Research Article

Evaluation of the Effect of Maxillary Incisor Labiolingual Inclination & Antero-Posterior Position on Smiling Profile Esthetics – A Computer Aided Photographic Study - 🔓

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ABSTRACT

Objective: To test the null hypothesis that there was no effect of maxillary incisor labiolingual inclination and Anteroposterior (AP) position on smiling profile esthetics in young adult females.

Sample population: Subjects to be screened were young adult females from Indian population.

Subject and method: A total of 5 subjects were selected after screening Indian population for the study. A total of 145 images of 5 subjects were assessed by each member of professional and non-professional groups. Professional group consist of 10 orthodontists of age group 28-35 years & non-professional group consist of 10 laypersons of age group 28-35 years.

Results: the average ratings for overall images (all images combined) did not differ significantly between orthodontists and laypersons. ($P\text{-value} > 0.05$).The overall distribution of attractiveness significantly differs across various types of images ($P\text{-value} < 0.001$) Depending on rating received images were grouped as most attractive, attractive, interim attractive, relatively unattractive and unattractive.

Conclusion: This study concludes that there is an effect of maxillary incisor labiolingual inclination and Anterioposterior (AP) position on smiling profile esthetics in young adult females selected from Indian population

INTRODUCTION

In persons with facial harmony, there is a correlation between the prominence and the inclination of the forehead and the Antero-Posterior (AP) positions of the teeth and jaws Maxillary incisor labiolingual inclination and Anteroposterior (AP) position have a key effect on the appearance of the smiling profile [1]. To improve the prediction of the most proper position of the maxillary incisors, many cephalometric and profilometric measurements have been suggested.

The maxillary incisors, when displayed, should be considered a part of the face both from the frontal and lateral perspectives. Contemporary orthodontic diagnosis includes assessing the display of the maxillary incisor teeth from the frontal perspective. In profile, however, the maxillary incisors are not typically assessed with regard to how they directly relate to the face. Instead, the soft tissue drape is relied on to reflect indirectly their positions, despite the potential unreliability of that method. Hence this study aimed to evaluate how the altered labiolingual inclination & Anterioposterior (AP) position of maxillary central incisor influence esthetics in young adult females.

AIM

The aim of this study was to evaluate the effect of maxillary incisor labiolingual inclination and Anterioposterior (AP) position on smiling profile esthetics in young adult females.

OBJECTIVES

To test the null hypothesis that there was no effect of maxillary incisor labiolingual inclination and Anteroposterior (AP) position on smiling profile esthetics in young adult females.

MATERIALS AND METHODS

Equipments

- Digital HD X-ray machine (Advapex)
- Photographic camera Canon EOS 600 DSLR
- Dolphin imaging 10.5 software
- Tracing paper(lead acetate)
- 0.35mm pencil
- Protractor,scale,set square
- Noritsu QSS 3300i Digital, High Quality Printer and Processor
- Photoshop CS6 software

METHODS

Source of data

Subjects to be screened were young adult females from Indian population.

Methods of collection of data

Sample size: A total of 5 subjects meeting the above criteria were selected after screening Indian population for the study. A total of 145 images of 5 subjects were assessed by each member of professional and non-professional groups. Professional group consist of 10 orthodontists of age group 28-35 years & non-professional group consist of 10 laypersons of age group 28-35 years.

Subject selection criteria: The subjects with following criteria were selected.

(1) Class I occlusion and Class I skeletal pattern.

(2) Hard tissue cephalometric analysis were in normal range.

(3) Soft tissue cephalometric analysis (including Ricketts' esthetic plane, Merrifield's z-angle, and measurements were within the normal range).

(4) Facial angle and H angle within the normal range, as described by Hold away, and Nasolabial angle and maxillary lip angle within the normal range, as described by Arnett and Bergman.

(5) Ideal maxillary incisor–to-forehead relationship, as described by Andrews and Andrews[43] and maxillary central incisors' Facial Axial Point (FA) on the Goal Anterior Limit Line (GALL).

Both hard & soft tissue analysis were done by using Dolphin imaging 10.5 software as well as manual tracing. (The subjects used for this study were provided the required dental treatment free of cost.)

Taking the Photographs

Right lateral profile photographs were taken for 5 patients with a digital camera under standard conditions by the same operator using a Canon EOS 600DSLR Camera having,18 Megapixels, image sensor 22.3X14.9mm,APS-C,CMOS type with maximum output resolution of 5184X3456, macro lens 18-55mm with image stabilizer, 0.25 meters oblique 8 feet, light sensitivity of 6400 ISO. The camera

was mounted to a frame set at a fixed distance of 36 inches between the lens and the subject. The patient was then asked to bodily turn to their left and asked to sit on a stool looking at vertical mirror and thus having a right profile side facing the clinician. The head should be in Natural Head Position, with their eyes fixed horizontally. Natural Head Position recorded with the help of fluid level device.[92] Light or Bright background, free of shadows and distractions was used. Before taking the smiling image, the photographer instructed the patient to "smile". Social or forced smile of the patient was captured due to its reproducibility in the natural head position.

The first profile photo was taken with a natural facial expression, for use in the profilometric assessment. The second profile photo was taken with a full smiling expression with a small 100-mm ruler was fixed above the head of the subject on the facial sagittal plane. The second profile photo was used for subsequent computer-aided image alterations. All the photographs were taken during day time, at 11 a.m., IST.

Image alteration

The subject's repeatable smiling profile photographs were altered with the Photoshop CS6 digital imaging program to obtain four series comprising 29 smiling profile photographs.

(A) The maxillary incisor labiolingual inclination was altered while FA will be kept unchanged on GALL, as the maxillary incisor was inclined labially by 5^0, 10^0, and 15^0 and lingually by 5^0, 10^0, and 15^0, respectively. There were seven images, including the original smiling profile photo, in the first series.

(B) The maxillary incisor was moved in a horizontal plane with the incisor AP position altered. The maxillary incisor was moved anteriorly by 1 mm, 2 mm, 3 mm, and 4 mm and posteriorly by 1 mm, 2 mm, 3 mm, and 4 mm, respectively. There were eight images in the second series. For retrusive simulations, the maxillary lip was moved at labrale superius at 1:2 to tooth movement; for protrusive simulations, the maxillary lip was moved at labrale superius at 1:3 to tooth movement.

(C) The smiling profile photo with maxillary incisor 2 mm anterior was altered. The maxillary incisor was inclined labially by 5^0, 10^0, and 15^0 and lingually by 5^0, 10^0, and 15^0, respectively, with FA 2 mm anterior to GALL. Another image was gained through alteration of the maxillary incisor labiolingual inclination with FA on GALL. There were seven images in the third series.

(D) The smiling profile photo with maxillary incisor 2 mm posterior was altered, just as in the third series. There were also seven images in the fourth series.

Image alteration was done by using photoshop CS6 digital imaging program. In that pen tool was used for cutting desired area then cropping selected area & rotating at specified inclinations to achieve desired alterations of inclinations.

For anterioposterior alterations, again using same tool desired area was cropped & did the protrusive & retrusive alterations in images.

Printing of the photographs

These digital images with 300 dpi resolution in JPEG format with a size of 10cm × 15cm (4 x 6 inch) were printed using Noritsu QSS 3300i Digital, High Quality Printer and Processor separately on Photo Quality Matte Paper with 180 GSM thickness.

Rating of photographs

A total of 20 judges (i.e. 10 Orthodontists, 10 Laypersons) received the profile photographs while seated and were asked to mark his or her assessments of the facial attractiveness of the subject on the 100 mm visual analogue scales, which were anchored by the descriptors "Least Attractive" (0) and "Most Attractive" (100). Visual analogue scales have been found to provide rapid, convenient, valid, reproducible, and representative ratings of dental and facial appearance. Each judge was asked to view each photograph for 30 seconds. The judges were given specific instructions on the use of the scale but no images with which to practice. No specific information was given regarding the faces they were to see. Each judge was asked to rate the attractiveness of the photographs on whatever criteria he or she deemed important and enter the ratings in evaluation sheet.

Data analysis

Descriptive statistical analysis was carried out in the present study to explore the distributions of ratings given by two groups of observers. Data on ratings (VAS) were presented with Mean and Standard Deviation across several types of images assessed. Higher mean ratings score indicated better appreciation and vice-versa for all the images.

RESULTS

1) The average ratings for the images (image nos: 1, 3, 4, 6, 8, 9, 13, 15, 16, 19, 20, 23, 24, 25, 26, 27 and 28) is significantly different between two groups of Observers (P-value < 0.05 for all).

2) Orthodontists gave significantly higher ratings for the images (image nos: 1, 3, 6, 13, 15, 16, 19, 20, 23, and 26) compared to the Lay persons (P-value < 0.05 for all).

3) Lay persons gave significantly higher ratings for the images (image nos: 4, 8, 9, 24, 25, 27 and 28) compared to the Orthodontists (P-value < 0.05 for all).

4) The average ratings for the images (image nos: 2, 5, 7, 10, 11, 12, 14, 17, 18, 21, 22, and 29) did not differ significantly between two groups of Observers (P-value > 0.05 for all).

5) The average ratings for overall images (all images combined) did not differ significantly between two groups of Observers (Orthodontists Mean Ratings = 68.26 v/s Lay persons Mean Ratings = 68.00) (P-value > 0.05).

6) 6)The overall distribution of attractiveness significantly differs across various types of images (P-value < 0.001).8)

7) The most attractive images being image no's: 2, 16, 9, 10, 1 and 18 by both the groups of raters (>90.0% ratings as Most Attractive – Score >75.0).

8) The most unattractive images being image no's: 7, 8, 21, 22, 23, and 29 by both the groups of raters (>75% ratings as Unattractive – Score < 60.0).

TO SUMMARIZE

The average ratings for overall images (all images combined) did not differ significantly between orthodontists and laypersons. (P-value
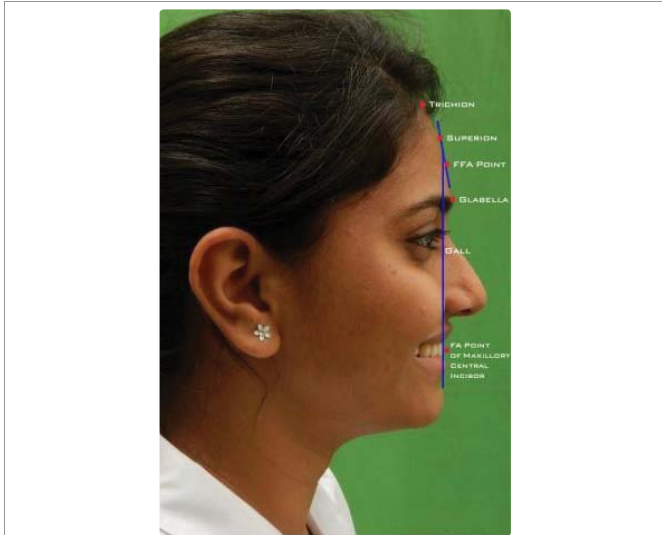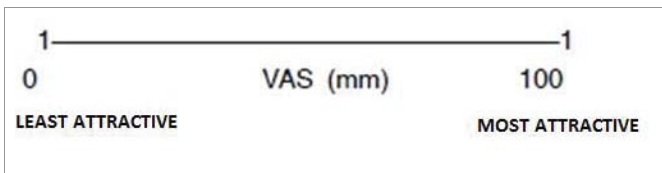
Figure 1: Landmarks.
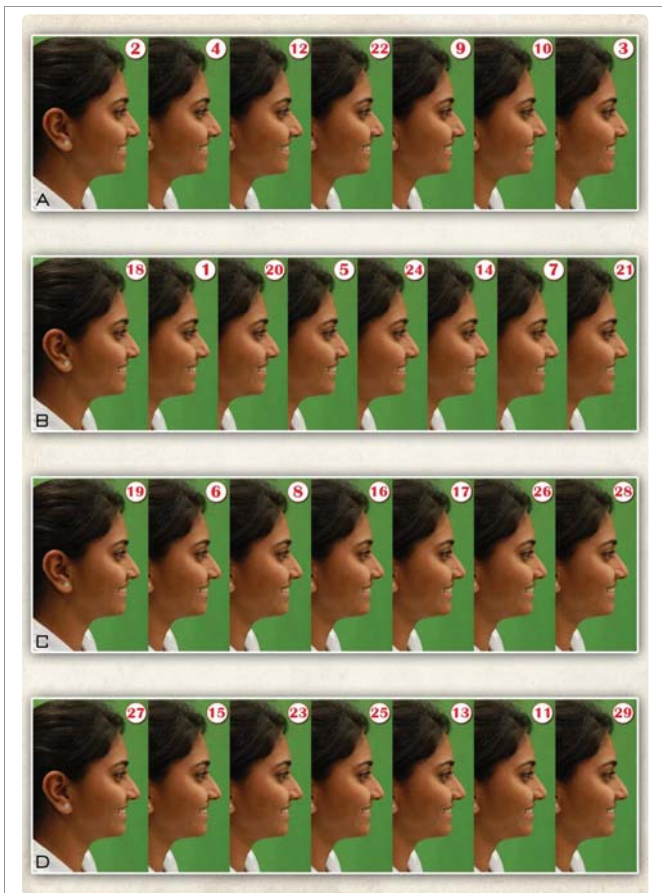

Figure 2: Visual Analogue Scale.

Figure 3: A,B,C,D Stands for Different Image Alterations with Image Codes.

Table 1: Images Alterations with Corresponding Image Codes.

Image Code	Image Alterations
1	+2mm protrusion
2	Normal
3	-15^0 lingual
4	+5^0 labial
5	+4mm protrusion
6	+2mm protrusion, +10^0 labial
7	-3mm retrusion
8	+2mm protrusion, +15^0 labial
9	-5 ^{0} lingual
10	-10 ^{0} lingual
11	-2mm retrusion, -15^0 lingual
12	+10^0 labial
13	-2mm retrusion, -10^0 lingual
14	-2mm retrusion
15	-2mm retrusion, +10^{0}labial
16	+2mm protrusion, -5^{0}lingual
17	+2mm protrusion, -10^0 lingual
18	+1mm protrusion
19	+2mm protrusion, +5 ^{0}labial
20	+3mm protrusion
21	-4mm retrusion
22	+15^0 labial
23	-2mm retrusion, +15^0 labial
24	-1mm retrusion
25	-2mm retrusion, -5^0 lingual
26	+2mm protrusion, -15^0 lingual
27	-2mm retrusion, +5^0 labial
28	+2mm protrusion FA on GALL
29	-2mm retrusion FA on GALL

> 0.05). The overall distribution of attractiveness significantly differs across various types of images (P-value < 0.001) Depending on rating received images were grouped as most attractive, attractive, interim attractive, relatively unattractive and unattractive.

DISCUSSION

Most patients seek orthodontist mainly for two reasons, first is the presence of any facial deformity or disharmony and the second is malalignment of teeth, and sometimes even both.

Edward J. Foster [2], had conducted a similar study to find out the common basis for judging the facial beauty. His study concluded that the diversified groups from the study do seem to share a common esthetic standard for the posture of lips in protruded cases. Also, fuller lips were more accepted in case of younger ages by the groups. For adult males, all groups but orthodontists preferred lips located back of the stated mean values for the E and H line. A straighter male profile was preferred as compared to 3mm fuller profile for females was accepted by most of the groups.

Sarver and Ackerman [3] stated while enlightening the re-emergence of esthetic paradigm that, extending the soft tissue envelope by expanding dental arches to increase hard tissue support

Table 2: The descriptive statistics of ratings (appreciation scores) across all the images assessed by the observers (Orthodontists and Lay persons combined).

Image ID	No.of images	Mean	Std.Deviation	Minimum	Maximum
1	100	79.00	4.266	73	89
2	100	83.55	4.074	76	93
3	100	70.05	2.801	64	77
4	100	73.02	3.156	70	83
5	100	62.87	3.786	57	72
6	100	66.77	3.478	59	75
7	100	57.00	5.980	50	72
8	100	57.76	6.641	48	73
9	100	82.54	5.340	74	94
10	100	78.41	3.755	72	86
11	100	64.43	4.038	51	74
12	100	65.41	4.757	51	75
13	100	66.71	3.026	60	74
14	100	64.66	3.707	60	74
15	100	64.74	5.038	51	75
16	100	83.58	4.789	75	95
17	100	75.15	2.683	73	83
18	100	77.31	3.678	72	86
19	100	74.34	3.669	70	84
20	100	69.83	3.785	63	79
21	100	51.16	6.527	41	67
22	100	54.43	6.114	47	70
23	100	56.91	7.088	47	73
24	100	67.74	3.889	58	77
25	100	75.04	3.256	71	84
26	100	65.56	3.115	58	73
27	100	70.45	3.151	63	79
28	100	66.09	2.927	59	74
29	100	51.32	6.760	41	67
Overall	**2900**	**68.13**	**10.088**	**41**	**95**

Higher the mean score better the appreciation and vice-versa.

for the lips and cheeks or enlarging the facial skeleton surgically to increase hard tissue support, usually is more esthetic than the reverse, especially when the effects of aging are considered. Greater soft tissue fullness gives a more youthful appearance.

This study was done on subjects selected from Indian population, the subject used for photographic alteration exhibited excellent adherence to the accepted hard and soft tissue normative values, and the crown axial line of her central incisors was on GALL that is ideal maxillary incisor-to-forehead relationship, as described by Andrews and Andrews [4].

Harmonious Smiling Profiles

The average scores of the relatively attractive group, Group A were all greater than 75, including numbers (Image codes) 9, 2, 16, 18, 1, and 10. The smiling profile with the highest score was the one with incisors with 5^0 of lingual inclination with FA on GALL (Image Code 9). The average scores of the acceptable group, Group B, were all greater than 70, including numbers 19, 4, 17, 27 and 25. The

harmonious smiling profiles above indicated that proper protrusion of maxillary incisors (FA a head of GALL within 2 mm) would not damage the esthetics of the smiling profile if the incisors were upright. Maxillary incisor lingual inclination (within 10^0) and a small degree of labial inclination were considered relatively esthetic as well.

Unharmonious Smiling Profiles

The average scores of the unattractive group, Group 1, were all less than or equal to 60, including numbers 21, 29, 22, 23, 7, and 8. The smiling profile with the lowest score was the one with incisors in 4 mm of retrusion (Image Code 21). The average scores of the relatively unattractive group, Group 2, were all lower than 65, including numbers 5, 11, 15, 14, and 12. The rest of the images belonged to the interim group, Group 3, for which the average score ranged between 65 and 70.

Those unharmonious smiling profiles above indicated that maxillary incisor retrusion of more than 1 mm would damage the smiling profile esthetics even if the incisors were upright. However,

Table 3: The distribution of overall attractiveness status of all assessments performed for each image (combined ratings by Orthodontists and Lay persons).

Image ID	Most Attractive (>75)	Attractive (70 to 75)	Interim Attractive (65 to 70)	Relatively unattractive (60 to 65)	Unattractive (<60)	Total
1	93	7	0	0	0	100
2	100	0	0	0	0	100
3	12	33	54	1	0	100
4	23	77	0	0	0	100
5	0	10	14	62	14	100
6	4	16	62	17	1	100
7	0	9	6	3	82	100
8	0	10	11	12	67	100
9	98	2	0	0	0	100
10	94	6	0	0	0	100
11	0	15	15	66	4	100
12	1	18	27	51	3	100
13	0	17	66	17	0	100
14	0	15	24	61	0	100
15	2	19	25	45	9	100
16	100	0	0	0	0	100
17	32	68	0	0	0	100
18	91	9	0	0	0	100
19	44	56	0	0	0	100
20	11	38	47	4	0	100
21	0	0	11	2	87	100
22	0	1	8	9	82	100
23	0	8	12	15	65	100
24	7	26	51	14	2	100
25	46	54	0	0	0	100
26	0	11	61	26	2	100
27	14	48	34	4	0	100
28	0	16	61	22	1	100
29	0	0	13	1	86	100

Values are no. of ratings (n) out of 100 ratings by both Orthodontists and Lay persons.

Table 4: The distribution of group of images with respect to the overall attractiveness status (combined ratings by Orthodontists and Lay persons).

Group code	Image Numbers (Group)	Overall Attractive Status	Ratings Received
A	1, 2, 9, 10, 16, 18	Most Attractive	>75
B	4, 17, 19, 25, 27	Attractive	70 to 75
E	3, 6, 13, 20, 24, 26, 28	Interim Attractive	65 to 70
C	5, 11, 12, 14, 15	Relatively Unattractive	60 to 65
D	7, 8, 21, 22, 23, 29	Unattractive	<60

Image no's 15, 20 and 27 had <45% borderline preference in the respective overall attractive group.

protrusion of less than 3 mm or less did not affect the smiling esthetics. All of the images showing 15⁰ labial inclination of the upper incisors were considered less attractive without exception, while the ones with 10⁰ lingual inclination were considered relatively esthetic. It was not difficult to draw the conclusion that maxillary incisor lingual inclination and protrusion were more acceptable than incisor labial inclination or retrusion.

In our study the subject met the requirement of the relationship between the maxillary incisors and the forehead, as described in Element II of the six elements of orofacial harmony. Forehead was used as a landmark for assessing the AP position of the maxillary central incisors in smiling profile. The original photo had received a relatively high score, which caused us to think that the subject's smiling profile was esthetic. Both images 29 (maxillary teeth in 2 mm of retrusion, with FA unchanged) and 28 (maxillary teeth in 2 mm of protrusion, with FA unchanged) did not belong to the relatively attractive or acceptable group, even though FA of the incisors was still on GALL.

On the other hand, incisor protrusion of less than 3 mm did not affect the smiling esthetics. This finding indicates that although the AP position of the incisors was important to the facial harmony, a small amount of the anterior movement of the maxillary incisors would not damage the smiling profile esthetics. However, improper labiolingual inclination of the upper incisors could easily ruin the pleasing appearance. Of all the factors related to a balanced smiling profile, one can easily be controlled by orthodontists— the labiolingual inclination of the maxillary incisors.

The expression of the incisor labiolingual inclination was influenced by various factors. However, most reports published on this issue indicate a loss of torque control of as high as 100% of the prescribed value. Based on the available evidence, Gioka and Eliades [5], suggested that a high-torque prescription should be selected to account for the lack of full expression of the prescribed torque that occurs clinically. However, Isıksal et al. found that although the inclination values of the maxillary incisors were statistically different between extraction and nonextraction groups, the difference did not affect smiling esthetics in either group.

Furthermore, increasing the labial inclination would cause smiling esthetics to deteriorate. The use of a high torque bracket system, particularly in nonextraction treatment with anterior crowding, when initial tooth torques are close to the desired angles, would be inappropriate. Increased maxillary incisor labial inclination might also flatten the smile arc and reduce incisor display, which would lead to negative esthetic consequences [6,7]. Our study corroborates these findings of others. Without exception, all of the images with 15^0 labial inclination of the upper incisors were considered less attractive.

When it comes to the AP position of the maxillary incisors, the ratings also showed us that the raters had some tendency with regard to smiling profile esthetics. The attractiveness of the images was reduced with the increase in maxillary incisor retrusion. All the images with 2 mm retrusion were considered unattractive, in spite of the different labiolingual inclinations. Only one image with slight lingual inclination was acceptable. Many other studies also found that the fuller smile was more attractive [8].

Schlosser et al [9]. Evaluated the effect of maxillary incisor AP relationship on smiling profile and found that the protrusion of the upper anterior teeth was more attractive than that of the retruded ones from an esthetic standpoint. This finding was consistent with that of our investigation. Thus, it is preferable to leave a normally protrusive maxillary dentition where it is, or else it is preferable to advance it rather than to retract the maxillary anterior teeth.

Furthermore, each individual is a unique entity. When making treatment plans, it is essential that practitioners aim not only to achieve a normative dentofacial index, but also to consider the objective of obtaining a balanced smiling profile. The jaw size, the original labiolingual inclination of the maxillary anterior teeth, the AP position, and the soft tissue should be evaluated cautiously. Those patients with a Class III face type should be taken much more seriously in terms of increasing the maxillary incisor labial inclination to compensate for the underdevelopment of the maxilla and the upper alveolar bone, because the small amount of labial inclination increase of the upper incisors would have great negative influence on the attractiveness of the smiling profile.

There were some limitations in this study that should be recognized. Although the study had digitally generated profile images altered from ideal profile based on the cephalometric norms from established researchers, it should be taken into consideration that sample size was small compared to entire indian population size. In this study, panel of evaluaters of orthodontists and laypersons may not be representative of the entire population. Also study was of only female population only and there was variation in ethanic as well as on regional basis in Indian population. Lastly images used in study were 2D images of 3D subject.

CONCLUSION

This study concludes that there is an effect of maxillary incisor labiolingual inclination and Anterioposterior (AP) position on smiling profile esthetics in young adult females selected from Indian population. This meansElement II of Andrews and Andrews six elements of orofacial harmony is a useful reference to the smiling profile esthetics in young adult women for Indian population also. A maxillary incisor that is upright or in slight lingual inclination is preferable, in spite of the AP position of the maxillary incisors. Labial inclination of the upper incisors could easily ruin a pleasing smiling appearance. Maxillary incisor protrusion is preferable to retruded incisors.

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