Establishment of cephalometric norms of Yen, W and Beta angle with assessment of sagittal jaw relationship in Eastern Indian population

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Abstract

Aim: To evaluate the validity of Yen, W and Beta angle and to compare it with other commonly used sagittal measurements in Eastern Indian population.

Materials and Methods: Sample size of 100 subjects (males -50, females 50, mean age - 25.5+-2 years) of indo aryan race were taken from the OPD of the College. The lateral cephalograms were traced for ANB, Wits appraisal, Beta angle, W angle and YEN angle. Lateral Cephalometric Head film was obtained with the patient positioned in Natural Head Position, seated Condyle, and with Passive Lips. The cephalograms were further traced by the same operator, this comprised the Cephalometric database for the study. The final results obtained were compared between Males and Females of the study to verify the acceptable standards of them.

Results: There was no statistically significant gender wise difference. Hence a common normative range applicable for both the genders can be proposed. The results show that all five-skeletal cephalometric sagittal analyses i.e. ANB angle Wits analysis, BETA angle, YEN angle and W angle are reliable and can used in different populations without any gross deviations in the findings.

Conclusion: Based on the present study, it can be concluded that no statistically significant differences in all parameters were found between the subjects of the Local Palamau population and also between the males and females. From the above statement ANB angle, Wits analysis, BETA angle, YEN angle and W angle can be used as they are reliable. All

Keywords: Cephalometric norms, W angle, YEN angle, Beta angle.

Introduction

Cephalometric analysis, which is based on various angular and linear measurements is an essential part of diagnosis and treatment planning in Orthodontics. Analysis of jaws in sagittal plane is a key step which was first introduced by Wylie in 1947. The analysis of skeletal relationships of jaws in the sagittal plane is of utmost importance in orthodontic diagnosis for which numerous lateral cephalometric analyses have emerged.[1] None of the analyses are without flaws. Assessment of anteroposterior jaw relationship is of great clinical importance in diagnosis and treatment planning. The skeletal pattern plays an important role in occlusal development and also imposes limitation to the anteroposterior movement of incisors during treatment.[2] To aid in diagnosing anteroposterior discrepancies, cephalometric analyses have incorporated various angular and linear measurements.

In 1948, Downs was the first to evaluate the anteroposterior apical base relationship cephalometrically by measuring the angle formed by A-B and N-Pog. Positive and negative signs were used to denote relative protrusion/retrusion of the mandible.[3] A few years later, Steiner in 1952 measured SNA and SNB and used their difference, ANB, to describe the apical base relationship. This has been widely adopted as a principal method of evaluating anteroposterior jaw relationships. However, both Down's and Stenier's methods are subject to anteroposterior and vertical variations in Nasion.[4] As an alternative to ANB, Jacobson suggested the Wits appraisal, which is derived by drawing perpendicular lines from points A and B to the functional occlusal plane (FOP). The distance between the

points of intersection (AO and BO) is measured to describe the maxillary/mandibular relationship.[5,6] Any change in the angulation of the functional occlusal plane will profoundly influence the positions of A and B and thereby the Wits appraisal reading.

Baik and Ververidou[7] introduced the Beta angle in 2004. Though it assesses sagittal discrepancies well, it depends on A and B, which are sometimes difficult to locate. In some situations, the condyle is not clearly visible either. W angle and Yen angle are claimed to be among them, since stable landmarks like Sella, M point and G points are utilized. W angle uses three skeletal landmarks point S, point M, and point G to measure an angle that indicates the severity and the type of skeletal dysplasia in the sagittal dimension. YEN angle uses the following three reference points: S, midpoint of the sella-turcica; M, midpoint of the premaxilla; and G, center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis.[8]

Several studies have been published on ANB and Wits appraisal.[9,10] However, very few researches are found on reliability and validity of Beta angle. W angle and Yen angle have not been evaluated for their validity and never been compared with other popular analysis to check their reliability in diagnosis.[11] Very few studies have been done on Eastern Indian population to evaluate these angles, hence the purpose of this study was to evaluate the validity of ANB angle, Wits analysis, Yen, W and Beta angle and to compare it with other commonly used sagittal measurements in Eastern Indian population.

Material and Methods

The present study was conducted at the Department of Orthodontics and Dentofacial Orthopedics, Vananchal Dental College & Hospital, Garhwa. The samples were screened from the OPD available from the department. The study sample consisted of 100 subjects (Indo-aryan origin,50 males & 50 females mean age - 25.5 years) of Palamu population from Eastern India. Sample grouping was based on the lateral cephalograms, clinical profile & dental occlusion. Class I skeletal pattern was confirmed by ANB angle which was 1-3 degrees & Wits appraisal 1mm (male), O mm (female). All the participants were explained the need and design of the study and their consent was taken.

Inclusion Criteria

1. Class I skeletal base with ANB angle 1-3 degrees.
2. Permanent dentition with no missing teeth.
3. No severe skeletal discrepancies

All the cephalograms were shot from the same machine (Villa-rotograph evo-d digital panaromic and Cephalometric System) and were printed using Konica dry pro Laser Printer.

The selected subjects were first assessed clinically in natural head position, with seated Condyles and passive lips. To assure Natural head position ear rods and mirrors was used. The patient was then placed on the Cephalostat Machine. The ear rods were placed and the patient was asked to look into the mirror at his/ her eye level into his/her own eyes as it establishes the Natural Head Position. With the help of the X-Ray Viewer all Lateral Radiograph Films were traced on a Transparent Cellulose Acetate Sheet of 0.003" thickness with sharp 3H pencil and landmarks were identified by the same operator. The ANB, Yen, W, wits appraisal and Beta angle were traced and measured for all the cephalograms.

Statistical Analysis

The Statistical Analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 Statistical Analysis Software. The values were represented in Number (%) and Mean ± SD. Descriptive statistics, i.e. Means, Standard Deviations (SD), and 95% Confidence Intervals were calculated for all variables in these groups and level of Statistical Significance was set at $p = 0.05$. Independent Student's t-Test was used to compare the values of males and females. An Error Analysis exercise was carried out using 10 radiographs, which were traced again second time after 3 to 4 weeks. Systematic bias was examined using a Paired t-Test, and Estimation of Random Error was done with the index of reliability by correlating repeat measurements. Error analysis showed no significant. Differences when Systematic Bias was tested ($p < 0.05$), and correlations were found to be greater than 0.95, indicating insignificant Random Error.

Results

There was no statistically significant gender wise differences (Table 1). Hence a common normative range applicable for both the genders can be proposed (Table 2). The results show that all five-skeletal cephalometric sagittal analyses i.e. ANB angle, BETA angle, YEN angle and W angle are reliable and can used in different populations without any gross deviations in the findings.

Table 1: Comparison of Normative Range of Different study parameters for males and females in the study population

Sex		N	Mean	Std. Deviation	Normative Range (Mean ± 1.96 SE)		Significance of difference (Male vs Female) Independent sample 't' -test	
					Lower Limit	Upper Limit	't'	'p'
ANB angle	Male	50	1.14	1.212	0.80	1.48	0.183	0. 855
	Female	50	1.18	1.193	0.84	1.58		
Wits appraisal	Male	50	.46	.450	0.33	0.59	0.692	0.491
	Female	50	.40	.416	0.82	0.52		
Yen angle	Male	50	123.92	3.596	122.90	124.94	0.544	0.588
	Female	50	123.54	3.388	122.58	124.50		
Wangle	Male	50	56.32	3.461	55.34	57.30	0.750	0.455
	Female	50	55.84	2.916	55.01	56.71		
Beta angle	Male	50	35.92	4.548	34.63	37.21	0.561	0.576
	Female	50	35.48	3.170	3458	36.38		

Table 2: Common normative range applicable for both the genders

	N	Mean	Std. Deviation	Normative Range (Mean±1.96 SE)	
				Lower Limit	Upper Limit
ANB angle	100	1.16	1.20	0.92	1.40
Wits appraisal	100	0.43	0.43	0.32	0.52
Yen angle	100	123.73	3.48	123.04	124.42
Wangle	100	56.08	3.19	55.45	56.71
Beta angle	100	35.70	3.91	34.92	36.48

Discussion

Lateral cephalometric radiographs are an extremely useful diagnostic tool in orthodontic practice was introduced in 1931 by Broadbent.[11,12] Most of the orthodontic problem occur in sagittal plane therefore analysis of jaws in anteroposterior plane is most important. Wylie assessed the maxilla-mandibular relationship in sagittal plane for the first time, since that time numerous analysis have been introduced. An accurate AP measurement of jaw relationships is critically important in orthodontic treatment planning. In cephalometrics, both angular and linear variables have been proposed to analyze sagittal jaw relationship and jaw position.[13-16] Angular measurements can be mistaken as a result of changes in facial height, jaw inclination, and total jaw prognathism. Whereas linear variables can be affected by the inclination of the reference line.

ANB angle is still widely used but it has its own demerits, it is affected by various factors and can often be misleading. When using the ANB angle, all those factors should be considered, this make the interpretation of this angle much more complex. The alternative of ANB angle is the Wits appraisal does not depend on cranial landmarks or rotation of the jaws but still has the problem of correctly identifying the functional occlusal plane, which can sometime be impossible. To overcome these problems, a new angle the Beta angle was developed. It uses 3 points located on the jaws point A, point B, and the apparent axis of the condyle (point C)-so changes in this angle reflect only changes within the jaws.[17-20] In contrast to the ANB angle, the configuration of the Beta angle gives it the advantage to remain relatively stable even when the jaws are rotated. However, precisely tracing the condyle and locating its center is not always easy. For that reason, some clinicians might hesitate to use the Beta angle.[21]

To overcome the deficits of previous parameters, measurements such as W angle, Yen angle were introduced. These do not utilize A and B points as skeletal landmarks, which are affected by local remodelling due to orthodontic treatment. Instead they utilize points M and G which are not affected by local remodelling and they approximate to being centroid points similar to sella. Concept of centroid was given by Johnson.[22-24] It's the center of an area of an image representing the mean point within the shape, about which it varies and is subject to least variation relative to non-mean anatomic points and therefore provides more stable reference points.[25,26] The present study we traced the lateral cephalogram of 100 individuals (50 males & 50 females). An attempt was made to analyse the normative value of Yen, W and Beta angle (for both males & females) among Palamau population. In the current study the independent sample t test for males and females showed no significant gender wise difference. Hence a common normative range is applicable for both the males and females and has been proposed.

The normative for Yen angle in Palamau population is 123.730 ±3.480. The range of value is form 123.040 to 124.420. The normative range for W angle is 56.080 with

standard deviation of 3.190. The range of W angle is from 55.45o to 56.710, which is increased when compared with South Indian population (55.5 ± 1.95) and also with the population of Maharashtra. The normative range for Beta angle is 35.700 with a standard deviation of 3.91 and the range is between 34.920 to 36.480 which is on a higher side when compare to the study done by Chong et al (31.10).[20] The value of Yen angle is less when compared to the South Indian norms which is (126.360 ± 3.0280). Larger sample size of the given population makes the scope for future studies in establishing norms for the local population. Further studies are needed to compare such result with those of the digital tracing and analysis to finally verify and co relate both the techniques.

Further studies are needed to compare the reliability of Beta angle, YEN angle and W angle in different mal-occlusions. Furthermore it is required to group the sample size into 3 groups namely Class I, Class II, Class III, and correlate the reliability of these angles over ANB angle and Wits analysis. A more extensive research could be done by dividing the Palamau District into grids and selecting equal number of individuals from each grid.

Conclusion

Based on the present study, it can be concluded that no statistically significant differences in certain parameters were found between the subjects of the Local Palamau population and also between the males and females. Beta angle does not depend on cranial landmarks therefore it is claimed to be least affected by change in cranial base and jaw rotation. Yen angle which involves Sella in its method but still it was claimed to be least affected by variations in facial height and jaw rotations. W angle is relatively new angle to measure skeletal sagittal discrepancies introduced by Bhad in 2011. From results of this study all five-skeletal cephalometric sagittal analyses i.e. ANB angle Witts analysis, BETA angle, YEN angle and W angle are reliable. All performed analyses have equal diagnostic importance and reliability therefore can be used as alternative analyses for each other, when certain factors make the use of one analysis difficult. This research opens up a scope of further study to compare the reliability of these angles and to incorporate the best reliable angle for diagnosis and treatment planning and also assessment of antero-posterior treatment progress in a better way.

Conflict of Interest: None.

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