Original Article

Establishment of norms of the beta angle to assess the sagittal discrepancy for Nellore district population

Mandava Prasad, Karnati Praveen Kumar Reddy, Ashok Kumar Talapaneni, Nellore Chaitanya, Myla Vijay Bhaskar Reddy, Rajendra Patil[1]

Department of Orthodontics and Dentofacial Orthopedics, Department of Oral Medicine, Diagnosis & Radiology,[1]Narayana Dental College and Hospital, Chinthareddypalem, Nellore, Andhra Pradesh, India

Address for correspondence:
Dr. Mandava Prasad, Department of Orthodontics and Dentofacial Orthopedics, Narayana Dental College and Hospital, Chinthareddypalem, Nellore, Andhra Pradesh, India.
E-mail: mandavabruno9@hotmail.co.in

Abstract

Background and Objectives: In orthodontic diagnosis and treatment planning, assessment of anteroposterior discrepancy is of importance to the orthodontist. Both angular and linear measurements have been incorporated into various cephalometric analyses to help the clinician diagnose anteroposterior 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 Nellore district population. **Materials and Methods:** The sample was screened from the old records of the Orthodontic department of Narayana Dental College and Hospital. One hundred and fifty pretreatment cephalometric radiographs (50 each of Class I, II, and III) 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. Each group was again divided into 2 subgroups consisting of 25 male and 25 female subjects with a mean age limit between 15 and 45 years old. **Results:** The Newman-keuls *post hoc* test and ANOVA showed that the 3 groups were significantly different ($P \leq 0.001$). The Newman-keuls *post hoc* test also found the groups to be significantly different. **Conclusions:** There was statistically significant difference for, the mean values and the standard deviation 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 Nellore district population and Caucasian norms and between male and female sex groups.

Key words: Beta angle, cephalometrics, orthodontic diagnosis, sagittal discrepancy

INTRODUCTION

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

In orthodontic diagnosis and treatment planning, assessment of anteroposterior discrepancy is of importance to the orthodontist. Both angular and linear measurements have been incorporated into various cephalometric analyses to help the clinician diagnose anteroposterior (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[8,9] and Jacobson[10,11] probably have gained the widest acceptance. The analyses of Coben,[12] Wylie,[13] Sassouni,[14,15] Enlow[16] and associates Bimler,[17] Edward Beatty's[18] AXD angle, Rocco J. Di Paolo,[19] Stephen Williams,[20] Sang D Yang[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,

Access this article online

Quick Response Code:

Website: www.jnsbm.org

DOI: 10.4103/0976-9668.117017

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 point 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]

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 anteroposterior 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 short coming 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]

Chong YolBaik and Maria 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 3 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. Amore acute beta (less than 27°) angle indicates a Class II skeletal pattern, and a more obtuse beta angle (more than 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 beta angle for Nellore district population. The aim of this present study is therefore to establish norm of beta angle for Nellore district population and to compare them with those of Caucasian groups.

- To determine the mean values and the standard deviation for beta angle in Nellore district population with the three skeletal patterns (Class I, Class II and Class III skeletal patterns).
- To compare the mean values of beta angle between Nellore district population and Caucasian norms.
- To compare the mean values of beta angle in Nellore district population between male and female sex groups.

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 Narayana dental college, Nellore, Andhra Pradesh. A total of 150 subjects were employed in the study. The sample employed in this study consisted of 3 skeletal pattern groups of 50 patients each, where each group was again divided into 2 subgroups consisting of 25 male and 25 female subjects. The 3 groups were selected based on Class-I, Class-II, Class-III skeletal discrepancy with a age limit of approximately 18 years and above for boys and 15 years and above for girls for standardization. A pre-treatment lateral cephalogram was collected from each patient and traced individually.

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 retraced 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 50 each. The criteria for the inclusion of the sample into the three different skeletal groups were

- Class I skeletal pattern group
  - ANB angle of 1° to 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 greater than or equal to-1 mm (AO ahead of BO), and
  - The profile had a Class II appearance.

- Class III skeletal pattern group
  - The ANB angle was less than or equal to 1°,
  - The Wits appraisal less than or equal to-4 mm, and
  - The profile had a Class III appearance.

Beta angle-The angle between the perpendicular from C-B line through point A and the A-B line [Figure 2].

Tracing of all cephalograms used in this study were made on matte acetate sheet of 0.004 inch thick and were traced by 0.5 mm, 2HB lead pencil. To identify the intra examiner error ten tracings were randomly picked up, retraced and the error was found to be insignificant.

Statistical analysis

Data were summarized by finding Means and Standard deviations. 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. A P value ≤ 0.05 was considered statistically significant.

RESULTS

The values of ANB, Wits appraisal and beta angle for the class I, II and III skeletal pattern groups were listed.

The mean value of beta angle in Nellore district population for the Class I skeletal pattern group was 31.06° with a standard deviation of ± 2.72°, in the class II skeletal pattern group, it was 24.04° with a standard deviation of ± 3.97° and in the class III skeletal pattern group, it was 38.68°with a standard deviation of ± 5.96° [Table 1 and Figure 3].

The ANOVA showed that the 3 groups were significantly

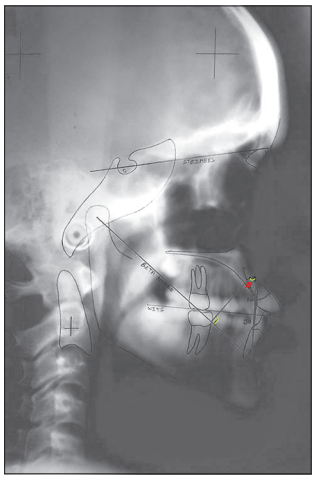

Figure 1: Lateral cephalogram tracing

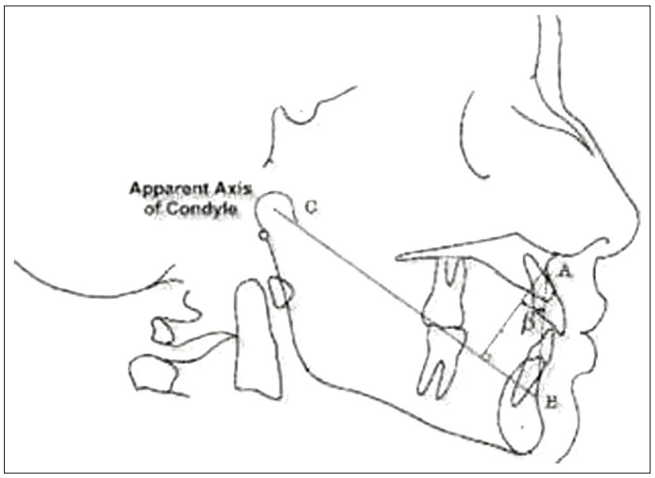

Figure 2: Apparent axis of condyle

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

Groups	*N*	Mean	Standard deviation	Standard error	95 % Confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Class I	50	31.06	2.72	0.38	30.28	31.83	27.00	35.00
Class II	50	24.04	3.97	0.56	22.91	25.16	14.00	27.00
Class III	50	38.68	5.96	0.84	36.98	40.37	35.00	56.00
Total	150	31.26	7.43	0.60	30.06	32.45	14.00	56.00

different ($P \leq 0.001$). The Newman-Keuls post-hoc test also found the groups to be significantly different [Table 2].

The mean value of beta angle in the Class I skeletal pattern group for male and female was 30.72° and 31.4° with a difference of 0.68°, in the Class II skeletal pattern group for male and female population was 23.04° and 25.04° with a difference of 2° and in the Class III skeletal pattern group for male and female population was 38.56° and 38.8° with a difference of 0.24° [Table 3 and Figure 4]. There was no statistically significant difference in the mean value of the beta angle of the sexes within the groups.

DISCUSSION

The study established norms of beta angle for Class I, Class II and Class III skeletal pattern groups in Nellore district population which are individualized for gender. The study was based on a large sample of 18 to 45-year-old individuals that was representative of its original population. 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 Nellore district population. However, there was no significant difference in the mean value of beta angle for Class I, Class II, Class III skeletal pattern groups between Nellore district population and Caucasian population groups [Tables 1 and 4].

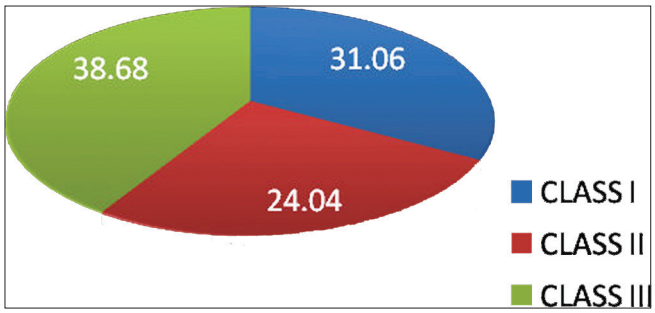

Figure 3: Mean values between the groups of nellore district population

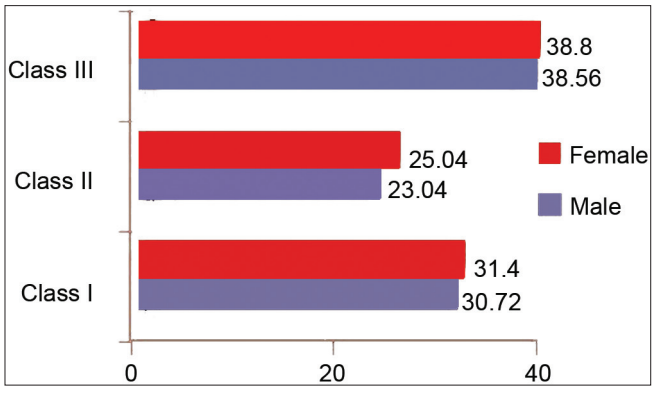

Figure 4: Mean values within and between the groups of nellore district population

Various authors like Zeng XL *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 anteroposterior 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.

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.

Table 2: Post-hoc tests: Homogenous subjects

Student-Newman-Keuls test[a]				
Subset for alpha=0.05				
Class	*N*	1	2	3
II	50	24.04		
I	50		31.06	
III	50			38.68
Significance		1.000	1.000	1.000

Table 3: Beta angle (Mean and standard deviation) values within class I, class II, and class III groups of nellore district population

Gender code	*N*	Mean	Standard deviation
Class I male	25	30.72	2.776
Class I female	25	31.4	2.677
Class II male	25	23.04	4.522
Class II female	25	25.04	3.115
Class III male	25	38.56	4.450
Class III female	25	38.8	4.123
Total	150	31.26	4.436

Table 4: Mean and standard deviation of beta angle for caucasian population group

Skeletal group	Mean	Standard deviation
Class I	31.1°	±2°
Class II	24.5°	±3°
Class III	40°	±4.2°

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.

In this study there was no statistically significant difference of the beta angle for Class I, Class II and Class III skeletal pattern groups between the male and female subjects [Table 3]. The gender difference was 0.68° in Class I skeletal pattern group, 2° in Class II skeletal pattern group and 0.2° Class III skeletal pattern group. The tendency towards a slight increase of the gender difference in the Class II skeletal pattern group could be due to decreased maxillomandibular differential length in the females when compared to the male population.

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 Indian ethnic groups.

CONCLUSION

The following conclusions were obtained from the present study;

- There was statistically significant difference for, the mean values and the standard deviation for beta angle in Nellore district 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 beta angle between Nellore district population and Caucasian norms.
- There was no statistically significant difference for, the mean values of the beta angle between male and female sex groups in Nellore district population.

REFERENCES

1. Ishikawa H, Nakamura S, Iwasaki H, Kitazawa S. Seven parameters describing anteroposterior jaw relationships: Post pubertal prediction accuracy and interchangeability. Am J Orthod Dentofacial Orthop 2000;117:714-20.
2. Baik CY, Ververidou M. A new approach of assessing sagittal discrepancy: The Beta angle. Am J Orthod Dentofacial Orthop 2004;126:100-5.
3. Broadbent BH. A new x-ray technique and its application to orthodontia. Angle Orthod 1931;1:45-66.
4. Downs WB. Analysis of the dentofacial profile. Angle Orthod 1956;26:191-212.
5. Steiner CC. Cephalometrics for you and me. Am J Orthod 1953;39:729-55.
6. Tweed CH. Evolutionary trends in orthodontics, past, present and future. Am J Orthod 1953;39:81-108.
7. Tweed CH. The Fränkfort-mandibular incisor angle [FMIA] in orthodontic diagnosis, treatment planning and prognosis. Angle Orthod 1954;24:121-69.
8. Ricketts RM, Schulhof RJ, Lindy B. Orientation-Sella-Nasion or frankfort horizontal. Am J Orthod 1976;69:648-54.
9. Ricketts RM. Perspectives in the clinical application of cephalometrics. Angle Orthod 1981;51:105-15.
10. Jacobson A. The "Wits" appraisal of jaw disharmony. Am J Orthod 1975;105:328-44.
11. Jacobson A. The Application of the "Wits" appraisal. Am J Orthod 1976;70:179-89.
12. Coben SE. The integration of facial skeletal variants. Am J Orthod 1955;41:407-34.
13. Wylie WL. The assessment of anteroposterior dysplasia. Angle Orthod 1947;7:97-109.
14. Sassouni V. A classification of skeletal facial types. Am J Orthod 1969;55:109-23.
15. Sassouni V. The Class II syndrome: Differential diagnosis and treatment. Angle Orthod 1970;40:334-41.
16. Enlow DH, Moyers RE, Hunter WS, McNamara JA Jr. A procedure for the analysis of intrinsic facial form and growth. Am J Orthod 1969;56:6-23.
17. Bimler HP. The Bimlercephalometric analysis. Germany: Wiesbaden; 1973.
18. Beatty EJ. Modified technique for evaluating apical base relationships. Am J Orthod 1975;68:303-15.
19. Di Paolo RJ, Philip C, Maganzini AL, Hirce JD, Hakensack NJ. The quadrilateral analysis: An individualized skeletal assessment. Am J Orthod 1983;83:19-32.
20. Williams S, Leighton BC, Niesen JH. Linear evaluation of the development of sagittal jaw relationship. Am J Orthod 1985;88:235-41.
21. Yang SD, Suhr CH. F-H to AB plane angle [FABA] for assessment of anteroposterior jaw relationship. Angle Orthod 1995;65:223-31.
22. Moyers RE, Bookstein FL, Guire KE. The concept of pattern in craniofacial growth. Am J Orthod 1979;76:136-48.
23. Praveen KN, Rohan M, Akhter H. A new sagittal dysplasia indicator: The YEN angle. World J Orthod 2009;10:147-51.
24. Nanda RS, Merrill RM. Cephalometric assessment of sagittal relationship between maxilla and mandible. Am J Orthod 1994;105:328-44.
25. Hussels W, Nanda RS. Analysis of factors affecting angle ANB. Am J Orthod 1984;85:411-23.
26. Steiner CC. Cephalometrics in clinical practice. Angle Orthod 1959;29:8-29.

How to cite this article: Prasad M, Reddy KP, Talapaneni AK, Chaitanya N, Bhaskar Reddy MV, Patil R. Establishment of norms of the beta angle to assess the sagittal discrepancy for Nellore district population. J Nat Sc Biol Med 2013;4:409-13.

Source of Support: Nil. **Conflict of Interest:** None declared.