Original Article

Establishment of Norms of the Beta Angle to Assess the Sagittal Discrepancy for Chennai Population: A Prospective Study

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Abstract

Background and Objectives: In orthodontic diagnosis and treatment planning, the assessment of anteroposterior (AP) discrepancy is of importance to the orthodontist. Both angular and linear measurements have been incorporated into various cephalometric analyses to help the clinician diagnose AP discrepancies and establish the most appropriate treatment plan. Hence, the present study is designed to establish the norms of beta angle to assess the sagittal discrepancy for Chennai population. **Materials and Methods:** The samples were screened from the records of the patient who visited Orthodontic Department of Saveetha Dental College and Hospital. One hundred fifty pretreatment cephalometric radiographs were subdivided based on ANB, Wits appraisal, and beta angle into skeletal Class I, II, III. The same cephalograms were again classified into skeletal Class I, II, and III based purely on beta angle. A total of 150 subjects were included in the study with the age group between 18 and 22 years old. **Results:** The analysis of variance showed that the three groups were significantly different ($P \leq 0.001$). The Newman–Keuls *post hoc* test also found the groups to be significantly different. **Conclusion:** There was statistically significant difference for the mean values for beta angle within the three skeletal patterns (Class I, Class II, and Class III skeletal patterns). There was no statistically significant difference among the mean values of beta angle between Chennai district population and Caucasian norms.

Key words: Beta angle, cephalometrics, orthodontic diagnosis, sagittal relationship, skeletal profile

Introduction

Over the last 50 years, many cephalometric parameters have been proposed to describe anteroposterior (AP) jaw relationships, and the conjunctive use of different parameters has been recommended for the assessment of the AP jaw discrepancy in individual patients.[1]

In orthodontic diagnosis and treatment planning, assessment of AP discrepancy is of importance to the orthodontist. Both angular and linear measurements have been incorporated into various cephalometric analyses to help the clinician diagnose AP discrepancies and establish the most appropriate treatment plan.[2] Since the introduction of cephalometrics by Broadbent,[3] numerous cephalometric measurements have been devised. Of those Downs,[4] Steiner,[5] Tweed,[6,7] Ricketts *et al*.,[8,9] and Jacobson[10,11] probably have gained the widest acceptance. The analyses of Coben,[12] Wylie,[13] Sassouni,[14,15] Enlow *et al*.[16] and associates Bimler,[17] Beatty[18] aorta-x-axis distance angle, Di Paolo *et al*.,[19] Williams *et al*.,[20] Yang and Suhr[21] are perhaps less widely used, but they are nevertheless well known.

Any cephalometric analysis based on either angular or linear measurements has obvious shortcomings, which have been discussed in detail by Moyers *et al*.[22] In cephalometric radiographic analysis, angle ANB is commonly used to describe skeletal discrepancies between the maxilla and the mandible. Some authors have stated that points A and B are dentoalveolar landmarks that are influenced by growth, as well as dentoalveolar remodeling during orthodontic treatment. Thus, changes in the position of points A and B are due to a combination of skeletal and dental changes.[23] The position of nasion is not fixed during growth, and any displacement of nasion will directly affect the ANB angle. Although the ANB angle is still very popular and useful, there is often a difference between the interpretation of this angle and the actual discrepancy between the apical bases.[2]

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Jacobson[10,11] showed that angle ANB does not provide an adequate assessment of variations in skeletal relationships because of inconsistent variations in craniofacial physiognomy, which includes (1) the AP spatial relationship of nasion relative to jaws and (2) the rotational effect of the jaws relative to cranial reference planes (high palatal, occlusal, and mandibular plane angles).[10]

Jacobson suggested the Wits appraisal as an alternative to the use of angle ANB. The singular advantage of the "Wits" appraisal is that it overcomes this shortcoming, i.e., relating jaw bases to the cranial reference plane and concomitantly emphasizes an awareness of this relationship in the overall interpretation of a cephalometric analysis.[11] The Wits appraisal relates points A and B to the functional occlusal plane. Therefore, consecutive comparisons of the Wits appraisal throughout orthodontic treatment might be of limited value because they also reflect changes in the occlusal plane instead of pure AP changes of the jaws.[2]

Other authors have suggested angles or linear measurements based on the palatal plane. Although a strong argument for this approach would be the high stability of the palatal plane with age, its inclination is highly variable, making it difficult to establish mean values for the norm. In a patient with a severely tipped palatal plane, additional cephalometric data should be considered to ensure a more accurate diagnosis.[24]

Baik and Ververidou introduced a new measurement named the beta angle,[2] which is independent of cranial reference planes or dental occlusion is an adjunct in determining the apical base relationship. It uses three skeletal land marks-point A, point B, and the apparent axis of the condyle (C). The angle formed between the A-B line and the perpendicular through point A from the apparent axis of the condyle (C) constitutes the beta angle. Beta angle between 27° and 35° can be considered to have Class I skeletal pattern. A more acute beta (<27°) angle indicates a Class II skeletal pattern, and a more obtuse beta angle (>34°) indicates a Class III skeletal pattern.

This angle does not depend on any cranial landmarks or dental occlusion and would be especially valuable whenever previously established cephalometric measurements, such as the ANB angle and the Wits appraisal, cannot be accurately used because of their dependence on varying factors.[2]

At present, there is no published cephalometric norm of the beta angle for Chennai district population. The aim of this present study is therefore to establish a norm of beta angle for Chennai population and to compare them with those of Caucasian groups.

- To determine the mean values for beta angle in Chennai population with the three skeletal patterns (Class I, Class II, and Class III skeletal patterns).

Materials and Methods

Samples assigned to the Classes I, II, and III skeletal pattern groups were screened from the old records available in the Orthodontic Department of Saveetha Dental College, Chennai, Tamil Nadu. A total of 150 subjects were employed in the study with the age group between 18 and 22 years old. The sample employed in this study consisted of three skeletal pattern groups. The three groups were selected based on Class I, Class II, Class III skeletal discrepancy. A pretreatment lateral cephalogram was collected from each patient.

All potential participants were explained the need and design of the study and the benefits if undergoing through clinical and radiographic investigations. Individuals who agreed to undergo this procedure were instructed to read and sign the consent form.

After the initial selection, all the lateral cephalograms were traced, and ANB, Wits appraisal and beta angle [Figure 1] were measured and tabulated.

From the above measurements, the sample was divided into three skeletal groups (Class I, Class II, and Class III) of fifty each. The criteria for the inclusion of the sample into the three different skeletal groups were as follows:

- Class I skeletal pattern group
- ANB angle of 1°–3°
- Wits appraisal between 0 and −3 mm (AO ahead of BO)
- A pleasant profile.
- Class II skeletal pattern group
- ANB angle was above 4°
- The Wits appraisal ≥−1 mm (AO ahead of BO), and
- The profile had a Class II appearance.
- Class III skeletal pattern group
- The ANB angle was ≤ 1°
- The Wits appraisal ≤−4 mm, and
- The profile had a Class III appearance.

Beta angle is the angle between the perpendicular from C-B line through point A and the A-B line.

Apparent axis of condyle

Tracing of all cephalograms used in this study was made on matte acetate sheet of 0.004 inches thick and was traced by

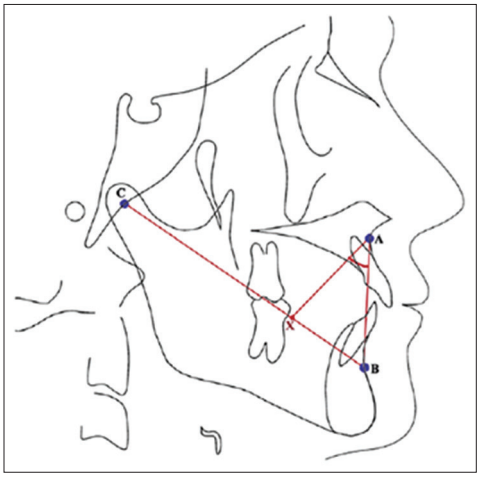

Figure 1: Lateral cephalogram tracing.

0.5 mm, 2HB lead pencil. To identify the intraexaminer error, ten tracings were randomly picked up, retraced and the error was found to be insignificant.

Statistical analysis

Data were summarized, and descriptive statistics was done. The one-way analysis of variance (ANOVA) was followed by Newman–Keuls test to determine whether there was a statistically significant difference among the mean values of beta angle in the three skeletal classes. $P \leq 0.05$ was considered statistically significant.

Results

The values of beta angle for the Class I, II, and III skeletal pattern groups is shown [Chart 1].

The mean value of beta angle in Chennai population for the Class I skeletal pattern group was 29.3°, in the Class II skeletal pattern group, it was 24° and in the Class III skeletal pattern group, it was 37° [Table 1].

The ANOVA showed that the three groups were significantly different ($P \leq 0.001$). The Newman–Keuls *post hoc* test also found the groups to be significantly different.

Discussion

The study established norms of beta angle for Class I, Class II, and Class III skeletal pattern groups in Chennai population with the age limit between 13 and 26 years old. The cephalograms were measured twice, and average figures were used.

The results of this study showed that there was a statistically significant difference in the mean value of beta angle for Class I, Class II, and Class III skeletal pattern groups of Chennai population.

Various authors like Hussels *et al*.[25] reported ethnic differences in various cephalometric variables between the Asian and Caucasian samples. However, the correlation of the mean values for beta angle in all the three skeletal pattern groups in the Indian and Caucasian population groups interprets the stability of the beta angle irrespective of the craniofacial morphology found in different ethnic groups. The norms for various jaw AP discrepancy indicators like ANB angle and Wits appraisal in the three skeletal pattern groups can have an ethnic difference because of the dependency of these indicators on the cranial base morphology, the inclination of jaw bases and the total vertical height of the craniofacial skeleton.

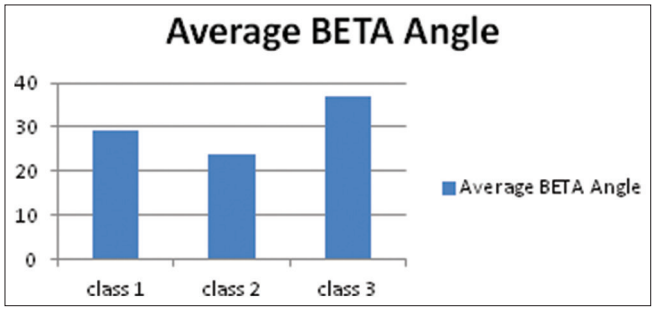

Chart 1: Mean values between the groups of Chennai district population.

Table 1: Central tendency and dispersion in Class I, Class II and Class III skeletal patterns for beta angle

Dental class	Beta angle
Class I	29.3°
Class II	24°
Class III	37°

The measurement of beta angle, based on the three points located on the jaws-point A, point B and the apparent axis of the condyle: Point C, introduces a specific measurement of the apical base difference independent of the cranial base morphology, rotation of the jaw bases, and vertical height of the face, thus incorporating a consistency for the beta angle in different ethnic groups with different craniofacial morphology.

This study showed that the Class II and Class III population groups showed a significant positive correlation for ANB and Wits appraisal, suggesting that as ANB increased Wits angle also increased and vice versa. This was supported by the previous study by Steiner,[26] who demonstrated an increased value of ANB angle for Class II skeletal pattern. Similarly, there was a significant negative correlation between ANB, Wits appraisal and beta angle in Class II and Class III population groups. This revealed that as ANB and Wits appraisal increased beta angle decreased and vice versa.

The beta angle, a valuable tool in assessing the apical base difference, has consistent mean values for Class I, Class II, and Class III skeletal pattern groups, irrespective of the ethnicity and race of the population group. Hence, the present study indicates that the Caucasian norms could be well utilized in assessing the sagittal jaw base discrepancy in the Indian ethnic groups.

Conclusion

The following conclusions were drawn from the present study:

- There was statistically significant difference for the mean values for beta angle in Chennai population within the three skeletal patterns (Class I, Class II, and Class III skeletal patterns)
- There was no statistically significant difference among the mean values of the beta angle between Chennai district population and Caucasian norms.

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Conflicts of interest

There are no conflicts of interest.

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