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Cephalometric reliability of Beta angle for evaluating antero-posterior skeletal discrepancy

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Abstract

Background & Objective: Precise assessment of antero-posterior discrepancy is important for orthodontic diagnosis and treatment planning. Beta angle introduced by Baik et al have been used for evaluating the skeletal discrepancy between maxilla and mandible in the sagittal plane. This angular measurement was not affected by the changes in the position of cranial landmarks, rotations of jaw or by functional occlusion. Hence, present study aim to evaluate the reliability of beta angle as an indicator of skeletal base discrepancy.

Methodology: Pretreatment lateral cephalometric radiographs of 75 patients between age group 8-25 years were divided into three groups. Group I comprised of skeletal Class I subjects with ANB angle of 1–3º and Wits appraisal between -3 and 0 mm. Group II consisted of subjects with Class II skeletal pattern having ANB angle equal to or greater than 4º and Wits appraisal greater than or equal to -1 mm. Group III comprised of Class III skeletal pattern with ANB angle less than or equal to 1º and Wits appraisal less than or equal to -4 mm.

RESULTS: The mean value for beta angle in class I patients was 30.4º ± 2.8º , class II patients was 24.4º ± 2.9º and class III patients was 39.6º ± 2.3º. ANOVA showed statistically significant difference between the three groups ($P<0.05$).

Conclusion: Beta angle can be used as a reliable measurement for assessing the sagittal skeletal discrepancies.

Keywords: Beta angle, sagittal dysplasia, Reliability

Cephalometric Reliability of Beta Angle for Evaluating Antero-Posterior Skeletal Discrepancy

Introduction

During orthodontic diagnosis and treatment planning, sagittal or antero-posterior skeletal discrepancy can be evaluated by cephalometric analysis. Various cephalometric variables like ANB angle by Reidel[1], Wits appraisal by Jacobson[2] have been suggested for assessing sagittal discrepancy but these variables are affected by other factors. ANB angle is influenced by the position of nasion and jaw rotations[3] while Wits appraisal is often deceived by the orientation of the occlusal plane and tooth eruption. To overcome the disadvantages of Wits appraisal, Baik and Ververidou[4] proposed beta angle which helps to assess the maxillo-mandibular skeletal discrepancies in the sagittal plane. This measurement was not affected by the variations in the position of cranial landmarks, maxilla-mandibular rotations or functional occlusion. Point A, point B, and the apparent axis of the condyle (point C) are the cephalometric landmarks when joined form an angle that determines the amount of sagittal skeletal discrepancy. Beta angle between 27-35º are considered as class I skeletal base, less than 27 º as class II skeletal base and more than 35 º as class III skeletal base.

Since variations are present between different ethnic groups, there is a need to assess the cephalometric norms of beta angle for the Kerala population and to compare it with the previously established norms from different populations. Thus the aim of this study was to assess the reliability of beta angle as an indicator of skeletal base discrepancy in a sample from Kerala population.

Materials & Methods

Study was conducted at Department of Orthodontics & Dentofacial Orthopedics, Amrita School of Dentistry, Kochi. Pretreatment lateral cephalometric radiographs of 75 patients (31 males and 44 females) between age group 8-25 years were included in the study.

Lateral cephalograms were recorded at natural head position with teeth in maximum intercuspation and lips in voluntary relaxed position. All radiographs were recorded with the same machine, Cranex D X-ray digital unit, version 3 (Soredex Co., Tuusula, Finland) and traced by hand on matte acetate by one investigator so as to eliminate any inter-examiner variability.

They were divided into three groups based on ANB angle and Wits appraisal.

Inclusion criteria

Group I - ANB angle of 1–3º and Wits appraisal between -3 and 0 mm- Class I skeletal pattern

- Group II - ANB angle equal to or greater than 4º and Wits appraisal greater than or equal to -1 mm - Class II skeletal pattern
- Group III - ANB angle less than or equal to 1º and Wits appraisal less than or equal to -4 mm - Class III skeletal pattern

Exclusion criteria

- Previous history of orthodontic treatment / orthognathic surgery
- Craniofacial syndrome
- Poor quality of cephalograms

Beta angle formed by the following landmarks

(1) A point (subspinale)

(2) B point (supramentale)

(3) C point – the center of the condyle

The three lines are:

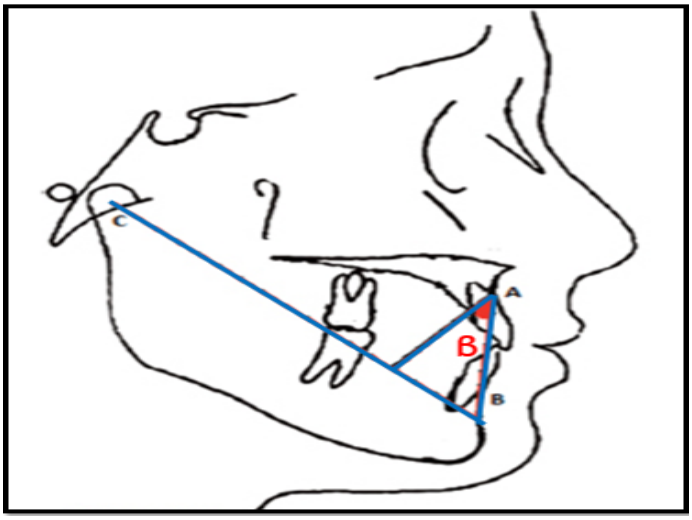
(1) Line drawn from point C to point B.

(2) Line drawn from point B to point A.

(3) Line perpendicular to CB from point A.

Beta angle was measured between the perpendicular line (dropped from point A to the C-B line) and the A-B line. (fig 1)

Fig 1: Cephlometric tracing of BETA ANGLE (β)



Statistical Analysis

Means and standard deviations of data collected from each group were summarized. Statistically significant difference among the three groups were determined using Analysis of variance (ANOVA) test. P value less than or equal to 0.05 was considered statistically significant.

Results

The values of ANB, Wits appraisal and beta angle for Group I, Group II and Group III patients were summarised. The mean value for beta angle in class I patients were 30.4º ± 2.8º , class II patients were 24.4º ± 2.9º and class III patients were 39.6º ± 2.3º. (Table 1) (fig 2)

ANOVA showed statistically significant difference in beta angle measurements between the three groups. P value less than 0.05. (Table 2)

There was no statistically significant differences in the mean value of beta angle between males and females. (Table 3)

Table 1: Descriptive Analysis

GROUP	n	Mean	SD
Class I	25	30.4	2.843
Class II	25	24.44	2.917
Class III	25	39.56	2.329

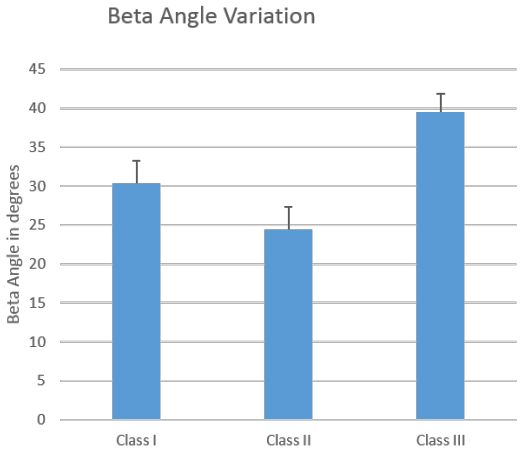
Table 2: ANOVA table showing statistical difference between the groups

Beta angle	Sum of squares	Degree of freedom (df)	Mean squares	F value	P value
Between groups	2900.347	2	1450.173	197.63	0.00*
Within groups	528.32	72	7.337		
Total	3428.667	74			
*P<0.05 is statistically significant					

Table 3: Mean values of Beta angle between males & females

Group	Male	Female
Class I	29.9	30.5
Class II	24.3	24.5
Class III	40.3	39.1

Fig 2: Beta angle variation in different groups



Discussion

The study determined the reliability of beta angle for Class I, Class II and Class III skeletal pattern groups among Kerala population between 18 and 25 years.

The results of this study showed that the mean value of beta angle among different skeletal pattern groups (Class I,II, III) were statistically significant.

Identifying the sagittal skeletal discrepancy plays an important role in orthodontic diagnosis and treatment planning. Since the introduction of lateral cephalometry by Broadbent[5], various analysis have been proposed to assess the anteroposterior jaw relationship. In borderline doubtful cases, different skeletal analysis may show contradictory results, and a proper diagnosis regarding the sagittal skeletal pattern is often difficult. ANB angle proposed by Reidel is considered as one of the most important parameter for measuring the sagittal jaw discrepancy. But it is affected by various factors like nasion position, rotation of jaws[3]. These disadvantages were overcomed by Wits appraisal as it was not based on cranial anatomical landmarks; but was affected by changes in occlusal plane, especially in open bite and mixed dentition cases[2].

Therefore, Baik et al[4] introduced beta angle which was not dependent on cranial anatomical landmarks or functional occlusal plane. Beta angle is formed by point A, point B and point C (axis of condyle). The advantage of beta angle is that it is not affected by the rotation of jaws and can also be used for evaluation of treatment progression. It is also used as a diagnostic tool for surgical planning in patients with sagittal or antero-posterior discrepancy. The disadvantage of beta angle is that it cannot identify which skeletal base has the abnormal growth pattern. Thus it requires further cephalometric evaluation.

In the original study among Caucasian population by Baik et al[4], class I skeletal pattern showed a beta angle value of 27°-35°, for class II skeletal pattern the beta angle is less than 27° and for class III skeletal pattern beta angle is more than 35°.

Beta angle evaluated in this study from a sample of Kerala population was found to be 30.4°± 2.8° for class I, 24.4°± 2.9° for class II, 39.56° ± 2.3° for class III subjects and showed very little deviation from the Baik[4] study among Caucasian population. Among Asian and Caucasian population, Hussel et al[6] found that cephalometric variables changes with ethnic differences.

Different studies have evaluated beta angle among different population groups. Singh et al[7] among North Indian population showed beta angle of 26° to 37.5° in Class I skeletal base. Aggarwal et al[8] found beta angle for class I to be 30.9° ± 2.57° among Mysore population. Prasad et al[9] showed a negative correlation between beta angle, ANB angle and Wits appraisal.

Among Kerala population, beta angle for class II skeletal base was 24.4°± 2.9° which was in correlation with beta angle of 23.76°± 2.86° by Aggrawal et al and 24° by Maruthi et al[10] in Chennai population. Whereas Prasad et al among Garhwali population found a beta angle greater than 28° for hypodivergent facial pattern.

For class III skeletal pattern, our study showed a beta angle of greater than 36º which was nearly similar to Baik et al. Whereas among Mysore population the value was 39.2°±3.82° and among North Indian population was greater than 37.5º. Among Garhwali population, beta angle more than 32º as considered as hyperdivergent facial pattern.

The reliability of beta angle was studied by Aparna et al[11] who found significantly consistent values of beta angle when compared to ANB angle and Wits appraisal. Sundareswaran et al[12] also suggested beta angle as an reliable indicator of antero-posterior dysplasia in horizontal and normal growth patterns. Thus Beta angle can be used as a reliable measurement for evaluating sagittal discrepancy since the mean value of beta angle among different populations showed consistent stable

values irrespective of craniofacial features among different ethnic groups.

Conclusion

The present study showed that beta angle measurement among Class I skeletal pattern ranges between 25 º and 37 º, Class II skeletal pattern had beta angle less than 25 º, Class III skeletal pattern had angle greater than 37 º. These values did not show significant difference from the values as described by Baik and Ververidou. Thus Beta angle can be considered as a relatively reliable cephalometric measurement for assessing maxillo-mandibular skeletal discrepancies in the sagittal plane irrespective of difference in ethnic background and craniofacial morphology.

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