

## Original Research

# Vertical Anterior Tooth Display and Smile Attractiveness

Kanu Priya<sup>1</sup>, Avesh Sachan<sup>1</sup>, Suman Yadav B<sup>1</sup>, Pratik Verma<sup>3</sup>, Sapna Arya<sup>2</sup>

<sup>1</sup>Departments of Orthodontics and Dentofacial Orthopedics,

<sup>2</sup>Prosthodontics and Crown and Bridge and Implantology, Rama Dental College and Research Centre, Kanpur, India

<sup>3</sup>Departments of Orthodontics and Dentofacial Orthopedics, Dental institute, RIMS, Ranchi

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## ABSTRACT

### Introduction

Our study is done to compare and verify if different levels of maxillary central incisal edges and gingival display influence the perception of smile among orthodontists, dentists, orthodontic patients, and laypersons.

### Methods

Photographs of the smiles of 1 male and 1 female showing the gingival contours of the incisors and the canines were digitally altered, creating steps from 0 to 2.0 mm in 0.5-mm increments, with and without gingival exposure. The 20 pictures were shown in random order to 160 evaluators divided into 4 groups who were asked to provide attractiveness scores on visual analog scales.

### Results

Both the steps (P<0.001) and the gingival exposure (P<0.05) had statistically significant influences on the evaluators in all groups. There was also a statistically significant difference (P<0.001) between the evaluations of orthodontists with the other groups.

### Conclusion

Vertical relationship of incisor borders with the 1.0-mm step was given the highest grading. There were significant differences in the evaluation of orthodontists when compared with the other 3 groups, and no significant difference was detected between the other 3 groups. The gingival display holds an important value in the esthetic perception of the smiles evaluated. There were significant differences between the evaluations of the smiles of the man and the woman.

## INTRODUCTION

A beautiful smile and an attractive face appears to be connected to each other. Major attention is directed towards the mouth and the eyes of the speaker's face.

This study verifies whether different sizes of maxillary incisal edges and gingival display effects the perception of smile attractiveness in various groups of orthodontists, dentists, orthodontic patients and laypersons.

What according to one group might be an attractive smile may not seem to the other group. So, it is important to address the relationship of the incisal

borders for a more esthetic smile, among not only orthodontic patients and orthodontists but also laypersons and dentists.<sup>1</sup>

## MATERIAL AND METHODS

This study includes smiles of 2 volunteers - a man and a woman with incisors aligned in a curve parallel to lower lip and showing the gingival contours of the maxillary teeth. This study includes four groups of evaluators: orthodontists, general dentists, laypersons, orthodontic patients.

\* Corresponding author: Kanu Priya, Departments of Orthodontics and Dentofacial Orthopedics

Group of orthodontists includes specialists who works with fixed orthodontic techniques. The dentist group are required to have graduated more than 2 years previously and to practice any speciality other than orthodontics. Layperson group are required to have a completed or an uncompleted college degree. Orthodontic patient group are required to be involved in active orthodontic treatment for at least 6 months in private offices or at the orthodontic OPD of Rama Dental College.

Age group for orthodontists – 28-60 years, general dentists – 25-60 years, laypersons - 18-60 years and orthodontic patients was 18-35 years.

### **MATERIALS USED**

Digital camera (CANON EOS REBEL), Adobe photoshop CS5 software, Digital caliper to measure the incisor length, Virtual ruler, G Power software to calculate sample size(version 3.1.9.213), 20 visual analog scales (VAS) 100 mm wide.

Keynote software (version 6.1,Apple) to assemble the 10 manipulated pictures of each model in a presentation. Statistical analysis with software (version 21,IBM)

### **METHOD**

The photographs of smiles of 2 volunteers-a man and a woman showing the gingival contours of the maxillary teeth with incisors aligned in a curve parallel to lower lip.



**1. Smiles of the man after manipulation**



**2. Smiles of the woman after manipulation**

Male and female volunteer was chosen according to the following selection criteria:

1. Resident of north india
2. High degree of facial attractiveness
3. Age between 20 and 28 years
4. Smile with characteristics close to esthetic norms

The photographs of the volunteers were taken in a frontal pose, smiling. The smile image of the volunteers was modified in different ways using Adobe photoshop CS5 software

The new manipulation simulated changes to the vertical relationship of the incisor borders, varying from 0 to 2.0 mm in 0.5mm steps exclusively by extrusion of the central incisors.

The real incisors of the volunteers was measured with a digital caliper. A virtual ruler was calibrated in proportion to the measurement in the software to standardize the 0.5mm increments.

Another manipulation, which consists of downward movement of upper lip. The manipulated side was mirrored to ensure perfect symmetry, resulting in 20 images, 10 for each sex. 40 evaluators were recruited in each of 4 groups(orthodontists, dentists, orthodontic patients and laypersons).

After a brief explanation of the study, and how to use the VAS, the evaluators were told to give grades to the following 10 pictures according to their attractiveness, taking 0 as unattractive and 10 as attractive. The grades can be marked at any point of the scale and the transition of pictures will be automatic.

The 10 pictures of each person was displayed at first all together for 20 seconds and then in random order, one by one, for 15 seconds each. The grading must be done when they are displayed one by one. Re-evaluation of the pictures was not allowed.

## STATISTICAL ANALYSIS

Data was analyzed using IBM SPSS Statistics- version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) Descriptive statistics included calculation of means, standard deviation, median and percentages. Data distribution was assessed for Normality using Shapiro-Wilk test. Repeated measures analysis of variance (SPANOVA) with Post hoc Tukey test was done. All values were considered statistically significant for a value of  $p < 0.05$ .

## RESULTS

The sample consisted of 160 evaluators, out of which, 87 were females and 73 were males. The mean age for the orthodontists group was 35 years whereas the mean age of dentists, patients and laypersons were 29.37, 22.45 and 27.58 years respectively.

The means for each picture were grouped and divided by the evaluator group. The highest ranked pictures without gingival exposure were the 1.0 mm step in all the groups amongst both the genders. While the highest ranked picture in the orthodontist and dentist group with gingival exposure was the 1.5 mm step amongst both the genders. In the patients and laypersons group, the highest ranked picture with gingival exposure was at 0.5 mm step amongst the males. In the females, the highest ranked picture with gingival exposure was at 0 mm step amongst the patients group and in the laypersons group, the highest ranked picture with gingival exposure was at 0.5 mm step amongst the females. (Table 4)

The variations of factors like sex, gingival exposure, step, step + group, sex + step, sex + step + group, gingival exposure + step and sex + gingival exposure + step showed statistically significant differences ( $p = 0.001$ ). (Table 1)

Statistically significant difference was found amongst the orthodontist group when compared with dentist, patients and laypersons ( $p = 0.001$ ) in the post hoc tukey test. (Table 2)

When the incisal step at 0 mm was compared with 0.5 mm, statistically significant differences were found between them ( $p = 0.001$ ). The incisal step at 0.5 mm was found to be statistically significant when compared with 1 mm and 1.5 mm ( $p = 0.001$ ). In addition, when the incisal step at 1.5 mm was compared to 2.0 mm, it was found to be statistically significant ( $p = 0.01$ ). (Table 3)

The graphic representations of the variations on the estimated marginal means, when crossing group vs step and group vs gingival exposure, whether statistically significant or not, can be seen in Fig 5 and 6.

The results of the SPANOVA are presented in Table 4.

**Table 1:** Shows the factors causing variation in aesthetic perception in SPANOVA

| Source                          | P      | Partial ETA Squared |
|---------------------------------|--------|---------------------|
| Sex                             | 0.001* | 0.110               |
| Sex + Group                     | 0.056  | 0.020               |
| Gingival Exposure               | 0.001* | 0.051               |
| Gingival Exposure + Group       | 0.44   | 0.011               |
| Step                            | 0.001* | 0.188               |
| Step + Group                    | 0.001* | 0.102               |
| Sex + Gingival Exposure         | 0.007  | 0.022               |
| Sex + Gingival Exposure + Group | 0.582  | 0.004               |
| Sex + Step                      | 0.001* | 0.272               |
| Sex + Step + Group              | 0.001* | 0.028               |
| Gingival Exposure + Step        | 0.001* | 0.266               |
| Gingival Exposure + Step +      | 0.001* | 0.039               |

| Group                                  |        |       |
|--|--------|-------|
| Sex + Gingival Exposure + Step         | 0.001* | 0.115 |
| Sex + Gingival Exposure + Step + Group | 0.462  | 0.007 |

\*Statistically significant ( $p < 0.05$ )

**Table 2:** Shows the comparison between evaluator groups overall means(Post Hoc Tukey test)

| Group                | Mean Difference | SD    | P      |
|----------------------|-----------------|-------|--------|
| <b>Orthodontists</b> |                 |       |        |
| Dentists             | -0.318          | 0.299 | 0.001* |
| Patients             | -0.513          | 0.301 | 0.00*  |
| Laypersons           | -0.168          | 0.299 | 0.001* |
| <b>Dentists</b>      |                 |       |        |
| Patients             | -0.238          | 0.299 | 0.91   |
| Laypersons           | 1.50            | 0.297 | 0.95   |
| <b>Patients</b>      |                 |       |        |
| Laypersons           | 0.388           | 0.299 | 0.65   |

\*Statistically significant  $p < 0.05$  (Bonferroni correction for multiple comparisons)

**Table 3:** Shows the differences in incisal step comparisons

| Step | Mean Difference | SD    | P      |
|------|-----------------|-------|--------|
| 0.0  |                 |       |        |
| 0.5  | 5.13            | 1.277 | 0.001* |
| 1.0  | 5.60            | 1.377 | 0.085  |
| 1.5  | 5.39            | 1.431 | 0.467  |
| 2.0  | 5.22            | 1.186 | 0.713  |
| 0.5  |                 |       |        |
| 1.0  | 5.59            | 1.370 | 0.000* |
| 1.5  | 5.36            | 1.447 | 0.001* |

|     |      |       |       |
|-----|------|-------|-------|
| 2.0 | 5.25 | 1.218 | 0.779 |
| 1.0 |      |       |       |
| 1.5 | 5.36 | 1.447 | 0.00* |
| 2.0 | 5.25 | 1.218 | 0.00* |

|     |      |       |       |
|-----|------|-------|-------|
| 1.5 |      |       |       |
| 2.0 | 5.36 | 1.447 | 0.01* |

\*Statistically significant  $p < 0.05$  (Bonferroni correction for multiple comparisons)

**Table 4:** Estimated Marginal Means From SPANOVA

|                                |       | Orthodontist |       | Dentist |       | Patient |       | Laypersons |
|--------------------------------|-------|--------------|-------|---------|-------|---------|-------|------------|
| Factor                         | Mean  | SD           | Mean  | SD      | Mean  | SD      | Mean  | SD         |
| <b>Sex</b>                     |       |              |       |         |       |         |       |            |
| Male                           | 41.76 | 0.24         | 41.02 | 0.21    | 44.71 | 0.25    | 41.60 | 0.25       |
| Female                         | 36.15 | 0.26         | 42.30 | 0.16    | 48.44 | 0.19    | 39.06 | 0.29       |
| <b>Gingival Exposure</b>       |       |              |       |         |       |         |       |            |
| No Exposure                    | 54.78 | 9.96         | 53.91 | 13.98   | 52.64 | 15.43   | 55.31 | 13.58      |
| Exposed                        | 57.34 | 9.73         | 56.05 | 14.39   | 52.58 | 16.52   | 56.13 | 13.50      |
| <b>Step (mm)</b>               |       |              |       |         |       |         |       |            |
| 0.0                            | 17.2  | 4.374        | 20.7  | 5.23    | 20.39 | 6.324   | 20.07 | 5.805      |
| 0.5                            | 19.3  | 3.5          | 21.79 | 5.264   | 21.24 | 6.348   | 23.49 | 5.369      |
| 1.0                            | 26.48 | 3.624        | 22.86 | 6.163   | 21.34 | 6.639   | 24.12 | 5.722      |
| 1.5                            | 26.17 | 4.139        | 22.63 | 6.633   | 21.7  | 6.11    | 22.47 | 5.145      |
| 2.0                            | 22.97 | 4.055        | 21.98 | 5.114   | 20.55 | 6.541   | 21.29 | 5.047      |
| <b>Sex + Gingival Exposure</b> |       |              |       |         |       |         |       |            |
| MN                             | 24.84 | 5.245        | 26.66 | 6.518   | 26.4  | 6.246   | 25.72 | 7.09       |
| ME                             | 31.45 | 4.907        | 28.13 | 7.406   | 31.56 | 8.497   | 29.87 | 6.397      |
| FN                             | 29.94 | 4.715        | 27.39 | 7.471   | 26.24 | 8.191   | 29.59 | 6.493      |
| FE                             | 25.89 | 4.825        | 27.92 | 6.992   | 26.13 | 8.028   | 26.21 | 7.108      |
| <b>Sex + Step</b>              |       |              |       |         |       |         |       |            |
| M0.0                           | 17.46 | 4.251        | 21.5  | 6.164   | 20.15 | 5.611   | 20.27 | 5.793      |
| M0.5                           | 20.09 | 3.254        | 21.4  | 4.852   | 22.06 | 6.309   | 23.64 | 5.583      |
| M1.0                           | 26.87 | 3.573        | 21.8  | 5.832   | 22.36 | 6.511   | 23.6  | 5.764      |
| M1.5                           | 26.5  | 4.208        | 22.5  | 6.057   | 21.24 | 5.813   | 21.72 | 4.992      |
| M2.0                           | 23.38 | 3.695        | 21.9  | 5.137   | 20.06 | 7.842   | 21.63 | 4.918      |
| F0.0                           | 16.8  | 4.6          | 20.44 | 4.86    | 20.56 | 6.729   | 19.83 | 5.85       |
| F0.5                           | 18.07 | 3.428        | 21.9  | 5.364   | 20.65 | 6.265   | 23.28 | 4.922      |
| F1.0                           | 25.86 | 3.658        | 23.19 | 6.212   | 20.56 | 6.641   | 24.77 | 5.625      |

|                                |       |       |       |       |       |       |       |       |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| F1.5                           | 25.66 | 4.111 | 22.91 | 6.816 | 22.05 | 6.225 | 23.38 | 4.664 |
| F2.0                           | 22.33 | 4.525 | 21.99 | 5.065 | 20.93 | 6.595 | 20.88 | 4.671 |
| Gingival Exposure + Step       |       |       |       |       |       |       |       |       |
| N0.0                           | 8.38  | 2.532 | 9.84  | 2.474 | 9.94  | 2.792 | 9.17  | 2.915 |
| N0.5                           | 9.33  | 1.713 | 10.71 | 2.61  | 10.66 | 3.05  | 11.38 | 2.713 |
| N1.0                           | 13.33 | 1.735 | 11.34 | 3.029 | 10.56 | 3.334 | 12.22 | 2.688 |
| N1.5                           | 12.43 | 2.124 | 11.29 | 3.396 | 11.2  | 3.147 | 11.47 | 2.52  |
| N2.0                           | 11.31 | 1.856 | 10.73 | 2.48  | 10.28 | 3.114 | 11.07 | 2.745 |
| E0.0                           | 8.82  | 1.842 | 10.86 | 2.756 | 10.45 | 3.532 | 10.9  | 2.89  |
| E0.5                           | 9.97  | 1.787 | 11.08 | 2.654 | 10.58 | 3.298 | 12.11 | 2.656 |
| E1.0                           | 13.15 | 1.889 | 11.52 | 3.134 | 10.78 | 3.305 | 11.9  | 3.034 |
| E1.5                           | 13.74 | 2.015 | 11.34 | 3.237 | 10.5  | 2.963 | 11    | 2.623 |
| E2.0                           | 11.66 | 2.199 | 11.25 | 2.617 | 10.27 | 3.427 | 10.22 | 2.302 |
| Sex + Gingival Exposure + Step |       |       |       |       |       |       |       |       |
| MN0.0                          | 4.28  | 1.413 | 4.60  | 1.194 | 4.79  | 1.281 | 4.45  | 1.413 |
| MN0.5                          | 4.56  | 0.754 | 5.32  | 1.234 | 5.20  | 1.305 | 5.48  | 1.519 |
| MN1.0                          | 5.64  | 0.903 | 5.63  | 1.337 | 5.58  | 1.678 | 5.52  | 1.485 |
| MN1.5                          | 5.28  | 1.191 | 5.46  | 1.567 | 5.60  | 1.614 | 5.10  | 1.374 |
| MN2.0                          | 5.08  | 0.984 | 5.51  | 1.186 | 5.23  | 1.368 | 5.17  | 1.299 |
| ME0.0                          | 4.79  | 1.031 | 5.54  | 1.502 | 5.10  | 1.630 | 5.42  | 1.338 |
| ME0.5                          | 5.59  | 0.910 | 5.88  | 1.327 | 5.53  | 1.867 | 6.43  | 1.130 |
| ME1.0                          | 7.38  | 0.877 | 5.93  | 1.738 | 5.40  | 1.661 | 6.40  | 1.588 |
| ME1.5                          | 7.41  | 1.117 | 5.51  | 1.535 | 5.35  | 1.594 | 6.15  | 1.331 |
| ME2.0                          | 6.28  | 0.972 | 5.27  | 1.304 | 5.07  | 1.745 | 5.57  | 1.010 |
| FN0.0                          | 4.10  | 1.119 | 5.24  | 1.280 | 5.15  | 1.511 | 4.72  | 1.502 |
| FN0.5                          | 4.77  | 0.959 | 5.39  | 1.376 | 5.46  | 1.745 | 5.90  | 1.194 |
| FN1.0                          | 7.69  | 0.832 | 5.71  | 1.692 | 4.98  | 1.656 | 6.70  | 1.203 |
| FN1.5                          | 7.15  | 0.933 | 5.83  | 1.829 | 5.60  | 1.533 | 6.37  | 1.148 |
| FN2.0                          | 6.23  | 0.872 | 5.22  | 1.294 | 5.05  | 1.746 | 5.90  | 1.446 |
| FE0.0                          | 4.03  | 0.811 | 5.32  | 1.254 | 5.35  | 1.902 | 5.48  | 1.552 |
| FE0.5                          | 4.38  | 0.877 | 5.20  | 1.327 | 5.05  | 1.431 | 5.68  | 1.526 |
| FE1.0                          | 5.77  | 1.012 | 5.59  | 1.396 | 5.38  | 1.644 | 5.60  | 1.446 |
| FE1.5                          | 6.33  | 0.898 | 5.83  | 1.702 | 5.15  | 1.369 | 4.85  | 1.292 |
| FE2.0                          | 5.38  | 1.227 | 5.98  | 1.313 | 5.20  | 1.682 | 4.65  | 1.292 |

M = Male; F = Female; N = No Exposure; E = Exposed; 00 = 0 mm; 05 = 0.5mm; 10 = 1.0mm; 15 = 1.5mm; 20 = 2.0mm

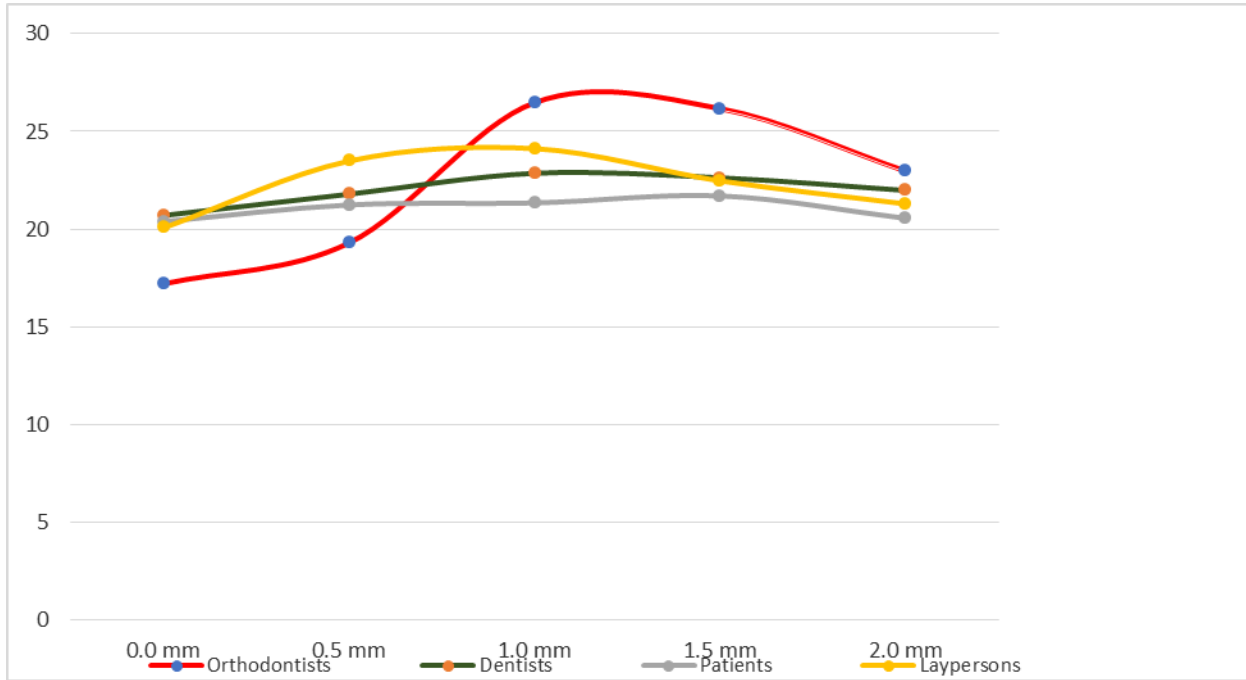


Fig 1: Shows the estimated marginal means of the steps according to each evaluator group

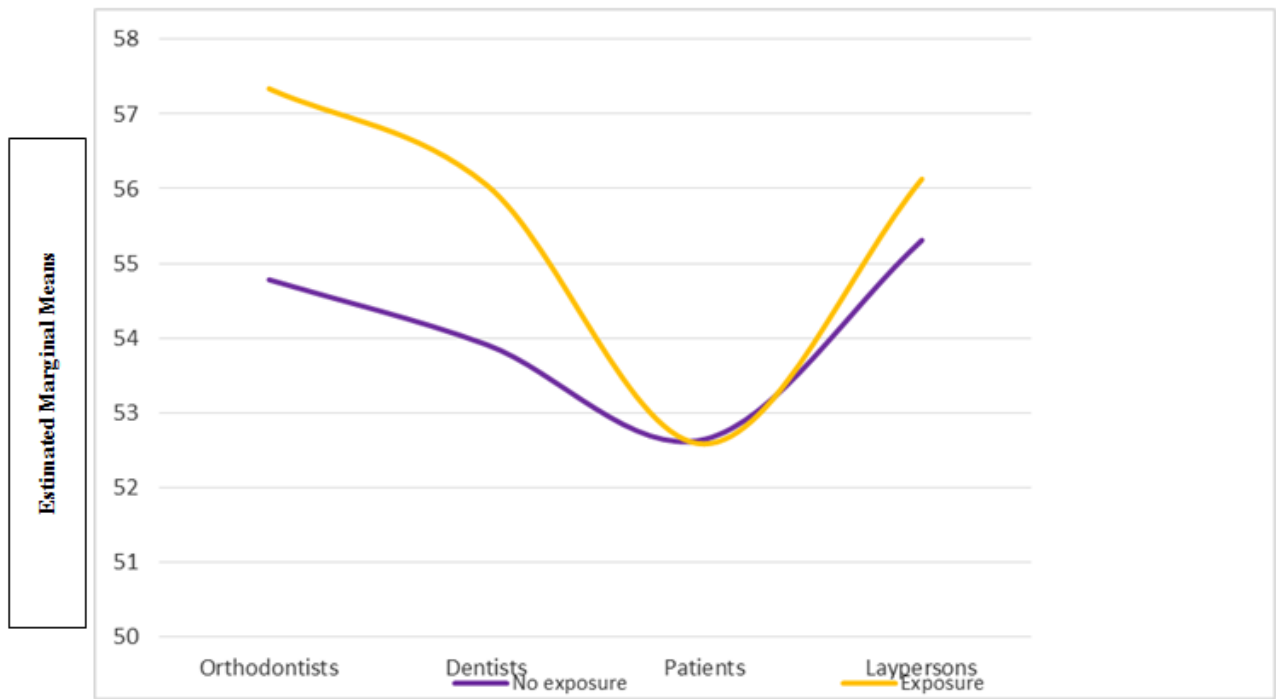


Fig 2: shows the estimated marginal means per evaluator group, according to the gingival exposure

## DISCUSSION

Smile esthetics is important for the self esteem of the patient as it gives a better quality of life and social well being. The key role of the anterior teeth in smile esthetics should be important, encouraging professionals to be mindful of the finishing procedures in a treatment.<sup>2</sup> In evaluating smile esthetics, the upper central incisors are the key teeth, so their vertical positioning is an aspect of chief importance.<sup>3,4</sup>

We conducted this study with photographs of smiles to increase the focus on local alterations which reduces the distraction of other facial characteristics.<sup>5,6</sup>

The photographs were taken with the mouth partially opened, resembling speech and spontaneous smiling.

The VAS is a reliable and commonly used scoring method in health research to generate parametric data from subjective notions.<sup>7,8</sup>

Our findings were obtained in a defined population, so their extrapolations to other situation should be done carefully, because of ethnic and sociocultural variations.<sup>9</sup> In our study, both vertical height of central incisor and gingival display had statistically significant influence on the perception of smile attractiveness, independent of age, rater group and sex.<sup>10, 11, 12,13</sup>

The orthodontist group was the only one with statistically significant difference compared with the others (Table 2) and provided the highest scores among the groups. This is a critical finding as the perception of smile attractiveness among people with different levels of dental and orthodontic knowledge vary considerably.<sup>9</sup>

It was also shown that the means for dentists and patients were similar, because both groups focused , on the more general characteristics of the smile.

Crossing step information with gingival exposure, we notice that for the extreme values (0.0 and 2.0mm), gingival exposure causes variations. This alteration is

unesthetic because it breaks the harmony of smile lines.<sup>14,15,16</sup>

Maxillary gingival exposure and the position of the maxillary front teeth have definitive effects on the esthetic perception of a smile.<sup>17</sup> The smiles with gingival exposure received better scores, especially of the female model. Other studies showed that smiles with gingival exposure were considered more attractive and young.<sup>18</sup>

The highest means for the smiles of the man and the woman without gingival exposure corresponded to the 1.0-mm step, but for the smiles with gingival exposure, the highest means corresponded to the 0.5-mm step for the man and the 1-mm step for the woman (Table 4). Our findings reinforce the hypothesis that flat smiles are more accepted for men, and convex smile arches better characterize attractive smiles for women.<sup>19</sup>

The orthodontists showed more homogeneity, preferring the 1.5-mm step in every variation of sex and gingival exposure tested.

For dentists, smiles of the woman with and without gingival exposure had a 1.5-mm step, whereas for the man, the higher means went to the 1-mm step with gingival exposure and the 1-mm step without gingival exposure.

Orthodontic patients selected the 1.5-mm step in every situation, without gingival exposure.

Laypersons preferred a smile for a man with 0.5-mm step with gingival exposure. The smile of the woman with a 1.0-mm step without gingival exposure was rated more.

In general, the smiles of the man got higher scores than that of the woman.

One limitation of this study is that it was carried out on participants of North Indian origin only. In addition, upper central incisor positioning is influenced by many variables, including age, sex, tooth anatomy, etc.<sup>20</sup>



## CONCLUSION

1. The most accepted vertical relationship of incisor borders was the 1.0-mm step.
2. There was a statistically significant difference in the esthetic perception from orthodontists when compared with dentists, laypersons, and orthodontic patients.
3. The gingival display altered significantly the esthetic perception of the smiles evaluated.
4. There were statistically significant differences between the evaluation of the smiles of men and women.

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