------------|
|        | n         | Consonant | Non-consonant | Average | Low | High | 1st Premolar | 2nd Premolar | 1st Molar | 2nd Molar | Coincident | Not Coincident |
|        | Males     | 6         | 24       | (20%)   | 25   | 3    | 2      | 1           | 9         | 20       | 0         | 16            | 14            |
|        | Females   | 11        | 19       | (36.7%) | 28   | 1    | 1      | 0           | 7         | 22       | 1         | 17            | 13            |
|        | P-value   | .152 (NS) | .472 (NS) | .504 (NS) | .795 (NS) |         |        |        |        |        |        |        |

Source: Taken from statistical analysis of study data.

Notes: NS—Non-significant.

Discussion

In the present study, a high correlation was found between evaluation of dental specialists and laypersons (r = 0.728). This is in accordance with the study by Flores-Mir et al which stated that the level of dental education has little impact on esthetic perception. Rajeev et al also observed no difference of perception between general dentists and laypersons. Saffarpour et al also observed a similar smile esthetic perception between laypersons and dental
specialists. Al Taki et al reported that orthodontists are more exact and perceptive in evaluating the smile arc and buccal corridor space. A similar observation was made by Sridharan and Samantha, which states that low scores were given by orthodontists as compared to other dental specialists. Another study concluded that laypersons were less discriminating in evaluating buccal corridor spaces than orthodontists and prosthodontists.

**Smile arc:** In this study, most of subjects had non-consonant smile arc (Table 2), and more female smiles showed consonant smile arc than male smiles. Gender difference for smile arc was also found by other studies. According to the visual analog scale, most subjects in the group of very good smiles had consonant smile arc ($P = .037$), which showed that consonant smile arc influenced the subjective evaluation of smile by evaluators (Table 3). Another study also reported that most of subjects had non-consonant smile arc; this finding is similar to our study result. In their study, Tjan et al and Dong et al found most of subjects had parallel smile arc, which is not in accordance with our study. Hulsey confirmed that smiles with flatter smile arc (non-consonant) are less attractive. Parekh et al also reported that both laypeople and orthodontists prefer smiles with parallel smile arcs, and the same fact is reported in our study.

**Buccal corridor space:** There was no significant difference in buccal corridor space between the very good smile group and the other groups, indicating no influence of buccal corridor space on smile esthetics (Table 3).

Various studies also found that buccal corridor space did not influence the esthetic evaluation of smile. Nimballkar et al reported that a medium buccal corridor is the esthetic characteristic of a pleasing smile. Loi et al, Tikku el al, and Parekh et al also found a significant effect of buccal corridor space on aesthetic perception of smile, as perceived by orthodontists, dental students, and laypeople. The differences in results of all these studies may be due to regional and ethnic differences in the perception of people. There was difference among male and female smile buccal corridor space, but it was not significant. Balani et al also reported a similar result.

**Modified smile index:** Mean value of MSI calculated in this study was 44.07. Although MSI value of very good smiles was not statistically different than others, this value is least in smiles rated as bad smiles. As we are aware, there is no previous research on smile esthetics and MSI value. Hence, this parameter needs a thorough research with a larger sample. There was no significant difference between male and female smile index.

**Anterior height of smile:** Most of subjects (88.3%) in our study had an average anterior height of smile (Table 2). A statistically significant relationship was found between perception of smile esthetics and anterior height of smile (Table 3).

Maulik and Nanda, Tjan et al, and Dong et al reported that most patients have average anterior smile height. Geron and Atalia studied the effect of gingival display on smile attractiveness and concluded that attractiveness decreased with increased gingival display during smile and speech. Hulsey and Mackley demonstrated that minimal gingival display is more esthetic. Hence, these studies are in favor of our study results. Average anterior height of smile was observed to be more in female smiles than male smiles, but the difference was not statistically significant.

**Most posterior maxillary tooth visible:** Most subjects (70%) in the present study had maxillary first molar visible while smiling and 26.7% had second premolar visible while smiling (Table 2). No statistically significant relationship was observed between the most posterior tooth visible while smiling and esthetics of smile (Table 3). Dong et al found 57% of their sample showed maxillary second premolar. In Maulik and Nanda’s study, 51% of sample displayed maxillary second premolars and 25% of sample showed first molar, while Tjan et al found only 4% of their sample showing maxillary first molar on smiling.

**Midline relationship of central incisors to philtrum:** A total of 55% subjects had coincident midline relationship of central incisors to philtrum (Table 2). Coincident midline relationship to philtrum was observed in 66.7% of most attractive smiles, but it was not statistically significant (Table 3). Midline discrepancy of greater than 2 mm is not esthetically acceptable. According to Kokich et al, discrepancies up to 4 mm may remain undetected. Janson et al recommended discrepancy up to 2.2 mm is acceptable. No significant difference was found between males and females for midline relationship of central incisors to philtrum.

These results need to be investigated further with a larger sample for their implementation in clinical use. Effect of facial hair on esthetics of smile in males was not taken into consideration in this study, which may affect esthetic perception. Therefore, this factor also needs to be further investigated.

**Conclusions**

- Dental specialists and laypersons had similar perceptions of smile esthetics in this study sample.
- Smile parameters affecting esthetics of smile are: Smile arc and anterior height of smile. Both dental specialist and laypeople preferred average anterior height of smile and consonant smile arc.
- There was no significant difference in male and female smile parameters except MSI, but this difference was not statistically significant.

Therefore, in planning orthodontic treatment, parameters influencing smile esthetics should be considered, but separate considerations for male and female patients are not of much importance. Although laypeople are not aware of orthodontic smile parameters, they have the same preference for smile parameters as that of dental specialists.
Therefore, orthodontists can rely on judgments of laypersons in determining and executing appropriate treatment for improving smile esthetics.

**Statement of Informed Consent and Ethical Approval**

Necessary ethical clearances and informed consent was received and obtained respectively before initiating the study from all participants.

**Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The authors received no financial support for the research, authorship, and/or publication of this article.

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