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RESEARCH ARTICLE

COMPARATIVE ASSESSMENT OF SAGITTAL JAW RELATIONSHIP USING ANB ANGLE, WITS APPRAISAL AND BETA ANGLE

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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 Bengali population. **Materials and Methods:** The samples were screened from the records of the patient who visited Orthodontic Department. The predictability of three cephalometric parameters ANB angle, Wit's appraisal and Beta angle were compared. A total of 254 subjects were included in the study with the age group between 12 and 18 years old. **Results:** The Pearson correlation showed that all the 3 parameters correlation are highly significant. **Conclusion:** The Beta angle was developed as a diagnostic aid to evaluate the sagittal jaw relationship and it is more consistent than Wits appraisal followed by ANB angle. The findings of ANB angle, Wits appraisal and Beta angle was unable to find any variation from the standard values of other populations.

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INTRODUCTION

Accurate planning and a precise diagnosis are crucial for a good orthodontic treatment outcome. In turn, a number of factors influence the proper diagnosis and treatment planning. The assessment of the sagittal connection is one of the important variables. To accurately diagnose antero-posterior discrepancies, cephalometric investigations integrate a variety of angular and linear measures. In quest of a simple and organized way of thinking about the arrangement of teeth in as well as between the dental arches E. H. Angle (1899) (1) put forward the "concept of occlusion". He classified the dental arch relation based on permanent 1st molar in sagittal variations with its impact on facial profile for communicating. ANB angle is one of the parameters of Steiner's analysis which measures sagittal relationships (2). It is one of the commonly used measurements for analyzing the antero-posterior discrepancy (3). 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 (4). Jacobson (5) in 1975 realising the limitations of point N being used in references planes, introduced the Wits appraisal, a linear method of measuring the relationship of point A to point B along the functional occlusal plane. Identifying and reproducing the occlusal plane, an important measuring parameter, is a significant challenge. Identifying the occlusal plane is crucial in situations like as multiple impactions, deep curve of Spee , mixed dentition,etc as it impacts the plane's reproducibility (6) . To address these issues, Baik et al. (2004) developed the Beta angle, an angular measurement. This angle is independent of cranial references and the dental occlusal plane (7). It accurately represents antero-posterior changes without being altered by growth or orthodontic interventions. This angle is effective for analysing changes in sagittal relation before and after therapy.The aim of this study was to compare Beta angle with ANB angle and Wits Appraisal and find their predictability.

MATERIAL AND METHOD

Sample Selection: This retrospective cross-sectional study with a sample size of 254 was conducted with the lateral cephalograms of patients who had reported to the department for orthodontic treatment. These lateral cephalograms were obtained from the archives of the Department of Orthodontics, Dr. R. Ahmed Dental College & Hospital, Kolkata, West

Figure 1. Taking Lateral cephalogram with Cephalostat

Figure 2. Lateral cephalogram

Bengal after the approval from the scientific board with the following inclusion and exclusion criteria:

Inclusion criteria for patients were

- Aged 12-18 years
- Permanent dentition with no missing teeth except third molars
- Synchronous molar relation and facial profile

Figure 3. Materials used for tracing

Exclusion criteria included patients with

- Previous history of orthodontic treatment;
- Cleft lip and palate, cranial or facial malformation and no history of craniofacial trauma
- Discrepancies in molar relation and its associated profile judged clinically.
- Any asymmetric molar relation.

Methodology

Lateral cephalogram of all the samples (n=254) were procured from the same X-ray machine (Planmeca Proline XC Dimax3) with teeth in maximum intercuspation and lips in repose. All the lateral cephalograms were traced by a single operator on 0.003-inch acetate matte tracing paper using 3H lead pencil in a standardized manner to avoid inter-operator variations. (Figure 1,2) The following measurements to analyze maxillo-mandibular relationship were done on all tracings:

- ANB angle
- Wits' appraisal
- Beta angle

Definition of landmarks

- **Sella (S):** The midpoint of the hypophysial fossa.
- **Nasion (N):** The most anterior point of the frontonasal suture in median plane.
- **Point A:** The deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla.
- **Point B:** The most posterior point in the outer contour of the mandibular alveolar process, in the median plane.
- **Center of condyle (C):** Found by tracing the head of thecondyle and approximating the centre.

Angular and linear measurements

Functional occlusal plane: drawn through the region of overlapping cusps of maxillary first molar and bicuspids.

ANB: Angle between points A, N, and point B
Wits: Distance between the perpendicular projection of A and B on the functional occlusal plane
Beta angle: Angle formed between A-B line and the perpendicular line dropped from point A on line connecting point C and point B. (Figure 3)

RESULT AND ANALYSIS

Software used

- Statistica version 6 (Tulsa, Oklahoma: Stat Soft Inc., 2001)
- Graph Pad Prism version 4 (San Diego, California: GraphPad Software Inc., 2005) Med Calc version 9.6.2 (Frank Schoonjans, 2008)

In the whole sample mean values for ANB, Wits appraisal & βangle are 3.78°, -0.02mm & 31.30° respectively. Pearson's product moment correlation values are significant for these three cephlometric parameters ($p < 0.05$ level). The correlation coefficient r between ANB & Wit's Appraisal is high ($r = 0.85$) which is statistically significant ($p< 0.001$). The r^2 ($r^2 = 0.72$) also shows high level of correlation ($r^2 > 0.7$). Thus, obtained equation of simple linear regression is Wits Appraisal = – 4.000 + 1.052 X ANB (Figure 4)

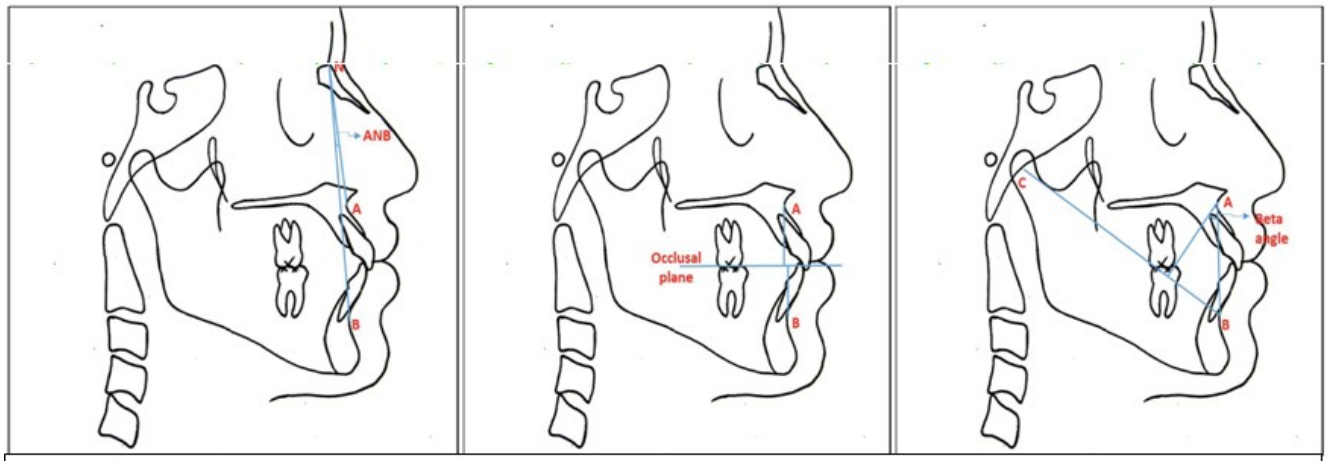

Figure 4. Angular and linear parameters used in the study

Table 1. Normative data of whole evaluable cohort [n = 254]

	Valid N	Mean	Confidence - 95.000%	Confidence+95.000%	Minimum	Maximum	Std.Dev.	Standard Error
ANB	254	3.78150	3.32551	4.23749	-8.0000	13.00000	3.690134	0.231540
Wits Appraisal	254	-0.02165	-0.58756	0.54425	-22.0000	10.00000	4.579612	0.287350
Beta Angle	254	31.29921	30.38958	32.20885	8.0000	56.00000	7.361302	0.461889
	Valid N	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Percentile 10.00000	Percentile 90.00000
ANB	254	4.00000	-8.0000	13.00000	2.00000	6.00000	-2.00000	8.00000
Wits Appraisal	254	0.50000	-22.0000	10.00000	-2.00000	3.00000	-6.00000	5.00000
Beta Angle	254	31.00000	8.0000	56.00000	26.00000	35.00000	23.00000	42.00000

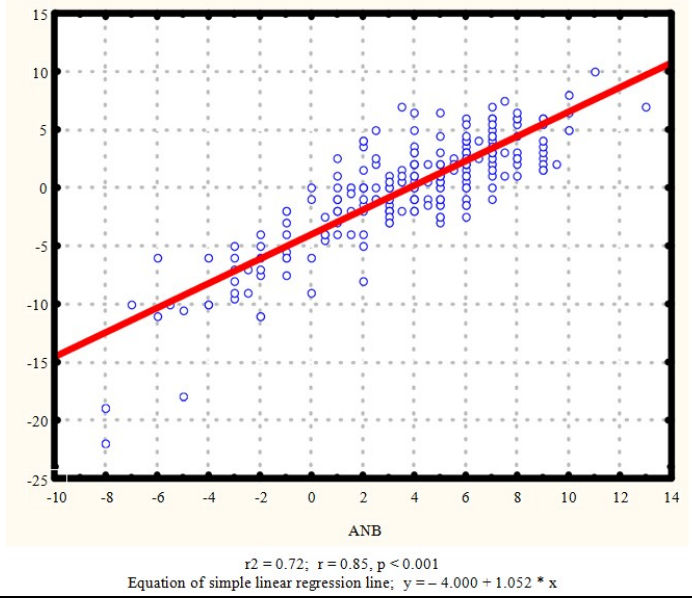

Figure 4: Scatterplot of Wits Appraisal versus ANB for whole evaluable cohort (n = 254)

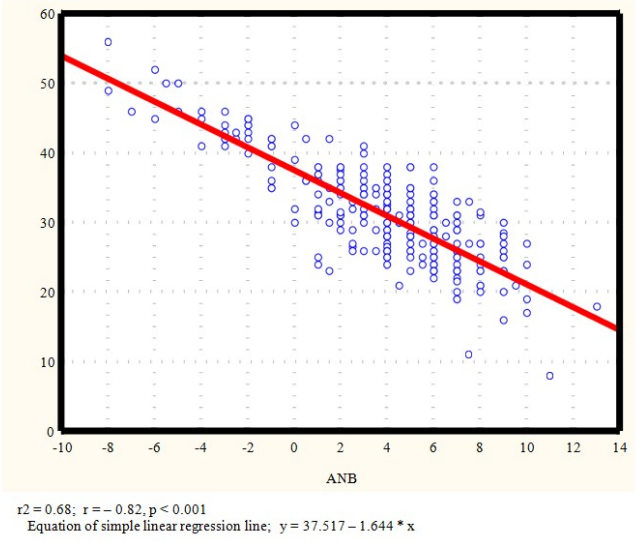

Figure 5: Scatterplot of Beta Angle versus ANB for whole evaluable cohort (n=254)

Table 2. Correlations between the three cephalometric parameters – Whole evaluable cohort [n = 254]

	ANB	Wits Appraisal	Beta Angle
ANB	1.00	0.85	- 0.82
Wits Appraisal	0.85	1.00	-0.85
Beta Angle	- 0.82	- 0.85	1.00

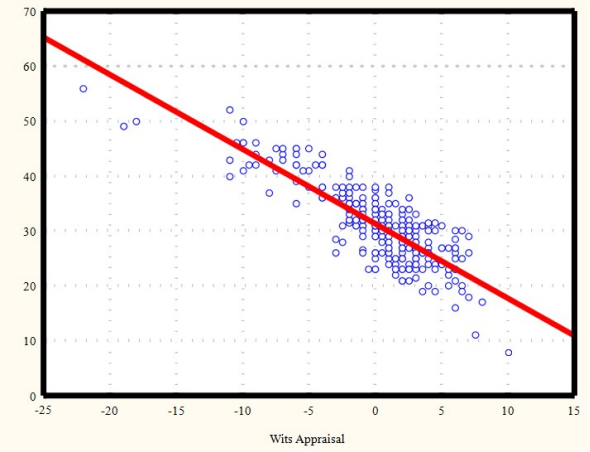

Figure 6. Scatter plot of Beta Angle versus Wits Appraisal for whole evaluable cohort (n = 254)

The correlation coefficient r between ANB & Beta angle is high (r = -0.82) and negative which is statistically significant ($p< 0.001$). The r^2 ($r^2 = 0.68$) shows moderate level of correlation ($0.4 > r^2 > 0.7$). Thus, the equation of simple linear regression obtained is Beta Angle = 37.517 – 1.644 XANB (Figure 5). The correlation coefficient r between Beta angle & Wit's Appraisal is high (r = -0.85) and negative which is statistically significant ($p< 0.001$). The r^2 ($r^2 = 0.71$) also shows high level of correlation ($r^2 > 0.7$). Thus, obtained equation of simple linear regression is Beta Angle = 31.270 – 1.359XWits Appraisal (Figure 6)

DISCUSSION

The correlation between ANB, Wits appraisal and Beta angle is high which mean if knowing one the other can be predicted using the equation and compare it with actual value obtained. Based on the value of r^2 reliability between ANB and Wits appraisal is 72 %, between ANB and Beta angle is 68% whereas between Wits and Beta angle is 71%. This difference shows predictability not the accuracy to predict correctly. The relation still needs to verify using other parameters. The correlation coefficient between ANB and Wits appraisal is positive which signifies that an increase in ANB increases Wits Appraisal whereas the same relation of ANB and Wits Appraisal with Beta angle is negative which signifies that an increase in ANB and Wits appraisal decreases Beta angle and decrease will increase the Beta angle. This study deal with the whole sample but these data will vary based on Class I, Class II and Class III samples. Based on previous studies it known that these predictabilities hold good for Class II and Class III samples but for Class I samples it decreases dramatically (8-10).

The distinguish between true skeletal Class I, Class II and Class III patterns can be done by Beta angle as compare to ANB & Wits appraisal. Thus, a misdiagnose by ANB has a high chance to be misdiagnose by Wits Appraisal than by Beta angle. All three parameters indicate Class II or Class III skeletal pattern but does not specify which jaw is prognathic or retrognathic. If the clinician needs to diagnose which jaw is at fault or whether the deformity is due to the aberrant growth of both the jaws, further cephalometric data are needed. All clinicians should be aware of as many cephalometric analyses as possible but should use them cautiously, appropriately and substantiated through clinical observations. By relying on a single or a couple of cephalometric analysis diagnosis might be misleading and treatment planning based on such a diagnosis can be insufficient.

CONCLUSION

The Beta angle was designed as a diagnostic tool to assess the sagittal jaw connection, and it is more consistent than the Wits assessment, which is followed by the ANB angle.

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