Soft tissue cephalometric analysis applied to regional Indian population

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ABSTRACT

Introduction: Importance of soft tissue consideration in establishing treatment goals for orthodontics and orthognathic surgery has been recognized and various cephalometric analysis incorporating soft tissue parameters have evolved. The great variance in soft tissue drape of the human face and perception of esthetics exists and normative data based on one population group cannot be applied to all. The study was conducted to compare the standard soft tissue cephalometric analysis (STCA) norms with norms derived for population of western Uttar Pradesh region of India. Materials and Methods: The sample consisted of lateral cephalograms taken in natural head position of 33 normal subjects (16 males, 17 females). The cephalograms were analyzed with soft tissue cephalometric analysis for orthodontic diagnosis and treatment planning, and the Student’s t test was used to compare the difference in means between study population and standard STCA norms. Results: Compared with established STCA norms, females in our study had steeper maxillary occlusal plane, more proclined mandibular incisors, and less protrusive lips. Both males and females showed an overall decrease in facial lengths, less prominent midface and mandibular structures and more convex profile compared with established norms for the White population. Conclusions: Statistically significant differences were found in certain key parameters of STCA for western Uttar Pradesh population when compared with established norms.

Key words: Cephalometrics, orthognathic, soft tissue

INTRODUCTION

The esthetics of the face depends upon the soft and hard tissue contour. A pleasant face can be a great asset to one’s personality while a facial deformity can greatly affect one’s social acceptance and behavior.\(^1\) Attaining excellence of facial form is one of the prime objectives of orthodontic treatment.

The role of skeletal structures influencing the facial form is a recognized and accepted fact. However, one must not lose sight of the fact that the soft tissue that covers the bony surface of the face plays an equally important part in the stability of the dental arches and aesthetic harmony. Much research demonstrates that soft tissues, which vary considerably in thickness, are a major factor in determining a patient’s final facial profile.\(^2\)\(^-\)\(^6\)

With advances in the field of orthognathic surgery, a need for a specialized cephalometric appraisal system was felt which would enable a comprehensive analysis of the skeletal, dental as well as the soft tissues. This led to the development of cephalometrics for orthognathic surgery (COGS) for hard tissue and soft tissue analysis.\(^7\) Epker and Fish also developed cephalometric analysis to aid in the successful diagnosis and treatment planning of an orthognathic surgical patient.\(^8\)
In 1999, a new cephalometric analysis was introduced by William Arnett called the soft tissue cephalometric analysis (STCA), which tried to amalgamate both the hard tissue and soft tissue analysis, and came up with a comprehensive analysis for patients needing orthognathic surgery. Arnett studied both hard tissue and soft tissue parameters and suggested ideal values to which patient values could be compared. He was of the opinion that the soft tissue profile is a critical guide to tooth placement, occlusal correction, and optimal facial harmony. It can also be a valuable tool in identifying subjects requiring surgery and improve the likelihood of successful outcome.

Important advantage of STCA over other cephalometric analysis is the use of natural head position (NHP) as reference plane. There is a plethora of cephalometric analysis, which put emphasis on hard tissue during treatment planning and uses cranial base structures as reference planes. When cranial base is used as the reference line for measuring dentofacial parameters, false findings can be generated because the cranial base is as variable as the dental and facial structures that it measures.

The concept of NHP was introduced to orthodontics in the 1950s. NHP has been found to be highly reproducible. Analysis based on NHP and the true horizontal as a reference plane should have greater clinical application than traditional methods.

The cephalometric norms of different ethnic and racial groups established in various studies. Most investigators have concluded that there are significant differences between ethnic and racial groups, and cephalometric standards have been developed for specific ethnic and racial groups. It is important while considering a patient’s treatment goals and needs to compare the cephalometric findings with the norms for his or her ethnic group for an accurate diagnostic evaluation.

The purpose of this study was to compare STCA norms derived for subjects belonging to western Uttar Pradesh region of India with standard STCA norms derived for Caucasians.

**Materials and Methods**

Thirty three adults from western Uttar Pradesh, India who fulfilled the selection criteria and were judged to have well balanced facial profiles and esthetics participated in the study. Subjects were selected after two stage screening procedure. First the subjects were screened based on following inclusion and exclusion criteria. Inclusion criteria were pleasing facial profile, competent lips, acceptable facial symmetry, class-I canine, and molar relationships. Subjects with past history of orthodontic treatment, prosthodontic treatment, or maxillofacial/plastic surgery treatment were excluded from the study. Subjects were given a questionnaire to confirm their past medical/dental history and also their ethnicity. Since the subjects were to undergo radiographic exposure, informed consent was obtained from everyone, who participated in the study. Second screening was done by a panel consisting of an orthodontist, a plastic surgeon, and a fashion designer who judged the extra-oral photographs of selected subjects on the basis of having reasonably balanced facial profile and pleasing facial appearance.

The subjects were first assessed clinically in NHP, with seated condyles and passive lips. Metallic markers were placed on various soft-tissue structures on the faces to study and relate them to the true vertical line (TVL) as described by Arnett et al. The subjects were then asked to swallow and bite into centric occlusion. A lateral headfilm was obtained with the subject in NHP, with seated condyle and with passive lips. Standard 8 × 10 in Kodak T-mat lateral radiographic headfilms (Eastman Kodak, Rochester, NY, USA) were used for each subject on Rotograph plus (Villa system Medical, Italy) panoramic and cephalometric equipment. All exposed films were developed and fixed manually by the same technician using standard procedures. All lateral cephalometric films were traced on a transparent cellulose acetate sheet of 0.076 mm thickness by the same technician. Similar conditions of the light box and general illumination were maintained during viewing and tracing of all headfilms. All reference points were first identified, located, and marked. The landmarks and measurements were taken according to the STCA. Mean and standard deviation were calculated for each parameter. The data were separated according to sex to obtain more specific and useful cephalometric normative values. Calculated values were compared between males and females within the study population and also between study population and standard STCA values. Significance of difference was evaluated using Student’s t test and level of significance was kept at 5%.

**Results**

Cephalograms obtained for 33 subjects (16 males, 17 females) selected from western Uttar Pradesh (W.UP) population were traced and STCA was done. Data was separated for males and females. Mean and standard deviation was calculated for each parameter [Table 1].

The obtained data was compared with standard STCA norms established for White population [Table 2].
Comparing Dento-skeletal factors, W.UP males and females had higher value for inclination of Maxillary Occlusal plane to TVL [98.78° vs 95.00° (males) and 100.09° vs 95.60° (females)] than their White counterparts. Moreover, W.UP females had lesser values than their white counterpart for the parameter of Mandibular incisor to occlusal plane (61.65° vs 64.30°). The value for overbite was less in W.UP males (2.63mm) compared with White males (3.20 mm).

Comparing soft tissue factors between two populations, W.UP females had thicker upper lips (1.08 mm) and thinner lower lips (1.01 mm) than their White counterparts. Moreover, W.UP females had lesser values than their white counterpart for the parameter of Mandibular incisor to occlusal plane (61.65° vs 64.30°). The value for overbite was less in W.UP males (2.63mm) compared with White males (3.20 mm).

Following facial length values were higher in White population: Maxillary incisor exposure [2.0 mm (males) and 1.9 mm (females)], maxillary height [4.1 mm (males) and 2.0 mm (females)], mandibular height [4.37 mm (males) and 2.3 mm (females)], interlabial gap [1.8 mm (males) and 3.3 mm (females)], length of lower third of face [7.8 mm (males) and 4.6 mm (females)].

Moreover, White males had higher values for total facial height (5.04 mm), upper lip length (1.7 mm), lower lip length (3.7 mm).

W.UP population had higher value (more negative to TVL) for the following parameters:

Orbital rims [2.13 mm (males) and 1.45 mm (females)], cheekbones [4.05 mm (males) and 4.31 mm (females)], A-point’ [1.86 mm (males) and 1.78 mm (females)], upper lip anterior [2.31 mm (males) and 2.55 mm (females)], maxillary incisor [3.37 mm (males) and 3.56 mm (females)], mandibular incisor [3.04 mm (males) and 3.25 mm (females)], lower lip anterior [1.84 mm (males) and 0.29 mm (females)], B-point’ [5.9 mm (males) and 5.38 mm (females)], and Pogonion’ [6.53 mm (males) and 5.75 mm (females)].

Moreover, nasal projection was greater [1.34 mm (males) and 1.0 mm (females)] in White population than in W.UP population.

Intramandibular harmony values for Mandibular incisor–Pogonion’ harmony were higher [3.52 mm (males) and 2.27 mm (female)] in White populations while harmony values for lower-lip–pogonion’ were higher [2.73 mm (males) and 1.47 mm (females)] are higher in W.UP population.

All three interjaw harmony values were higher in W.UP population: Subnasale–pogonion’ harmony [5.59 mm (males) and 5.06 mm (females)]; A-point’–B-point’ harmony [3.92 mm (males) and 3.6 mm (females)]; Upper lip anterior’–lower lip anterior’ [1.54 mm (males) and 1.61 mm (females)].

Orbit to jaw harmony value for orbital rim’–pogonion’ harmony was higher [4.46 mm (males) and 4.0 mm (females)] in White population.

Facial angle was higher [5.34 mm (males) and 4.1 mm (females)] in White population. Moreover, Glabella’–Pogonion’ harmony values were higher [6.88 mm (males) and 7.81 mm (females)] in White population. Females of White population had higher values (4.4 mm) for Glabella’–A-point’ harmony than for females of W.UP population.

**DISCUSSION**

Our findings are discussed under the five headings of the STCA: [9]

1. **Dentoskeletal factors**
   - When compared with White population, following significant differences ($P < 0.05$) were found in our study population. Both males and females had higher value for inclination of Maxillary Occlusal plane to TVL than their white counterparts. This suggests a steeper occlusal plane in our study population compared with White population. Moreover, females had lesser value for Mandibular incisor to occlusal plane and overjet and males had lesser values for overbite compared with their White counterparts. These differences can be attributed to racial and ethnic differences between the two populations.

2. **Soft tissue structures**
   - When compared with White population, following significant differences were found in our study population. Females had thicker upper lips and thinner lower lips than their White counterparts. Moreover, upper lip angle was lower in females of our study sample. Males had thinner lower lips than their White counterparts. These findings suggest that females in our study had more retropositioned lips than their White counterparts.

3. **Facial lengths**
   - Significant difference was noted while analyzing facial lengths between our study population and White population. Maxillary incisor exposure, maxillary height, mandibular height, interlabial gap, and length of lower third of the face are greater in White population. Moreover, total facial height, upper lip length, lower lip length were higher in White males. Similar findings for Indian population have been reported in previous studies. [21-23]
Table 1: STCA values derived for subjects selected from western Uttar Pradesh population

| Parameter                                      | Sex   | N  | Mean   | Std. deviation | P value |
|------------------------------------------------|-------|----|--------|----------------|---------|
| **Dentoskeletal factors**                      |       |    |        |                |         |
| Maxillary central incisor to maxillary occlusal plane (°) | Male  | 16 | 58.719 | 4.3281         | 0.695   |
|                                                | Female| 17 | 58.000 | 5.9214         |         |
| Mandibular central incisor to mandibular occlusal plane (°) | Male  | 16 | 62.406 | 4.9471         | 0.667   |
|                                                | Female| 17 | 61.847 | 5.0952         |         |
| Overjet (mm)                                   | Male  | 16 | 2.844  | 0.6511         | 0.847   |
|                                                | Female| 17 | 2.882  | 0.4851         |         |
| Overbite (mm)                                  | Male  | 16 | 2.625  | 0.6455         | 0.132   |
|                                                | Female| 17 | 3.029  | 0.8380         |         |
| Maxillary occlusal plane (°)                   | Male  | 16 | 98.781 | 2.7566         | 0.242   |
|                                                | Female| 17 | 100.088| 3.4742         |         |
| **Soft tissue structures**                     |       |    |        |                |         |
| Upper lip thickness (mm)                       | Male  | 16 | 14.938 | 1.1815         | 0.001   |
|                                                | Female| 17 | 13.676 | 0.7276         |         |
| Lower lip thickness (mm)                       | Male  | 16 | 14.094 | 1.1287         | 0.000   |
|                                                | Female| 17 | 12.588 | 0.8703         |         |
| Pogonion–menton’ (mm)                          | Male  | 16 | 12.294 | 1.5817         | 0.002   |
|                                                | Female| 17 | 9.500  | 0.7952         |         |
| Menton–menton’ (mm)                            | Male  | 16 | 9.500  | 1.1547         | 0.000   |
|                                                | Female| 17 | 7.912  | 0.7952         |         |
| Nasolabial angle (°)                           | Male  | 16 | 102.438| 8.9589         | 0.942   |
|                                                | Female| 17 | 102.676| 9.7387         |         |
| Upper lip angle (°)                            | Male  | 16 | 5.594  | 4.2238         | 0.591   |
|                                                | Female| 17 | 6.324  | 3.4728         |         |
| **Facial lengths**                             |       |    |        |                |         |
| Nasion–Menton’ (mm)                            | Male  | 16 | 132.656| 4.5267         | 0.000   |
|                                                | Female| 17 | 122.265| 4.2431         |         |
| Upper lip length (mm)                          | Male  | 16 | 22.750 | 1.6733         | 0.032   |
|                                                | Female| 17 | 20.794 | 3.0724         |         |
| Interlabial gap (mm)                           | Male  | 16 | 0.063  | 0.0000         | 0.310   |
|                                                | Female| 17 | 0.063  | 0.0000         |         |
| Lower lip length (mm)                          | Male  | 16 | 50.625 | 2.6426         | 0.000   |
|                                                | Female| 17 | 45.794 | 2.8617         |         |
| Lower 1/3rd of face (mm)                       | Male  | 16 | 73.313 | 2.8040         | 0.000   |
|                                                | Female| 17 | 66.500 | 4.7269         |         |
| Overbite (mm)                                  | Male  | 16 | 2.625  | 0.6455         | 0.034   |
|                                                | Female| 17 | 3.176  | 0.7694         |         |
| Maxillary central incisor Exposure (mm)        | Male  | 16 | 1.906  | 0.9869         | 0.014   |
|                                                | Female| 17 | 2.824  | 1.0299         |         |
| Maxillary height (mm)                          | Male  | 16 | 24.375 | 2.0453         | 0.504   |
|                                                | Female| 17 | 23.765 | 3.0162         |         |
| Mandibular height (mm)                         | Male  | 16 | 51.625 | 2.0290         | 0.000   |
|                                                | Female| 17 | 46.353 | 2.5906         |         |
| **Projections to TVL**                         |       |    |        |                |         |
| Glabella (mm)                                  | Male  | 16 | -7.750 | 4.7293         | 0.516   |
|                                                | Female| 17 | -6.765 | 3.8735         |         |
| Orbital rims (mm)                              | Male  | 16 | -24.531| 3.5752         | 0.000   |
|                                                | Female| 17 | -20.147| 2.4159         |         |
| Cheek bone (mm)                                | Male  | 16 | -29.250| 3.8557         | 0.001   |
|                                                | Female| 17 | -24.912| 2.7400         |         |
| Subpupil (mm)                                  | Male  | 16 | -19.813| 2.9826         | 0.000   |
|                                                | Female| 17 | -15.794| 2.3787         |         |
| Alar base (mm)                                 | Male  | 16 | -14.469| 2.2020         | 0.001   |
|                                                | Female| 17 | -11.882| 1.8331         |         |
| Nasal projection (mm)                          | Male  | 16 | 16.063 | 1.8697         | 0.098   |
|                                                | Female| 17 | 15.029 | 1.6054         |         |
| Subnasale (mm)                                 | Male  | 16 | 0.000  | 0.0000         |         |
|                                                | Female| 17 | 0.000  | 0.0000         |         |
| A point’ (mm)                                  | Male  | 16 | -2.156 | 0.9953         | 0.359   |
|                                                | Female| 17 | -1.882 | 0.8738         |         |
| Upper lip anterior (mm)                        | Male  | 16 | 0.906  | 1.8277         | 0.659   |
|                                                | Female| 17 | 1.147  | 1.2345         |         |
| Maxillary central incisor (mm)                 | Male  | 16 | -15.469| 2.4253         | 0.004   |
|                                                | Female| 17 | -12.765| 2.5194         |         |
| Mandibular central incisor (mm)                | Male  | 16 | -18.438| 2.5941         | 0.004   |
|                                                | Female| 17 | -15.647| 2.6325         |         |
| Lower lip anterior (mm)                        | Male  | 16 | -2.844 | 2.8327         | 0.360   |
|                                                | Female| 17 | -2.088 | 1.7432         |         |

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4. Projections to TVL
   - Significance difference is noted while analyzing ‘projections to TVL’ between our study population and standard STCA values. Orbital rims, cheek bone, nasal projection, A-point, upper and lower lips, maxillary and mandibular incisors, B-point, and pogonion are more prominent in White population. The difference can be attributed to ethnic difference between the two populations.

5. Facial harmony
   - Comparison of intramandibular harmony reveals statistically significant higher values for Mandibular incisor-pogonion’ harmony in White population suggestive of more prominent chin in White population compared to our study population. Moreover, lesser value for lower lip anterior to Pogonion’ harmony in White population suggest more prominent chin in White population.
   - Comparison of mean interjaw relationships of facial harmony showed that all values were higher in our sample compared with STCA norms. This was indicative of more convex profiles in our study population compared with White population. Moreover, mean facial angle of facial harmony values of this study were lower than those of STCA further confirming more convex profile in our sample. Comparison of orbit to jaw harmony values reveal that while orbital rim–A-point’ harmony is comparable between two population, the values for orbital rim–pogonion’ are significantly higher in W.UP population. This suggests convex profile in our study sample is due to more retropositioned mandible and chin compared with White population. This point is further validated by higher values for Glabella’-pogonion’ harmony in White population. Similar findings were reported by Grewal et al.[22] for north Indian population and Kalha et al.[21] for south Indian population when compared with standard STCA.

**Conclusions**

From the cephalometric study which was conducted on the 33 subjects (16 males and 17 females) selected from W.UP region of India, according to Arnett’s STCA, following conclusions were drawn: (1) Compared with White population, females in our study sample had steeper maxillary occlusal plane, more proclined mandibular incisors and less protrusive lips. (2) Subjects had overall decrease in facial lengths, less prominent midface and mandibular structures and more convex profile compared with...
Table 2: Comparison of STCA values for Western Uttar Pradesh Population with Standard STCA norms

| Parameter                                      | STCA values for W.UP population | Standard STCA norms |
|------------------------------------------------|---------------------------------|---------------------|
| Sex | Mean | Std. Deviation | Sex | Mean | Std. Deviation | P Value |
| Dento skeletal factors                        |                                 |                     |
| Maxillary central incisor to maxillary occlusal plane (°) | Male 58.72  4.33 | Female 58.00  5.92 | Maxillary central incisor to maxillary occlusal plane (°) | Male 57.80  3.00 | Female 56.80  2.50 | 0.4575 |
| Mandibular central incisor to mandibular occlusal plane (°) | Male 62.41  4.95 | Female 61.65  5.10 | Mandibular central incisor to mandibular occlusal plane (°) | Male 64.00  4.00 | Female 64.30  3.20 | 0.2923 |
| Overjet (mm)                                  | Male 2.84  0.65 | Female 2.88  0.49 | Overjet (mm) | Male 3.20  0.60 | Female 3.20  0.40 | 0.0239 |
| Overbite (mm)                                 | Male 2.63  0.65 | Female 3.03  0.84 | Overbite (mm) | Male 3.20  0.70 | Female 3.20  0.70 | 0.0172 |
| Maxillary occlusal plane (°)                  | Male 98.78  2.76 | Female 100.09  3.47 | Maxillary occlusal plane (°) | Male 95.00  1.40 | Female 95.60  1.80 | 0.0001 |
| Soft tissue structures                        |                                 |                     |
| Upper lip thickness (mm)                      | Male 14.94  1.18 | Female 13.68  0.73 | Upper lip thickness (mm) | Male 14.80  1.40 | Female 12.60  1.80 | 0.024 |
| Lower lip thickness (mm)                      | Male 14.09  1.13 | Female 12.59  0.87 | Lower lip thickness (mm) | Male 15.10  1.20 | Female 13.60  1.40 | 0.0146 |
| Pogonion–pogonion’ (mm)                      | Male 14.23  1.81 | Female 12.29  1.58 | Pogonion–pogonion’ (mm) | Male 13.50  2.30 | Female 11.80  1.50 | 0.3111 |
| Menton–menton’ (mm)                          | Male 9.50  1.15 | Female 7.91  0.80 | Menton–menton’ (mm) | Male 8.80  1.30 | Female 7.40  1.60 | 0.2313 |
| Nasolabial angle (°)                         | Male 102.44  8.96 | Female 102.68  9.74 | Nasolabial angle (°) | Male 106.40  7.70 | Female 103.50  6.80 | 0.7464 |
| Upper lip angle (°)                          | Male 5.59  4.22 | Female 6.32  3.47 | Upper lip angle (°) | Male 8.30  5.40 | Female 12.10  5.10 | 0.0002 |
| Facial lengths                               |                                 |                     |
| Nasion’–Menton’ (mm)                         | Male 132.66  4.53 | Female 122.26  4.24 | Nasion’–Menton’ (mm) | Male 137.70  6.50 | Female 124.60  4.70 | 0.0128 |
| Lower lip length (mm)                        | Male 22.75  1.67 | Female 20.79  3.07 | Lower lip length (mm) | Male 21.00  1.90 | Female 20.00  1.90 | 0.0287 |
| Intercanine width (mm)                       | Male 0.06  0.25 | Female 0.00  0.00 | Intercanine width (mm) | Male 2.40  1.10 | Female 3.30  1.30 | 0.0001 |
| Lower lip length (mm)                        | Male 50.63  2.64 | Female 45.79  2.86 | Lower lip length (mm) | Male 54.30  2.40 | Female 46.90  2.30 | 0.0167 |
| Lower 1/3rd of face (mm)                     | Male 73.31  2.80 | Female 66.50  4.73 | Lower 1/3rd of face (mm) | Male 81.10  4.70 | Female 71.10  3.50 | 0.0007 |
| Overbite (mm)                                 | Male 2.63  0.65 | Female 3.18  0.77 | Overbite (mm) | Male 3.20  0.70 | Female 3.20  0.70 | 0.9303 |
| Mandibular height (mm)                       | Male 24.38  2.05 | Female 23.76  3.02 | Mandibular height (mm) | Male 28.40  3.20 | Female 25.70  2.10 | 0.017 |
| Mandibular height (mm)                       | Male 51.63  2.03 | Female 46.35  2.59 | Mandibular height (mm) | Male 56.00  3.00 | Female 48.60  2.40 | 0.0058 |
| Projections to TVL                           |                                 |                     |
| Glabella (mm)                                 | Male -7.75  4.73 | Female -6.76  3.87 | Glabella (mm) | Male -8.00  2.50 | Female -8.50  2.40 | 0.0396 |
| Orbital rims (mm)                            | Male -24.53  3.58 | Female -20.15  2.42 | Orbital rims (mm) | Male -22.40  2.70 | Female -18.70  2.00 | 0.0385 |
| Cheek bone (mm)                              | Male -29.25  3.86 | Female -24.91  2.74 | Cheek bone (mm) | Male -25.20  4.00 | Female -20.60  2.40 | 0.0002 |
| Subpupil (mm)                                | Male -19.81  2.98 | Female -15.79  2.38 | Subpupil (mm) | Male -18.40  1.90 | Female -14.80  2.10 | 0.0935 |
| Alar base (mm)                               | Male -14.47  2.20 | Female -11.88  1.83 | Alar base (mm) | Male -15.00  1.70 | Female -12.90  1.10 | 0.0374 |
| Nasal projection (mm)                        | Male 16.06  1.87 | Female 15.03  1.61 | Nasal projection (mm) | Male 17.40  1.70 | Female 16.00  1.40 | 0.0425 |
| Subnasale (mm)                               | Male 0.00  0.00 | Female 0.00  0.00 | Subnasale (mm) | Male 0.00  0.00 | Female 0.00  0.00 | NA |
| A-point’ (mm)                                | Male -2.16  1.00 | Female -1.86  0.67 | A-point’ (mm) | Male -0.30  1.00 | Female -0.10  1.00 | 0.0001 |
| Upper lip anterior (mm)                      | Male 0.81  1.83 | Female 1.15  1.23 | Upper lip anterior (mm) | Male 3.30  1.70 | Female 3.70  1.20 | 0.0001 |
| Maxillary central incisor (mm)               | Male -15.47  2.43 | Female -12.76  2.52 | Maxillary central incisor (mm) | Male -12.10  1.80 | Female -9.20  2.20 | 0.0001 |
| Mandibular central incisor (mm)              | Male -18.44  2.59 | Female -15.65  2.63 | Mandibular central incisor (mm) | Male -15.40  1.90 | Female -12.40  2.20 | 0.0001 |

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with White population. The findings of this study re-
emphasize the need to devise orthodontic/orthognathic
treatment goals based on ‘normative values’ derived for
individual’s own racial and ethnic background, as the
concept of beauty and esthetic vary between different
ethnic groups and different geographic regions.

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