

TO ESTABLISH MEAN VALUE FOR BETA ANGLE AND TO COMPARE ITS RELIABILITY WITH WITS APPRAISAL IN SOUTH-WEST MAHARASHTRA POPULATION - A CEPHALOMETRIC STUDY



Dental Science

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ABSTRACT

Aims and objectives: Orthodontic diagnosis and treatment planning immensely depends on the assessment of anteroposterior relationship. The aim of the study was to establish the mean value for beta angle in South-West Maharashtra population and to compare the reliability of the beta angle with WITS appraisal.

Material and Methods: Total sample of 100 patients were included in the study. Samples were assigned into 3 groups based on Classes I, II, and III skeletal pattern. Lateral cephalograms of the samples were traced. The Beta angle was measured for each patient in all 3 groups and the mean values were calculated. A comparative study of the beta angle with WITS appraisal was carried out for the same set of patients. Obtained data was subjected to statistical analysis.

Result: A new norm for beta angle ranging from 30-33° for class I skeletal pattern was established. The beta angle proved to be 30% more reliable when compared to wits appraisal.

Conclusion: The reliability of beta angle was comparatively high than WITS appraisal though, it is a little time consuming. Consistency and accuracy of beta angle makes it reliable to evaluate the sagittal jaw discrepancy.

KEYWORDS

Beta Angle, Cephalometry, Sagittal Relationship

INTRODUCTION:

A successful prognosis in orthodontic treatment is immensely ruled by the perfect diagnosis and accurate planning. The correct diagnosis and treatment planning in turn is governed by various factors. One of the factors playing a crucial role is the evaluation of sagittal relationship. So, numerous angular and linear measurements have been proposed and incorporated in various cephalometric analyses for accurate diagnosis of the antero-posterior discrepancy.

ANB angle is one of the parameters of Steiner's analysis which measures sagittal relationships^[1-3]. It is one of the commonly used measurements for analyzing the antero-posterior discrepancy^[4]. However over the years the accuracy of this angular measurement has been questioned because of various factors like the position of Nasion, the change in rotation of the jaws due to growth and degree of facial prognathism^[5-8].

WITS appraisal is another linear measurement used for determining the antero-posterior discrepancy. This measurement relates point A and point B to the occlusal plane. The Occlusal plane being the important parameter in the measurement has a major drawback of identification and reproducibility^[9]. The occlusal plane identification is critical in various scenarios like in cases of multiple impactions, deep curve of Spee, mixed dentition, development of dentition etc, thereby affecting the reproducibility of the plane.

In recent years palatal plane along with mandibular plane have aided in the determination of antero-posterior discrepancy. Many linear and angular measurements proposing the palatal plane has been suggested. This plane is not reliable because the stability is questionable as the age and plane inclination is highly variable and therefore a mean value for norm cannot be established^[9].

In order to overcome the above mentioned problems Baik et al in 2004 introduced an angular measurement called the Beta angle. This angle

does not depend on any cranial references or dental occlusal plane^[10]. It reflects the true antero-posterior changes taking place without being influenced by growth or orthodontic intervention. Hence this angle can be efficiently be used to analyze pre and post treatment changes in sagittal relation.

The aim of this study was to establish the norm for beta angle in South-West Maharashtra population and also to compare the reliability of the beta angle against WITS appraisal keeping ANB as the standard.

METHODS AND MATERIAL:

Two sixty eight radiographs were obtained from the Department of Orthodontics, School of Dental Sciences, KIMSUDU, Karad, Maharashtra. Out of the 268 samples 100 samples fulfilled the inclusion and exclusion criteria and were undertaken for the study.

Exclusion criteria:

1. Orthodontic intervention
2. Poor radiographic quality leading to inability to trace the landmarks.
3. Occlusal disturbances eg: Impaction, missing teeth
4. Improper head position with respect to the FH plane.

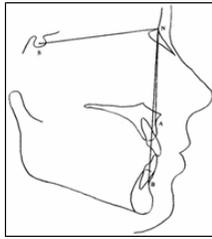
Inclusion criteria:

1. Age group: 18- 32 years
2. Completely erupted dentition

These radiographs were traced by a single operator to reduce the error which might occur while reproducing the planes and landmarks. The ANB angle was traced for these radiographs. The landmarks required were Nasion (N), point A (A) and point B (B). ANB angle is the angle formed between (Fig1):

1. Line connecting point A and Nasion
2. Line connecting Nasion and point B.

Fig 1: ANB Angle



Based on the ANB angle traced the samples were divided into 3 groups. The groups included:
 1. Group I (ANB=1-3deg) : 35deg
 2. Group II (ANB>4deg) : 33deg
 3. Group III (ANB<1deg) : 32deg

After segregating into 3 groups WITS appraisal and beta angle were traced for all the 100 radiographs.

Landmarks in WITS appraisal included:

1. Point A
2. Point B
3. Functional Occlusal plane

After tracing the landmarks, the points A and B were projected on the functional Occlusal plane [11] (Fig 2). The points of contact of the perpendiculars onto the occlusal plane are labeled AO and BO, respectively. According to the literature in female's points AO and BO should coincide and in male's point BO is located 1 mm ahead of point AO [11]. In skeletal Class II jaw dysplasia's, point BO is positioned well behind point AO (positive reading), whereas in Class III skeletal jaw disharmonies, point BO ahead of point AO (negative reading).

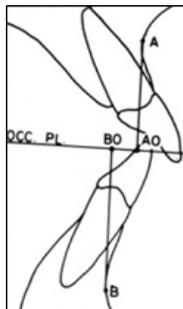


Fig 2: WITS appraisal

Next the beta angle was traced. The Beta angle uses 3 skeletal landmarks- point A, point B, and the apparent axis of the condyle (C)—to determine the type of skeletal dysplasia in the sagittal dimension^[12](Fig 3).

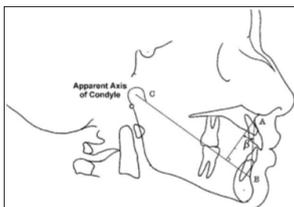


Fig 3 Beta angle

1. A point (subspinale)—The deepest midline point on the premaxillae between the ANS and prosthion
2. B point (supramentale)—The most posterior point in the concavity between infradentale and pogonion
3. The center of the condyle, found by tracing the head of the condyle and approximating its center (C).

3 lines included in the formation of the angle are:

1. C-B line- Line connecting the center of the condyle C with B point.
2. A-B line- Line connecting A and B points.
3. Line from point A perpendicular to the C-B line.
4. The Beta angle is measured between the perpendicular line and the A-B line.

STATISTICAL ANALYSIS:

All the results obtained were subjected to statistical analysis. One-way

analysis of variance (ANOVA) was used followed by Boneferroni post hoc testing to determine whether there was any statistically significant difference between the mean values of the 3 classes. P value less than or equal to 0.05 was considered to be statistically significant. All statistics were performed in SPSS (SPSS, 17.0 Maharashtra).

RESULTS:

The mean value for Beta angle in the Class I skeletal pattern group was 32°, with a standard deviation of 1.74, for Class II skeletal pattern group it was 24.26°, with a standard deviation of 3.3 and for III skeletal pattern group it was 36.67°, with a standard deviation of 3.55. The ANOVA showed that the 3 groups were not the same; the Boneferroni post hoc test found the groups to be significantly different (Table 1).

Table.1: One way ANOVA Boneferroni testing

Class	N	Subset*	ANOVA F	P-value
I	30	32		
II	34		24.26	170.02 0.0001**
III	36			36.77

*Subset represents means of different classes

**represent significance (p<0.05)

There was no statistically significant difference in the mean value of the Beta angle of the sexes within the groups (Table 2).

Table.2: Class wise mean distribution of Beta Angle of Sex.

Sex	Class I	Class II	Class III
Male	32.83	24.125	37.21
Female	31.44	24.38	36

Wits Appraisal Vs Beta Angle

Sex wise distribution of the population into skeletal bases based on WITS Appraisal is plotted (Fig 4). After comparing Wits Appraisal and Beta angle at 95% level of significance using one sample t-test mean value of WITS appraisal was -0.31 and standard deviation 3.586 whereas mean value of Beta Angle was 31.09 and standard deviation was 6.0. After application of one sample t-test WITS appraisal t-value was 0.8644 and p-value was 0.1747 hence we can conclude that there was no statistical significance. On the other hand one sample test value of Beta Angle was 51.8115 and p-value was 0.0001 hence we can state that there was statistical significance. On the p-value we can predict that Beta angle method was superior to wits appraisal. (Table: 3).

Table.3: Wits Appraisal vs. Beta Angle

Study Variables	Mean	SD	Mean Difference	t-value	p-value
Wits Appraisal	-0.31	3.586	-0.31	0.8644	1.1747
Beta Angle	31.09	6	31.09	51.815	0.0001*

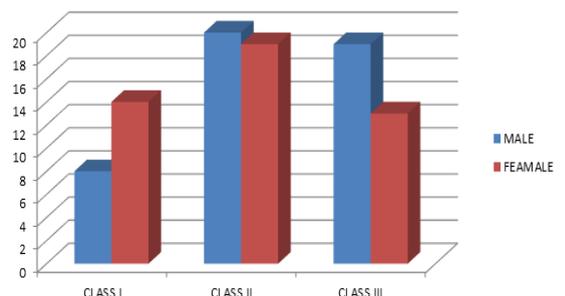


Fig 4 : Sex wise distribution of skeletal base using WITS Appraisal

A comparison was carried out between WITS Appraisal and Beta angle with ANB angle. Both the angles show significant association to the ANB angle but the beta angle has proved to be showing closest association with ANB angle. The p-value of WITS with ANB angle was 0.0008 and that of Beta angle and ANB angle was 0.0001. Considering the p-value the association between beta angle and ANB angle has proved to be more significant than WITS Appraisal (Table: 4).

Table.4: Significance of Wits Appraisal and Beta Angle compared to ANB angle.

ANB	N	WITS APPRAISAL (mm)			BETA ANGLE (angle)		
		Class I	Class II	Class III	Class I	Class II	Class III
Class I	35	19	10	6	19	11	5
Class II	33	7	18	8	1	32	0
Class III	32	6	9	16	2	0	33
Chi-square value		19.049			114.85		
p-value		0.0008			<0.0001**		

**represent significance (p<0.05)

DISCUSSION:

The study included a total sample of 100 radiographs which included patients with age ranging from 18 to 32 years. The results of this study showed significant difference between the mean value of class I, class II and class III pattern group of population. There was also a comparison done to find out the reliability of the angle by comparing it with WITS appraisal.

The ANB angle has been used as an indicator for determining skeletal sagittal discrepancy and has been the most commonly used measurement [14]. But it is affected by various factors [15-16]. Consideration should be given to all those factor while implementing this angle, making the interpretation of this angle much more complex.

WITS appraisal establishes the sagittal measurements with linear values. It is independent of the cranial landmarks or rotation of jaw bases. The problem encountered with this measurement is the identification of occlusal plane [17-18]. There can also be changes occurring in the WITS measurement throughout the treatment as a result of changes in the functional occlusal plane and not due to sagittal changes of jaw bases. Roth and Chang showed that the Wits appraisal is also affected by the vertical dimensions of the jaws [20-21].

Baik established Beta angle for assessing the sagittal relation with reproducibility and precision. Beta angle is independent of the cranial landmarks and also not dependent on occlusal plane [12]. The measurement of beta angle, is 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 (Fig: 5).

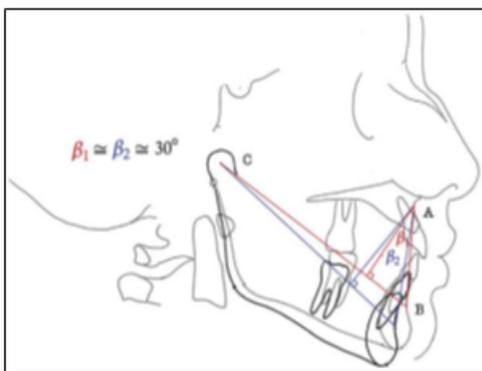


Fig 5: Relative stability of beta angle even when jaws rotated

Considering downward and backwardly rotated point B, the C-B line is also rotated in the same direction, carrying perpendicular point A with it. As the A-B line rotates in the same direction, the Beta angle remains constant. Therefore, whenever there is clockwise or counterclockwise rotation of jaws the Beta angle can assess the sagittal jaw relation accurately [12].

Advantage of Beta angle over the WITS measurements is that it can be used in consecutive comparison throughout orthodontic treatment as it reflects the true changes of the sagittal relationship of jaws which may be due to growth or orthodontic or orthognathic intervention.

The mean value obtained for class I skeletal base in the current study is within the angular range established by Baik et al. A mean value of 32° with a standard deviation of 1.74 is obtained in the current study and according to Baik et al the value for class I skeletal base was 31.1° with a standard deviation of 2° [10]. Prasad et al had conducted a similar study in Nellore district to attain the mean value of beta angle in the Andhra population. He attained the mean value for class I as 31.06° with a standard deviation of ± 2.72°. It is closely associated to the mean value attained in this study for class I which is about 32° [19]. In contrast to the previous studies, the study conducted by Maruthi et al among Chennai population had shown the mean value for beta angle in class I skeletal base as 29.3° [22]. It falls within the range suggested by Baik et al but is differing from the current study by about 4°.

According to Baik et al the mean value established for class II skeletal base was an angle less than 27° [10]. In the current study the angle for class II skeletal base is obtained as 24.26°, with a standard deviation of 3.3. It is in accordance with the values given by Baik et al. In the study by Prasad et al the mean value for class II skeletal base was obtained as 24.04° with a standard deviation of ± 3.97. The value for class II skeletal base obtained in the current study is similar to the values obtained by Prasad et al [19]. The results of the study conducted by Maruthi et al for class II skeletal base also coincides with the current study and the study by Prasad et al [22].

As established by Baik et al for class III skeletal base the mean value was beta angle more than 33°. The current has obtained the beta value for class III skeletal base as 36.67°, with a standard deviation of 3.55. This value falls under the range given by Baik et al for class III skeletal base. The current study has a similar value as obtained by Maruthi et al. According to Maruthi et al mean value for class III skeletal base was obtained as 37° [22]. But according to the study conducted by Prasad et al there is a difference of about 2° in the results obtained by him and the current study. Prasad et al had obtained a mean value for class III skeletal base as 38.68° with a standard deviation of ± 5.96° [19].

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. Zeng XL et al. reported ethnic differences in various cephalometric variables between various ethnic groups [10]. Prasad et al studied the correlation of the mean values for beta angle in three skeletal pattern groups in the Indian and Caucasian population groups and interpreted the stability of the beta angle irrespective of the craniofacial morphology found in different ethnic groups [19]. This study also coincides with the previous studies showing that beta angle is not dependant on the different ethnic groups and is stable and independent on the craniofacial morphology.

Studies are required to be done to establish the mean beta angle among the Indian population. Further research is also required regarding the reliability of the angle and its comparison with the other linear measurements.

CONCLUSION:

1. Available cephalometric measurements for assessing the sagittal discrepancy were easily reproducible but are not reliable.
2. The beta angle has proved to be more reliable in comparison to WITS Appraisal.
3. In South-West Maharashtra population beta angle for class I skeletal base was established ranging from 27-33°, anything below 27° will be considered as class II and above 33° will be considered as class III.
4. No statistical difference present between the beta angle values of male and female group.

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