

# Turning subjective into objective: Profile smile perception of I<sup>2</sup> (incisor inclination) and its impact on treatment planning

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## ABSTRACT

**Objectives:** (1) To evaluate the impact of maxillary incisor inclination on the aesthetics of the profile view of a smile, (2) to determine the most aesthetic inclination in the profile view of a smile and correlate it with facial features and (3) to determine whether dentists, orthodontists and laypeople appreciate differently the incisor inclination in smile aesthetics. **Materials and Methods:** A smiling photograph of a female subject (23 years of age) who fulfilled the criteria of soft tissue normative values and a balanced smile was obtained. The photograph was manipulated to simulate six lingual and labial inclinations at 5-degree increments to a maximum of 15 degrees. The seven photographs were randomly distributed in a binder to three groups of raters (20 dentists, 20 orthodontists and 20 laypeople) who scored the attractiveness of the photographic variations using a visual analogue scale (VAS). Comparisons of the mean scores were carried out by repeated analysis of variance, univariate tests and multiple Bonferroni comparisons. **Results:** The results showed a statistically significant interaction between the rater's profession and the aesthetic preference of incisor inclination. The profile smile corresponding to an increase in a labial direction had the highest score among all professions and among male and female raters. **Conclusions:** Orthodontists preferred the labial crown torque; dentists preferred the lingual crown torque; and laypeople appreciated the mild to moderate incisor inclination in both the lingual and the labial directions. The most preferred smile matched with a maxillary incisor inclined 98° to the horizontal line and +8° to the lower third of the face.

**Keywords:** Incisor inclination, orthodontics, profile smile perception, smile aesthetics, treatment planning

## Introduction

The smile is an important feature in daily life, and should be of interest to an orthodontist. It is an essential asset for psychosocial adaptation. People with beautiful teeth and smiles are considered more attractive and more popular with the opposite gender.<sup>[1,2]</sup> The lateral view of the smile is still unexplored. Sarver and Ackerman focused their treatment planning on analysis of the smile in all dimensions.<sup>[3]</sup> In the profile view, incisor inclination is important. Profile views

rated high for the smile as compared with the frontal for aesthetic appeal.<sup>[4,5]</sup> From an aesthetic point of view, it is preferable to either leave a normally protrusive maxillary dentition in its original position or advance rather than retract the maxillary anterior teeth.<sup>[6]</sup> On the other hand, among the factors that negatively influence smile and give the face an "old" appearance, is lingual inclination of the upper incisors as a result of loss of torque.<sup>[7]</sup> Several cephalometric standards have been introduced to assess the attractiveness of the face; yet, it has been shown that good facial harmony can exist within a wide range of cephalometric values.<sup>[8,9]</sup> Even a well-treated case in which the final records meet every criterion of the American Board of Orthodontics for successful treatment may not produce an aesthetic smile.<sup>[10]</sup> Besides this, the professional opinions regarding evaluation of smile aesthetics may not coincide with the perceptions and expectations of laypeople.<sup>[11-15]</sup> Ideally, the buccal face of the maxillary incisors should

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be vertical and parallel to the frontal plane of the face.<sup>[16]</sup> The purposes of this study were: (1) to evaluate the impact of maxillary incisor inclination on the aesthetic view of a smile; (2) to determine the most aesthetic inclination in the profile view of a smile and to correlate it with facial features; (3) to determine whether dentists, orthodontists and laypeople appreciate differently incisor inclination in smile aesthetics.

### Objectives of the Study

- To evaluate the impact of maxillary incisor inclination on the aesthetics of the profile view of a smile
- To determine the most aesthetic inclination in the profile view of a smile and correlate it with facial features
- To determine whether dentists, orthodontists and laypeople appreciate differently incisor inclination in smile aesthetics.

## Materials and Methods

### Subject

An undergraduate female student of age 23 years from the dental institute [Figure 1].

### Selection criteria

Harmonious smile in both the frontal and the profile views. Class I canine and molar relations with adequate overjet and overbite [Tables 1 and 2].

### Image alteration

Adobe Photoshop CS, Version 8.0; Adobe system Inc., San Jose, CA, USA. One parameter changed: inclination of maxillary incisor. In 5-degree increments, three modifications in the labial and three in the lingual direction were made. Seven final images were obtained and printed separately on digital royal paper with a Canon Pixma iP300 printer [Figure 2].



Figure 1: Subject photo

### Judges

Three panels: twenty orthodontists (11 males and nine females), 20 dentists (nine males and 11 females) and 20 laypersons (nine males and 11 females. Their mean ages and SD were orthodontist: 26 ± 4.5 years, dentists: 28 ± 4.8 years and laypersons: 25 ± 4.1 years.

The panel of judges belonged to the Kannadigas ethnic group (dominant ethnic group in Karnataka, comprising up to 70% of the total population of the state) and to the Dravidian race.

### Incisor inclination

A profile photograph was taken with the head in the “aesthetic position.” The natural head posture/position.

Table 1: Subject cephalometric parameters

Maxillary incisors position according to cephalometric parameters		
Incisor Inclination Parameters	Norm	Subject
U1-SN	102 - 105°	105°
U1-FH	111 ± 5°	113°
U1-A-pog	26	26°
U1-NA	20 ± 4°	24°

Table 2: Subject cephalometric parameters

Profilometric measurements with in normal range		
Measurement	Norm (SD)	Subject
Facial Angle	87.85 ± 71°	89°
ANB	2° ± 1.97°	3°
SGN-FH	57.52° ± 3.32°	57°
FMA	20.54° ± 5.59°	29°
NLA	114.8° ± 9.58°	118°
Nasal Prominence	16-20mm	18mm
Upper lip to Sn-pg	+3.5 ± 1.4mm	+3.5mm
Lower lip to Sn-pg	+2.2 ± 1.6mm	+3.7mm



Figure 2: Subject with image alterations

Two angular measurements for each of the seven inclinations were obtained.

- Tg/Hr: Angle between incisor inclination aesthetic horizontal
- Tg/Sn-pg': Angle between incisor inclination and lower third of the face. This angle positive when tangent is forward and negative when it is backward [Figure 3]. Table 3 shows angular inclinations of incisors in all modified photographs.

### Ratings of photographs

A survey was carried out twice within an interval of 2 weeks among three panels. The order of the seven photographs was randomly changed between the two evaluations. A modified Visual Analogue Scale (VAS) was used for this purpose.

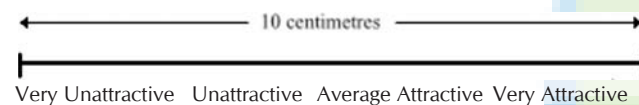
### Rate the Attractiveness of the Smile on the Ruler Below

(With a vertical line with a pen/pencil.)

Name of the rater:

Profession:

Criteria of rating (as per the rater):



Signature of the rater with date

### Statistical analyses

The statistical analyses were conducted using the Statistical Package for Social Sciences for windows (SPSS Inc., Chicago, IL, USA).

- Intraclass Coefficient Correlation (ICC) - For reliability of the ratings by the panel

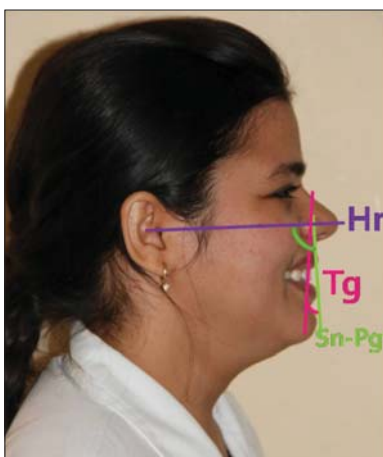


Figure 3: Incisor inclination angualtions

- ANOVA - For determination of significant differences in the mean scores based on two independent variables: Profession and incisor inclination in each photograph
- Repeated ANOVA - To ensure that the factor gender had not influenced the results
- Chi-square/Fisher's test - To determine the criterion that lead the panel choice of score for smile attractiveness
- Z-scores - To remove intraexaminer variation.

## Results

### Reliability

Because each judge scored every photograph twice, reliability of the ratings was tested using the ICC. For attractiveness, the overall ICC for rating the same photograph was 0.632 with orthodontists, 0.061 with dentists and 0.67 with laypeople. The judge's scores were moderately reliable with a 95% confidence level.

Age comparison showed no statistical difference between the three groups of panelists ( $F = 2.376, P = 0.099$ ). The analysis of scores showed that photograph +5 was scored highest by orthodontists and laypeople (55.65% of orthodontists and 60% of laypeople) and that photograph -5 scored the highest by dentist and laypeople (53.33% of dentists and 57% of laypeople). While exploring the impact of incisor inclination on the smile aesthetics, a significant interaction effect was found between incisor inclination and panel profession (Wilk's Lamda,  $F = 2.224, P = 0.013$ ), which was the same among male and female raters. The following figure shows that the modification of incisor inclination can be differently perceived according to the judge's profession [Table 4].

A statistically significant difference between the appreciations of photographs by each profession was found ( $P = 0.001$ ), which was not different between male and female raters. For each profession, additional multiple comparisons detected whether judges appreciate differently the smile aesthetics: the photograph +5 degrees was the most appreciated by the orthodontists and laypeople

Table 3: Angular inclinations of incisors in all modified photographs

Angular Inclination of incisor inclination of the face (In all 7 Photographs)			
S. No.	Photograph	Angle (TG/HR)	Angle (TG/Sn-Pg)
1.	-15°	75°	-16°
2.	-10°	81°	-10°
3.	-5°	85°	-6°
4.	Normal	98°	+8°
5.	+5°	102°	+13.5°
6.	+10°	104.5°	+15°
7.	+15°	106°	+17°

whereas the photograph -5 was the most appreciated by the dentists and laypeople. The normal photograph was aesthetically preferred by all the panelists ( $P = 1.00$ ). On the other hand, photograph -15, +15, -10 and +10 degrees were not appreciated by dentists and laypeople, while -10 degrees had the lowest scores in the orthodontist panel. The image +15 degrees were aesthetically acceptable only by orthodontists [Graphs 1 and 2].

Regarding smile aesthetics in total facial concept, the preferred smile matched with an upper incisor angulated +98 degrees to the horizontal line and +8 degrees to the lower facial third as shown in Table 5.

## Discussion

Physical attractiveness is an important social issue and face is one of its key features. Peck and Peck<sup>[17]</sup> have reported hierarchy in the characteristics that determine aesthetic perception of a person, with face being the most important factor. Over the last decade, smile aesthetics has gained immense importance in dentistry in general and orthodontics in particular.<sup>[18]</sup> Because the patient's decision to undertake orthodontic treatment is based primarily on aesthetic considerations, the evaluation

and understanding of the factors that influence their decision is of key importance.<sup>[19]</sup> An understanding of the factors that help or harm the attractiveness of a smile is an important step in creating attractive smiles, and these beauty norms and standards can be applied in line with diagnostic methods and esthetic treatment modalities.<sup>[20]</sup>

Aesthetic perception varies from person to person, and is influenced by their personal experience and social environment. For this reason, professional opinions regarding evaluation of facial aesthetics may not coincide with the perception and expectations of patients, general dentists or laypeople. Defining these attributes and prioritizing them within and between dentists and specialists allows predictable utilization in defining perception and subsequently providing patients with realistic goals and objectives.<sup>[21]</sup>

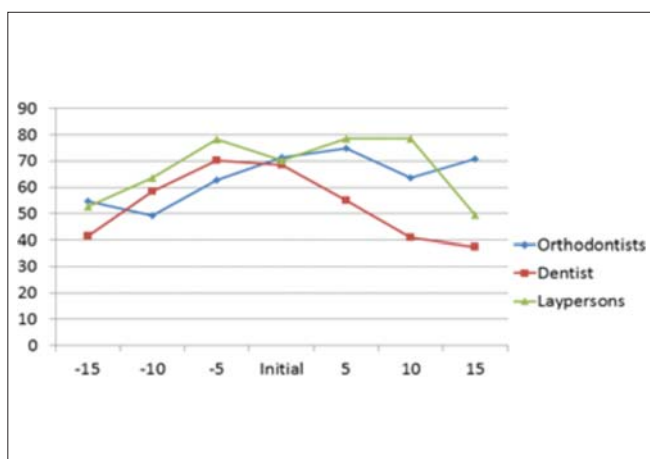
Enhancing smile attractiveness relies on a multifactorial process: One that can be easily controlled is maxillary incisor position. The teeth should be angulated and positioned favorably in an antero-posterior and vertical relationship to all facial structures to ensure maximum facial harmony.<sup>[22]</sup> The vertical dimension of incisors is

**Table 4: Attractiveness rating scores by different panels of judges**

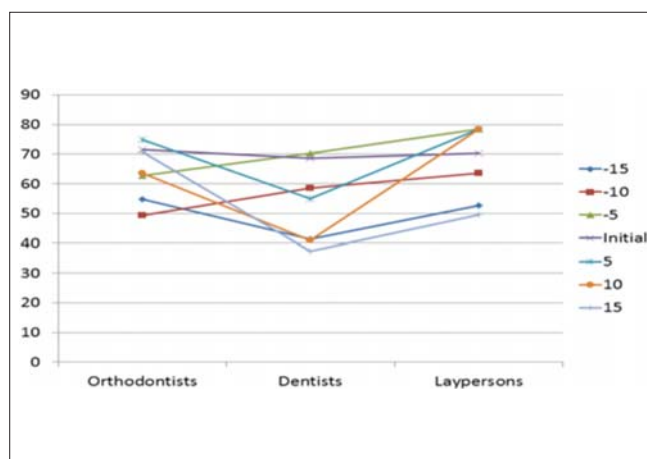
Photograph	Attractiveness rating scores		
	Orthodontist N = 20 Mean mm	Dentists N = 20 Mean mm	Laypeople N = 20 Mean mm
-15°	54.75	41.42	52.6
-10°	49.31	58.57	63.51
5°	62.7	70.35	78.4
Normal	71.45	68.61	70.17
+5°	74.91	54.92	78.48
+10°	63.62	40.88	70.53
+15°	70.71	37.31	49.43

**Table 5: Preferred incisor angulation values**

S. No.	Smile esthetics in total facial concept Most preferred smile matched with Incisor angulations		
	Photograph	Angle (TG/HR)	Angle (TG/Sn-Pg)
1.	-15°	75°	-16°
2.	-10°	81°	-10°
3.	-5°	85°	-6°
4.	Normal	98°	+8°
5.	+5°	102°	+13.5°
6.	+10°	104.5°	+15°
7.	+15°	106°	+17°



**Graph 1:** Perception plots of the photographs for the three panels of judges



**Graph 2:** Perception plots of the photographs for the three panels of judges

mostly determined by (1) lip contour at rest and (2) lower incisor edge should touch the upper vermillion border.<sup>[23]</sup>

On smiling - Most orthodontists and dentists prefer that the elevation of lip stop at the gingival margins of the incisor. Some amount of gingival display is certainly acceptable.<sup>[24]</sup> The bucco-lingual inclination of the maxillary incisor has a major effect on profile smile attractiveness. Lingual inclination, characterized by torque loss, was found to be one factor leading to an unpleasant smile and to an "OLD" appearance.<sup>[25,26]</sup> Isikasal *et al.* (2006), when comparing smile esthetics, reported a statistical difference between inclinations of the maxillary incisors in patients treated with or without extraction and the control group. It seems that the maxillary incisors needed more labial crown torque after retraction in the extraction group. However, the difference did not affect smile aesthetics in their groups (extraction, non-extraction and control).<sup>[27]</sup>

This cross-sectional comparative study was carried out with panels of orthodontists, dentists and laypeople. Advances in the present study were to emphasize the importance of incisor inclination in smile attractiveness. When judges were asked to specify which criteria lead to their appreciation, the majority was susceptible to incisor inclination modifications (as shown in results and table), with orthodontists being more sensitive.

- Most criticized factors of unattractive smile
- Exaggerated retrusion and protrusion of the incisors
- Lack of parallelism between the crown axes of the central and lateral incisors
- Rabbiting
- Gingival display
- Tipping of the lateral incisor
- Increased overjet
- Disharmony between incisor position and lip contour.

To quantify innate feelings about the impact of incisor inclination on smile aesthetics, an anchored scale VAS was used. This method has been endorsed by many investigators for use in attractiveness ratings because of its simplicity and ease of use.<sup>[28]</sup> It avoids bias toward preferred values found with numeric or interval scales. Complete profile photographs, not only dental views, have been used to obtain a true valuation of attractiveness.<sup>[29]</sup> Variety of profession leads to a wide range of aesthetic opinions and, subsequently, large standard deviations, especially in the lay panel. A study was conducted to determine whether differences in ethnic background, including the possibility of assimilation, affected a layperson's perception of esthetic and smile characteristics. A convenience sample (n = 288) comprising of US whites, US Asian Indians and Indians living in India was surveyed. A difference between these groups showed the power of ethnicity and no difference

between these groups showed the power of assimilation. The ratings of the Asian Indians and the US whites showed a clinically significant difference for Ideal Buccal Corridor and Maximum Smile Arc. There were no significant differences between the US Asian Indians and Asian Indians. There was a clinically significant difference between the US Asian Indians and the US whites only for Ideal Buccal Corridor. Ethnicity had a significant effect on the aesthetic choices for Buccal Corridor and Smile Arc. There is no conclusive evidence for assimilation. There appeared to be little ethnic difference in the perception of smile esthetics.<sup>[30]</sup>

In this study, the laypeople panel belonged to the Kannadiga ethnic group of Dravidian race of the south Indian population. This study was the first of its kind in evaluating profile smile aesthetics by such an ethnic group. Individual and cultural characteristics must be considered in smile evaluation. It is important to consider the particular ethnic group and race in drawing conclusions because the concept of beauty differs between races and ethnicities.<sup>[31]</sup> Schlosser *et al.* (2005), in a similar study but with antero-posterior movements without any torque variations, found higher aesthetic scores for protrusive maxillary incisors. A very close relationship between smile aesthetics and orientation of teeth is unquestionable. The present study showed that the best smile corresponded to a well-angulated maxillary incisor. Aesthetically, the preferred smile was of the modification of 5-degree augmentation in the labial direction by the orthodontist and laypeople and 5-degree reduction in lingual direction by the dentists and laypeople in this study. Contrary to Isiksal *et al.*'s (2006) results that increasing the incisor inclination to SN line deteriorates smile aesthetics and incisor inclination does not affect smile attractiveness, our results show a statistical significant correlation of incisor inclination to smile aesthetics. An additional aim of the present study was to correlate incisor inclination with the facial profile and to create an aesthetic outcome for the patient without restriction to cephalometric values. In the lateral photographic position, the aesthetically desired smile had an upper incisor inclined 98° to the horizontal and +8° to the lower facial third, represented by the Sn-Pg' line. Cephalometric standards should not be the main goal of orthodontists; they must be a general guide and a complement to visual aesthetic perception. In an agreement with the results of Schabel *et al.* (2008), who suggested that additional criteria might be incorporated into the assessment of overall orthodontic treatment outcome, including the variables evaluating the smile, in the present study, incisor inclinations above normal standard values were preferred by the orthodontists and laypeople. On the contrary, just below normal standard values were preferred

by dentists and laypeople. As laypeople preferred both, their opinion in achieving adequate maxillary incisor Inclination and torque should be of utmost importance to an orthodontist toward the mid- or end stages of the treatment with appropriate prognostic tools.

## Conclusions

- Maxillary incisor inclination affects smile aesthetics in the profile view.
- There is a significant interaction effect between appreciation of the incisor inclination and the judge's profession.
- Incisor inclination above normal standard values was preferred by orthodontists and laypeople, whereas below normal was preferred by dentists and laypeople.
- In the aesthetic photographic position, the preferred incisor is angulated 98° to the horizontal and +8° to the lower facial third.
- Orthodontists tend to prefer labial crown torque in comparison with lingual crown inclination.
- As laypeople preferred both, their opinion in achieving adequate maxillary incisor inclination and torque should be of utmost importance to an orthodontist.

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