

# Cephalometric Norms For The Position Of Maxillary Incisor And Upper Lip In A Sample Of North Indian Population

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## Abstract

**Objectives:** The purpose of this study was to evaluate the position of the maxillary incisor and upper lip cephalometrically in a North Indian population and to compare them with the other established cephalometric norms.

**Materials and Methods:** Digital lateral cephalograms were taken on 60 subjects (30 males and 30 females) of 18-30 years having well-balanced faces and good occlusion. The cephalograms were traced and parameters relating to upper incisor and upper lip position were evaluated and assessed.

**Results:** Significant differences were seen on gender wise comparison in the U1-TVL, upper lip thickness and upper lip-E line parameters. Highly significant differences were seen in the parameters on comparison with their respective established norms showing distinctions between the North Indian population and the Caucasian population.

**Conclusion:** Females exhibited more forwardly placed maxillary incisors and upper lip when compared to males of the North Indian population. The males however presented with more incisor proclination than the females. Males were observed to have thicker lips when compared to the females. The North Indian population presented with more proclined and more forwardly placed incisors and have thinner lips when compared to the established Caucasian norms for both genders.

**Key Words:** Cephalometric norms, Maxillary Incisor position, Upper lip position, North Indian population

## Introduction

In the late 1920s when Edward H. Angle introduced his classification of malocclusion, orthodontics focused predominantly on the molar relationship as Class I, Class II or Class III. Non-extraction and expansion was generally the treatment of choice. Tweed later in the 1940s emphasized on the lower incisors as he clearly noticed the shortcomings of the non-extraction treatment as believed by his mentor, Angle. The minimal emphasis on the upper

incisors was due to the fact that no surgical correction was available at the time, nor was the facial appearance improved with functional appliances. But with the advent of improved orthodontic and orthognathic techniques and protocols, the focus has shifted more to the upper incisors as the starting point for treatment planning.<sup>1</sup> One of the major concerns for most patients is an abnormal position of the maxillary incisor, thus planned incisor position is a criterion of paramount importance for achieving sound and good orthodontic results. The thickness of the lip at the vermilion border is one of the key factors for a pleasant smile and also has shown positive correlation with the position of the upper incisors and their degree of proclination.<sup>2</sup> Taking these factors into account, an ideal position for upper incisors can be envisioned and the treatment mechanics can eventually be planned to accommodate all the other teeth around this position. Arnett's soft tissue cephalometric analysis, or STCA, was studied on white subjects<sup>3</sup> and similarly, Down's samples also consisted of white subjects.<sup>4</sup> All these studies did not take into account the ethnic and racial variations, so using the Caucasian values in our North Indian population may often result in erroneous values. There are currently very less cephalometric studies in the available literature which emphasize the positions of the maxillary incisors and the upper lip in North Indian subjects with well-balanced faces. Therefore, a cephalometric study is required to establish norms for the population.

## Aims and Objectives

1. To study the maxillary incisor and upper lip positions cephalometrically in North Indian subjects with proportional facial profiles.
2. To investigate the sexual dimorphism in the maxillary incisor positions in these subjects.
3. To compare maxillary incisor and upper lip positions in North Indian subjects with the other established cephalometric norms.

## Materials and Methods

The sample of this study consisted of lateral cephalograms of 60 subjects (30 males and 30 females) in the age group of 18-30 years belonging to the North Indian population. The criteria for the selection of the sample were: Orthognathic to mildly convex facial profile, Class I molar relationship, Normal overjet and overbite, Competent lips, No history of previous orthodontic treatment. Digital Lateral cephalograms were taken on the selected North Indian subjects. All the cephalograms were taken with the patients in a relaxed standing position looking into an imaginary point in front of them at eye level to register the natural head position. The central ray beam was directed towards the external auditory meatus and perpendicular to the midsagittal plane. The cephalograms were taken with the teeth in centric occlusion and the lips in rest position and traced on lead acetate sheets with extra smooth finish HB pencil with a diameter of 0.5 mm. The following cephalometric parameters were studied:

### Maxillary Incisor Position

1. Upper central incisor to palatal plane (°): The angle between the long axis of the maxillary central incisor to the plane connecting ANS-PNS.
2. Upper central incisor to maxillary occlusal plane (°): The angle between the long axis of the maxillary central incisor to the maxillary occlusal plane.
3. Upper central incisor to TVL (mm): The distance from the tip of the maxillary central incisor to a plane passing through sub-nasale.
4. Upper central incisor to nasion perpendicular (mm): The distance from the tip of the maxillary central incisor to a perpendicular line passing through the nasion on FH plane.
5. Upper central incisor to point A vertical (mm): The distance between the most prominent point on facial surface of upper central incisor to point A vertical.
6. Upper central incisor to sella-nasion plane (°): The angle between the long axis of the maxillary central incisor to the plane joining the sella and nasion points.
7. Upper central incisor to NA (°): The angle between the long axis of maxillary central incisor to the plane joining nasion to point A.
8. Upper central incisor to NA (mm): The distance between the most prominent points on the labial surface of maxillary central incisor to a plane formed by joining the nasion to point A.
9. Upper central incisor to N-Pog (mm): The distance between the most prominent point on the labial surface of maxillary central incisor to the

plane joining points N and Pog. 10. Upper central incisor to point A-Pog (mm): The distance between the most prominent point on the labial surface of maxillary central incisor to the plane joining points A and Pog

### Upper Lip Measurements

1. Upper lip angle ( $^{\circ}$ ): The angle between the plane passing through the anterior most point of upper lip to the plane passing through sub nasale. 2. Upper lip to true vertical line (mm): The distance between the anterior most point of the upper lip to the plane passing through sub nasale. 3. Upper lip thickness (mm): The distance between the anterior most point of the upper lip to the most prominent point on the labial surface of the maxillary central incisor. 4. Upper lip to S line (mm): The distance from the anterior most point of the upper lip to a line extending from the soft tissue contour of chin to the middle of S formed by the lower border of the nose. 5. Upper lip to E line (mm): The distance from the anterior most point of the upper lip to a line extending from the anterior most point of nose to the anterior most point of chin.



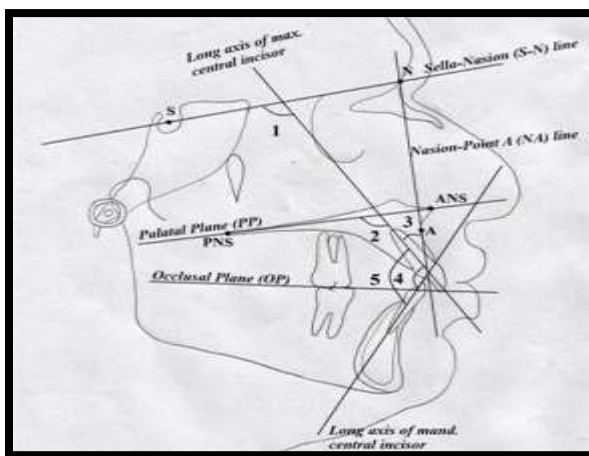
**Figure 1:** Standardized Lateral Cephalogram With Subject In Natural Head Position



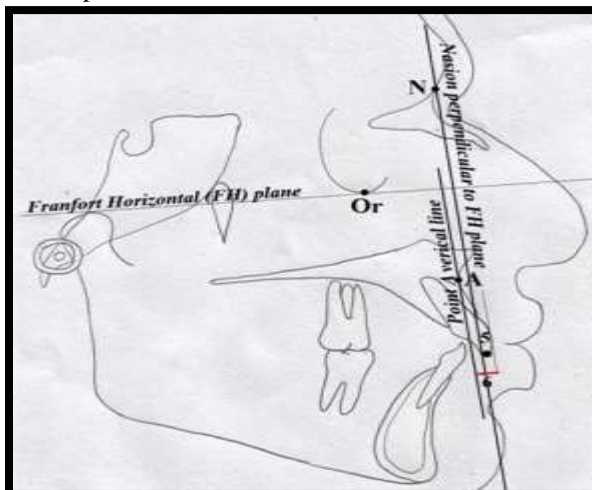
**Figure 2:** Lateral Cephalogram Of Subject



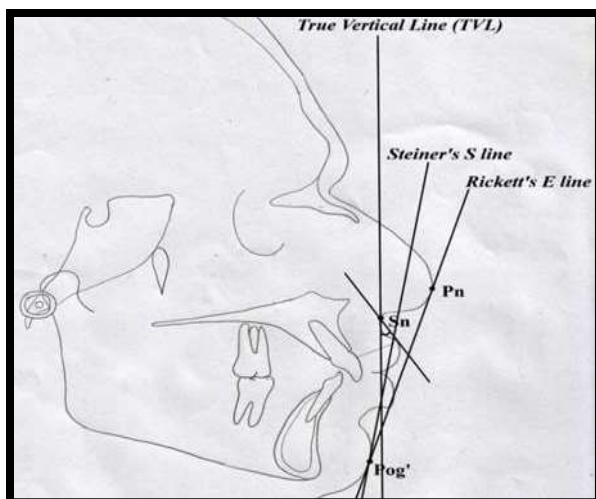
**Figure 3:** Armamentarium Required For Tracing Of A Lateral Cephalogram



**Figure 4:** Angular parameters in upper central incisor evaluation. 1.) U1-SN 2.) U1-PP 3.) U1-NA 4.) U1-OP 5.) Interincisal angle. Landmarks depicted: S-Sella, N-Nasion, A-Point A, ANS- Anterior Nasal Spine, PNS-Posterior Nasal Spine



**Figure 5:** Linear parameters in upper central incisor evaluation 1.) U1-TVL 2.) U1-NA 3.) U1-APog 4.) U1-NPog 5.) U1-N perpendicular 6.) U1-Pt. A vertical. Landmarks depicted: N-Nasion, A-Point A, Sn-Subnasale, Pog-Pogonion, Or-Orbitale



**Figure 6:** Upper lip parameters include – Upper lip angle, Upper lip thickness, Upper lip to TVL, Upper lip to Steiner’s S line, Upper lip to Rickett’s E line. Landmarks depicted: Pn-Pronasale, Sn-Subnasale, Pog’-Soft tissue Pogonion

## Statistical Analysis and Results

The results were analyzed using descriptive statistics and making comparisons among the various groups. Discrete data were summarized as in mean & SD. The p-value was taken significant when less than 0.05 ( $p < 0.05$ ) and Confidence interval of 95% was taken. Analysis of sexual dimorphism in maxillary incisor and upper lip position was done firstly. There was a high statistical significant difference between males and females in the U1-TV L incisor parameter ( $p < 0.001$ ) with the males exhibiting a lower mean value ( $-13.43 \pm 3.95$ ) compared to the females ( $-9.70 \pm 2.22$ ). The other parameters related to the upper incisor were observed to be not statistically significant. (Table 1) Amongst the upper lip parameters, high statistical significant difference between males and females was seen in the parameter upper lip thickness ( $p < 0.001$ ) with higher mean values exhibited by males ( $14.17 \pm 1.95$ ) as compared to females ( $11.70 \pm 1.49$ ). Significant difference was also seen in the upper lip to E-line parameter ( $p = 0.016$ ) with females presenting higher mean values ( $-2.48 \pm 1.69$ ) as compared to males ( $-3.77 \pm 2.25$ ). (Table 2) Comparative analysis of maxillary incisor and upper lip position of current study with their respective standard values was also attempted. In the upper incisor parameters, the males of the current study exhibited statistical significance wrt U1-NPog ( $p = 0.002$ ) with higher values as compared to their norms. High statistical significant differences ( $p = 0.001$ ) were seen in U1-APog, U1-PP, U1-SN, U1-NA (angular), and Interincisal angle parameters. The females presented significant differences in the U1-pt. A vertical ( $p = 0.011$ ) and U1-PP ( $p = 0.002$ ). Highly significant differences were seen in the U1-NPog ( $p = 0.001$ ), U1-APog, U1-SN, U1-NA (angular) and Interincisal angle with  $p < 0.001$ . The upper lip parameters on comparison to their respective norms exhibited statistical significance especially in the females with all parameters having significant differences. However in the males, only the parameter upper lip angle showed significant difference on comparison ( $p = 0.002$ ) while the other parameters were seen to be not statistically significant.

**Table – 1:** Comparison of Upper Incisor Parameters between Males & Females

Upper Incisor	Male		Female		unpaired t test	
	Mean	SD	Mean	SD	t-value	p-value
U1-pt.A vertical (mm)	5.85	2.56	5.90	1.80	-0.09	0.931
U1-TV L (mm)	-13.43	3.95	-9.70	2.22	-4.52	<b>&lt;0.001</b>
U1-NA (mm)	4.77	2.22	4.77	2.26	0.00	1.000

U1-N Pog (mm)	7.27	2.77	7.03	2.17	0.36	0.718
U1-A Pog (mm)	6.03	2.01	5.90	1.67	0.28	0.781
U1-PP (degree)	118.23	7.20	116.43	6.25	1.03	0.305
U1-N perpendicular (mm)	2.73	5.92	3.75	2.92	-0.84	0.402
U1-OP (degree)	56.97	6.13	57.47	4.64	-0.36	0.723
U1-SN (degree)	111.80	8.47	109.27	5.41	1.38	0.173
U1-NA (degree)	28.57	5.81	26.43	4.86	1.54	0.128
Interincisal	123.07	7.83	123.60	6.46	-0.29	0.775

Table – 2: Comparison of Upper Lip Parameters between Males & Females

Upper Lip	Male		Female		unpaired t test	
	Mean	SD	Mean	SD	t-value	p-value
Upper Lip- TVL (mm)	2.90	2.11	2.97	1.43	-0.14	0.887
Upper Lip Thickness (mm)	14.17	1.95	11.70	1.49	5.51	<0.001
Upper Lip- S line (mm)	0.18	1.79	0.67	1.45	-1.15	0.256
Upper Lip- E line (mm)	-3.77	2.25	-2.48	1.69	-2.49	0.016
Upper Lip Angle	13.13	7.56	14.37	6.02	-0.70	0.487

Table –3: Comparison of Upper Incisor Parameters with Standard values among Males

Upper Incisor	Male		Standard Value	One sample t test	
	Mean	SD	Mean/Range	t-value	p-value
U1-pt.A vertical (mm)	5.85	2.56	4 - 6	1.82	0.080
U1-TVL (mm)	-13.43	3.95	-12.1±1.8	1.85	0.074
U1-NA (mm)	4.77	2.22	4.00	1.89	0.069
U1-N Pog (mm)	7.27	2.77	5.51	3.48	0.002
U1-A Pog (mm)	6.03	2.01	2.70	9.09	<0.001
U1-PP (degree)	118.23	7.20	106.3°-115.7°	5.50	<0.001
U1-N perpendicular (mm)	2.73	5.92	NA	NA	NA
U1-OP (degree)	56.97	6.13	56.8 ± 2.5	0.15	0.883
U1-SN (degree)	111.80	8.47	102±2	6.34	<0.001
U1-NA (degree)	28.57	5.81	22.00	6.19	<0.001
Interincisal	123.07	7.83	135.40	8.62	<0.001

**Table – 4:** Comparison of Upper Incisor Parameters with Standard values among Females

Upper Incisor	Female		Standard Value	One sample t test	
	Mean	SD	Mean/Range	t-value	p-value
U1-pt.A vertical (mm)	5.90	1.80	4 - 6	2.74	<b>0.011</b>
U1-TVL (mm)	-9.70	2.22	-9.2±2.2	1.24	0.226
U1-NA (mm)	4.77	2.26	4.00	1.86	0.073
U1-N Pog (mm)	7.03	2.17	5.51	3.84	<b>0.001</b>
U1-A Pog (mm)	5.90	1.67	2.70	10.51	<b>&lt;0.001</b>
U1-PP (degree)	116.43	6.25	106.3°-117.8°	3.45	<b>0.002</b>
U1-N perpendicular (mm)	3.75	2.92	NA	NA	NA
U1-OP (degree)	57.47	4.64	57.8 ± 3.0	0.39	0.697
U1-SN (degree)	109.27	5.41	102±2	7.35	<b>&lt;0.001</b>
U1-NA (degree)	26.43	4.86	22.00	5.00	<b>&lt;0.001</b>
Interincisal	123.60	6.46	135.40	10.00	<b>&lt;0.001</b>

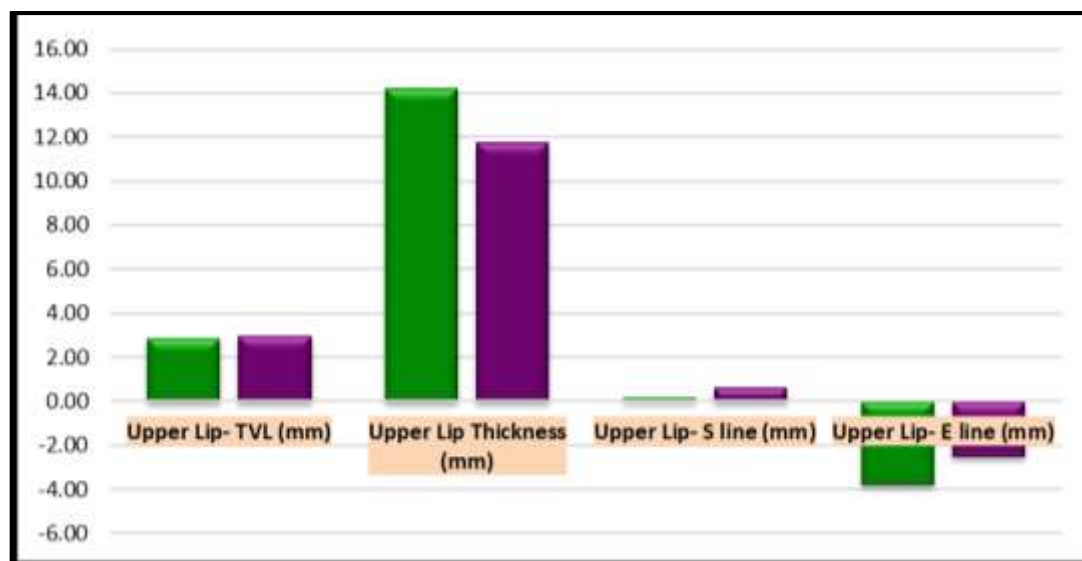
**Table – 5:** Comparison of Upper Lip Parameters with Standard values among Males

Upper Lip	Male		Standard Value	One sample t test	
	Mean	SD	Mean/Range	t-value	p-value
Upper Lip- TVL (mm)	2.90	2.11	3.3±1.7	1.04	0.307
Upper Lip Thickness (mm)	14.17	1.95	14.8±1.4	1.78	0.086
Upper Lip- S line (mm)	0.18	1.79	0.00	0.56	0.580
Upper Lip- E line (mm)	-3.77	2.25	-4.00	0.57	0.575
Upper Lip Angle	13.13	7.56	8.3±5.4	3.50	<b>0.002</b>

**Table – 6:** Comparison of Upper Lip Parameters with Standard values among Females

Upper Lip	Female		Standard Value	One sample t test	
	Mean	SD	Mean/Range	t-value	p-value
Upper Lip- TVL (mm)	2.97	1.43	3.7±1.2	2.81	<b>0.009</b>

<b>Upper Lip Thickness (mm)</b>	11.70	1.49	12.6±1.8	3.31	<b>0.002</b>
<b>Upper Lip- S line (mm)</b>	0.67	1.45	0.00	2.52	<b>0.018</b>
<b>Upper Lip- E line (mm)</b>	-2.48	1.69	-4.00	4.90	<b>&lt;0.001</b>
<b>Upper Lip Angle</b>	14.37	6.02	12.1±5.1	2.06	<b>0.048</b>



**Graph 1:** Summary of Upper Lip Linear Parameters

## Discussion

An individual's psychological well-being and social acceptance are significantly impacted and influenced by facial aesthetics. Facial aesthetics along with function are paramount factors to be taken into consideration in the treatment planning and nowadays are also considered to be the primary objectives which determines the success of various orthodontic and orthognathic treatment procedures.<sup>5</sup> Any feature or parameter which may be deemed to be aesthetically pleasant by various ethnic groups varies depending on their respective populations. Therefore, due to such variations, a standard established for a particular demographic cannot be universally applied or followed. Comparing Caucasians to Asians, it was found that the upper and lower lips protruded more. The combination of a short nose and a lack of chin prominence, he continues, may be to blame for this fact.<sup>6,7</sup> The men displayed less pronounced soft tissue profile variations whereas the women displayed less pronounced upper and lower lip protrusion. In this study, statistically significant differences in the mean values of U1-TVL were seen between males and females, with the females exhibiting more forwardly positioned incisors. This is in concordance with the studies done by various researchers in the literature. In comparison to the North Indian population, South Indian ethnic population displayed more forwardly placed maxillary incisors.<sup>8,9</sup> In a study on the Marathi population although exhibited similar results but with larger values, suggest of a more forwardly positioned central incisors. The upper lip to E line mean values showed statistical significance with the females indicating more lip projection when compared to males. Few other researchers showed similar projections in both males and females.<sup>10,11</sup> In the studies conducted on the Kashmiri populace, they were also in concordance with the findings of the current study but they presented with smaller values of lip projection to the E plane which may indicate either retrusive lips or increased nasal projection. The upper lip to S line parameter however did not show any statistical significance in the study with both



genders presenting nearly similar values, although a slightly greater mean was derived from the females.<sup>12,13</sup> In other imperative studies, gender-wise comparison of this parameter were seen to be significant, but in the latter's study, the females were seen to have more retrusive lips which is contradictory to the former in which females exhibit more protrusive lips.<sup>14,15</sup> Studies on the Tamil Nadu population was shown to have similar projection in both genders. In few important photographic studies, the values depicted very retrusive lips in both sexes when compared to the other groups.<sup>16,17</sup> The projection of the upper lip to TVL showed no statistical significance with similar values between males and females. Studies on the South Indian and Himachali population showed statistical significance in comparison between males and females with males showing more protruded lips than the females. The Bihar population however, exhibited more protrusive lips in the females. In this study, TVL projection measurements were done for both upper incisor and upper lip. TVL projections, which measure soft tissue anteroposteriorly, combine the dentoskeletal position and the thickness of the soft tissue covering the hard tissue landmark.<sup>18-22</sup> A landmark's absolute value is the horizontal distance measured perpendicular to the TVL. The projection of the upper lip to TVL was found to have significant difference in the females of the present study showing decreased projection or less protrusive lips in comparison to the standard norms. The study done on white Brazilian adults also reported the same findings. In a study of facial profile evaluation of Japanese-Brazilian adults, males were found to have significant differences in contrast to the females who presented no significance even though slightly higher values were observed.<sup>23-25</sup> The studies conducted on the Turkish, Japanese and Italian women all reported less protrusive lips. The Sudanese population however exhibited significantly higher projection of the lips when compared to the other groups.<sup>26-28</sup> This study emphasises how various ethnic groups exhibit variations in incisor and lip positions, as reported by various authors. Separate norms for various ethnic communities are required and what is normal for one ethnic group might not be for another. India is a distinctive nation with great diversity in ethnic groups, race, and religion in which not marked differences and sexual dimorphism with other countries is observed, but also between its citizens as well. This infers that for the purpose of orthodontic treatment planning, gender-specific norms should be used instead of the generalised norms.<sup>29-32</sup> In fact, the cephalometric norms for maxillary incisor and upper lip position could provide a baseline data for the diagnosis and planning of orthodontic therapy for North Indians. But instead of being used as a model for therapy, these norms ought to be used as a guide. The ultimate goal of treatment should be to meet each individual's requirements and preferences. The distinctions between North Indians and Caucasians and other groups in such dimensions emphasize the significance of identifying what is normal for a particular ethnic group or population.

## Conclusion

Based on the findings and results of this study, the following conclusions can be drawn. 1) Females exhibited more forwardly placed maxillary incisors and upper lip when compared to males of the North Indian population. The males however presented with more incisor proclination than the females. 2) Males were observed to have thicker lips when compared to the females. 3) The North Indian population presented with more proclined and more forwardly placed incisors when compared to the established Caucasian norms for both genders. 4) The North Indians presented with thinner lips as compared to the Caucasians.

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