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Original Research Article

Comparative analysis and co-relation of antero-posterior jaw dysplasia indicators in angle's Class I molar relation and normal overjet subjects of Central India – A pilot study

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ABSTRACT

Aim: To assess and compare anteroposterior jaw dysplasia indicators i.e. (Wits-appraisal, ANB-angle, β(Beta)-angle, W-angle, YEN-angle and π(Pi)-angle) in Angle's Class I molar relation subjects with normal overjet of central India.

Materials and Methods: Sum of 40 lateral cephalograms were traced in line with the inclusion criteria of Angle's Class I molar relation subjects. Subjects had to be between the ages of 18 and 30 and have a normal overjet and aligned arches. We measured and compared the Wits-appraisal, ANB-angle, (Beta)-angle, W-angle, YEN-angle and Pi-angle. The statistical package for social sciences (SPSS) 20.0 version was used to examine the data. We used descriptive statistics. The Spearman's correlation coefficient was used to evaluate the correlation between the variables. Statistics were judged as significant at a p-value of 0.05. 95% of the confidence interval was chosen.

Results: The result showed descriptive statistical representation for the norms of Wits-appraisal, ANB-angle, Beta-angle, Yen-angle, W-angle, and Pi-angle for the Central India population. We found a high correlation of ANB-angle with YEN-angle, ANB-angle and Pi linear, ANB-angle and W-angle, Beta-angle and W-angle, YEN-angle and W-angle and Pi-angle and Pi linear.

Conclusion: Among the angles used for the comparative evaluation for the prediction of anteroposterior jaw dysplasia, W-angle and YEN-angle had the utmost accuracy, whereas Beta-angle had the least. Therefore, YEN-angle and W-angle are reliable in our practice in the prediction of anteroposterior jaw dysplasia in the Central India population.

1. Introduction

Broadbent introduced cephalometric in 1931. Cephalometrics is regarded as a crucial tool for evaluating jaw relationship in all spatial planes, including anterior-posterior, vertical, and transverse. The Anterior posterior plane has been one of the mainstays in the diagnosis, prognosis, treatment planning as well as mid-treatment/post-treatment/retention evaluation. The relationship of the maxilla and the mandible in the sagittal plane is the most crucial criteria employed in orthodontic diagnosis as early as the 1900s, even before Angle created his classification of malocclusion.[1]

ANB-angle, Wits appraisal, YEN-angle, Beta-angle, Pi-angle, and W-angle are some geometric characteristics that have been defined and utilised successfully to aid the physician in the diagnosis of sagittal jaw discrepancies. Particular and unique reference lines, planes and points are employed for each of these attributes.

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In 1952, Riedel[2,3] introduced the ANB-angle. Using the Nasion as a point of reference, he measured the difference between the SNA and SNB, or angle-ANB, as a representation of the dental apical base relationship. The lines that connect Nasion to points A and B cross to create this angle. It indicates how the maxilla and mandible are situated in relation to one another.

Jacobson made the Wits evaluation suggestion in 1975.[4] It gauges how closely the mandible and maxilla are connected to one another in the sagittal or anteroposterior plane. Points B and A are separated by a linear AO-BO distance that is perpendicularly projected on the occlusal plane.

Baik and Ververidou invented the Beta-angle for the first time in 2004.[5] Point B, Point A, and the condylar axis of the mandible are used as references to measure this angle that depicts the skeletal dysplasia in the sagittal direction (C).

The YEN-angle was introduced as a sagittal dysplasia indication by Neela et al[6] in 2009. To calculate the YEN-angle, reference points are utilised at locations M (the centre of the pre maxilla), G (the midpoint at the mandibular symphysis), and S (the midway of the sella).

Bhad et al[7] proposed the W-angle in 2013. True sagittal dysplasia is reflected, and growth rotations have no impact on it. Three skeleton landmarks—Points M, G, and S—are used as reference points in this angle. A line drawn at 90° from point M on the S-G line and the M-G line, the W-angle is calculated.

In 2012, Kumar S et al[8] introduced the Pi analysis. According to the authors, this angle wouldn't be affected by how the jaws rotated. The genuine horizontal line that passes through Nasion, which is liable to vary with growth, serves as the reference for the (Pi)-angle.

Numerous research have been conducted to evaluate and compare different anteroposterior jaw dysplasia markers in various classes and populations. However, inconsistent outcomes and a lack of distinct clinical use indications were found.

Thus, this study was planned to assess and compare anterior-posterior jaw dysplasia indicators i.e. Beta-angle, Wits-appraisal, ANB-angle, W-angle, YEN-angle and π(Pi)-angle in Angle's Class I molar relation subjects with normal overjet of Central India and to evaluate the correlation between anteroposterior dysplasia indicators.

2. Materials and Methods

A sum of 40 Angle's Class I molar relation participants with normal overjet and aligned arches between the ages of 18 and 30 were chosen; those with history of orthodontic treatment, congenital abnormalities, or obvious asymmetries were excluded. A 0.5 mm lead pencil was used to hand trace each cephalogram onto a piece of 0.003-inch acetate paper while using the same lighting. The lead investigator conducted each and every trace. To determine the measurement error, the same observer retraced 5 randomly selected cephalograms 1 week following the original assessment for each of the parameters.

Identification & tracing of these following landmarks were done

1. Nasion (N)
2. Midpoint of the sella (S)
3. Subspinale (A)
4. Supramentale (B)
5. Mandibular condylar axis (C)
6. Centre of the anteriormaxilla (M)
7. Centre of the circle (G), i.e., at a tangent to the three inner surfaces of the symphysis of the mandible.
8. G' point: The G point perpendicularly projected onto the true horizontal.
9. M' point: M point perpendicularly projected onto the true horizontal.

2.1. Tracing of these following lines were done

1. Plane of the occlusion (Functional).
2. The N-B line: Segment joining Nasion and Supramentale points.
3. The N-A line: Segment joining Nasion and subspinale points
4. The A-B line: Segment joining subspinale and supramentale points.
5. The C-B line: Segment joining the midway of the condyle(C) and supramentale point.
6. The S-M line: Segment joining S and M points.
7. A segment at right angle from subspinale: Segment from subspinale point at right angle to the C-B line.
8. The M-G Line: Segment joining M and G points.
9. A segment at right angle from point M: Segment from point M at right angle to the S-G line.
10. The S-G Line: Segment joining S and G points.
11. True vertical (Tv): True vertical metallic scale line created from radiography picture.
12. True horizontal (Th): Nasion is located along a line perpendicular to the real vertical.
13. The G'-M line: Segment joining G' and M points.
14. A segment at right angle from point M: Segment from point M at right angle to the true horizontal line.
15. The N-M' Line: Segment joining N and M' points.
16. A segment at right angle from point G: Segment from point G at right angle to the true horizontal line.
17. The N-G' line: Segment joining N and G' points.

2.2. The six parameters were measured as follows

2.2.1. ANB angle

We shall identify points A, B, and Nasion in order to create the ANB-angle. Two lines A-N and B-N are drawn. The angle ANB is formed when the A-N line and the B-N line cross at Nasion. Angle ANB typically falls between 0° and

4°". Class II is believed to be ANB > 4°, while class III is skeletal ANB 0°. (Figure 1)

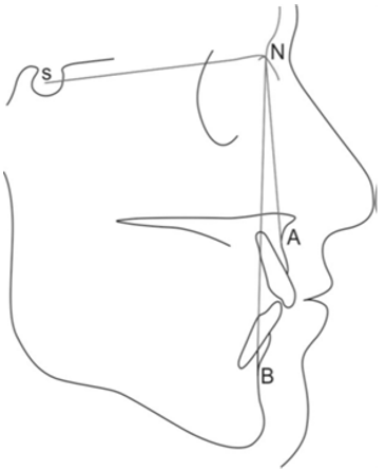


Fig. 1: ANB-angle

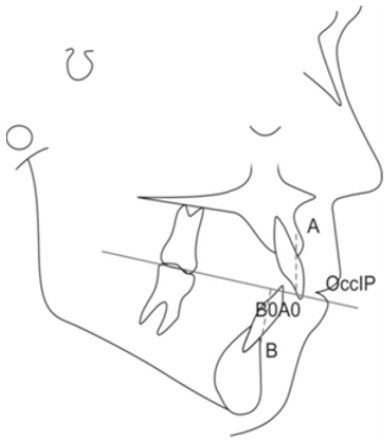


Fig. 2: Wits appraisal

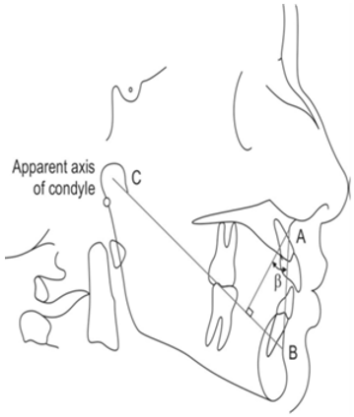


Fig. 3: Beta-angle

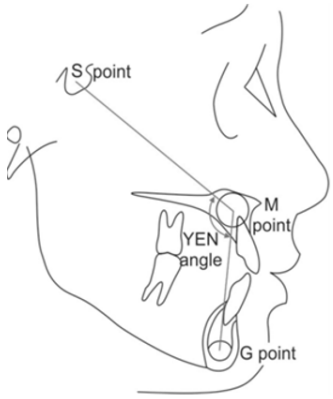


Fig. 4: YEN-Angle

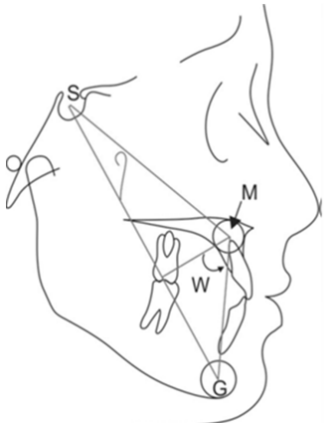


Fig. 5: W-angle

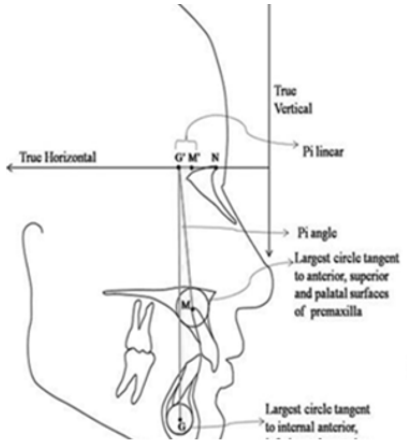


Fig. 6: Pi-angle and Pi linear

2.2.2. Wits appraisal

The AO-BO distance, sometimes referred to as the Wits assessment, Points A and B are projected at right angle to the occlusal plane. The normal value in women is 0 mm, whereas in men it is -1 mm. Point AO was placed ahead point BO in skeletal class II, while in class III, point AO is far behind of point BO. (Figure 2)

2.2.3. β(Beta)- angle

To draw Beta-angle, points Subspinale(A), Supramentale(B), and C (the mandibular condylar axis) will be used. A-B, C-B, and a segment from point A that is at right angle to the C-B segment are the three lines that will be drawn. The beta-angle is the intersection of the A-B line and the 90° segment. Beta-angles between 27° and 35° can be categorised as class I skeletal patterns. Class II and class III skeletal patterns are indicated by angles between 27° and 35°, respectively. (Figure 3)

2.2.4. YEN-angle

Points S, M, and G will be found in order to create the YEN-angle. S-M and M-G will be the two lines we draw. Calculating the 'YEN-angle' between both the lines at point M. Skeletal class I is defined as YEN-angles between 117 and 123°, skeletal class II as YEN-angles below 117°, and skeletal class III as YEN-angles above 123°. (Figure 4)

2.2.5. W-angle

The points S, M, and G will be chosen in order to form the W-angle. M-G, S-M, S-G, and a segment from M point that is at 90° to the S-G segment are the four lines that will be drawn. The W-angle is the angle formed by the 'M-G' line and the segment at right angle from point 'M' to the 'S-G' segment. W-angles with a 51° to 56° angle are categorised as class I skeletal patterns. A skeletal class II connection is a W-angle of less than 56 degrees. Skeletal class III relationships are those with W-angles greater than 56°. (Figure 5)

2.2.6. π(Pi)-angle

It was created by drawing a segment at right angle from G point to the real horizontal line's intersection at G', then creating another segment from G' to M point. The angle GG'M, often known as the Pi-angle, is created by joining the points G'G and G'M. Additionally, a virtual line will be created from the M point to cross the real horizontal line at M'. The Pi linear was assumed to represent the distance between points G' and M'. (Figure 6)

The SPSS (Statistical Package for Social Sciences) 20.0 version was used to examine the data once they had been collected. The Kolmogorov-Smirnov test was used to determine the probability distribution of the data; a p value of less than.05 showed that the data were not normally distributed. The use of descriptive statistics was used. The Spearman's correlation coefficient was used to evaluate the correlation between the variables. Statistical significance was defined as a p-value of 0.05 or below. 95% of the confidence interval was chosen.

3. Result

Table 1 shows the descriptive statistical representation for the norms for all the parameters for the sample of 40 subjects of the Central India population.

The six anteroposterior jaw dysplasia indicators are all included in Table 2 along with their Spearman's correlation coefficients for the whole sample. As can be seen, we found a significant correlation of ANB-angle with YEN-angle, Pi linear and W-angle. Furthermore of W-angle with YEN-angle and Beta-angle. Pi-angle and Pi linear had a significant correlation as well.

4. Discussion

ANB-angle is considered a pioneer in measuring anteroposterior jaw dysplasia to date. Age of the patient, poor repeatability of landmarks, rotation of the jaw, changes in reference planes caused by growth, and changes brought on by orthodontic treatment are all variables that have an impact on all other anterior-posterior criteria that have been presented throughout the years (Ishikawa et al., 2000). The typical ANB-angle range, according to Riedel (1952), is 0° to 4°. The ANB-angle range, according to Polina et al[9](2015), is 0° to 4.5° in Andhra population. However, in our study, the range of ANB-angle is 0.0° to 10.0°.

By employing wits evaluation, one may determine the degree or severity of the anteroposterior skeletal disharmony of the jaws. There are no cranial landmarks involved. For females, the value is 0mm, while for males it is -1mm, according to Jacobson (1975). The range of Wits, according to Polina et al[9](2015), is -3mm to 2.5mm in Andhra population. However, the range of wits evaluation in our study is 0.0 mm to 8.0mm.

Rotations of the jaw do not impact beta-angle, and it does not employ a functional plane (Baik and Ververidou, 2004). However, it makes use of points A and B, which are prone to alter with development and orthodontic treatment (Richardson 1982; Frank, 1983; Rushton et al., 1991). On mouth-closed lateral head films, the point condylion(C) is not very reproducible (Adenwalla et al., 1988; Moore et al., 1989; Ghafari et al., 1998). Class I skeletal patterns can be categorised as beta-angles between 27° and 35°. The range of Beta-angle, according to Polina et al[9] (2015), is 27° to 37° in Andhra population. However, the range of Beta-angle in our study is 19.0° to 43°.

Points S, M, and G will be found in order to create the YEN-angle. Skeletal class I is defined as YEN-angles between 117° and 123° (Neela et al). According to studies, the sella turcica undergoes constant remodelling from

Table 1: Description of different variables

Variables	ANB angle	WITS appraisal	BETA angle	Yen- angle	PI angle	PI Linear	W angle
Mean	3.7^o	2.55 mm	29.25^o	116.35^o	3.55^o	4.2 mm	52.95^o
Std. Deviation	2.77394^o	1.84890 mm	5.59958^o	25.38809^o	2.43818^o	2.85804 mm	3.85903^o
Range	0.0^o -10.0^o	0.0-8.0 mm	19.0-43.0^o	112.0^o -133.0^o	1.0^o -10.0^o	1.00-12.0 mm	44.0^o -59.0^o
Median	3.0^o	2.5 mm	28.0^o	122.5^o	3.0^o	3.5 mm	53.0^o
Inter-quartile range	1.25^o -5.0^o	1.0-3.0 mm	26.0^o -32.75^o	116.25^o -124.75^o	2.0^o -4.75^o	2.0-5.75 mm	51.0^o -56.0^o

Table 2: Correlation between different variables

Variables	Spearman's correlation coefficient	P value
ANB angle & WITS appraisal	.359	>.05 (NS)
ANB angle & BETA angle	-.570	<.05 (S)
ANB angle & SMG (Yen) angle	-.677	<.001 (HS)
ANB angle & PI angle	.591	<.05 (S)
ANB angle & PI Linear	.716	<.001 (HS)
ANB angle & W angle	-.768	<.001 (HS)
BETA angle & Wits appraisal	-.424	>.05 (NS)
Yen-angle & Wits appraisal	-.099	>.05 (NS)
WITS appraisal & PI angle	.263	>.05 (NS)
WITS appraisal & PI Linear	.141	>.05 (NS)
WITS appraisal & W angle	-.177	>.05 (NS)
BETA angle & SMG (Yen) angle	.626	<.05 (S)
BETA angle & PI angle	-.032	>.05 (NS)
BETA angle & PI Linear	-.116	>.05 (NS)
BETA angle & W angle	.696	<.001 (HS)
SMG (Yen) angle & PI angle	-.232	>.05 (NS)
SMG (Yen) angle & PI Linear	-.312	>.05 (NS)
SMG (Yen) angle & W angle	.744	<.001 (HS)
PI angle & PI Linear	.856	<.001 (HS)
PI angle & W angle	-.460	<.05 (S)
PI Linear & W angle	-.567	<.05 (S)

S- Significant, HS- Highly significant, NS- Non-significant

puberty forward. As a result, its midpoint's location shifts. It is not a stable point as a result. True basal dysplasia may be concealed by any jaw rotations brought on by development or orthodontic therapy. The range of YEN-angle, according to Polina et al[9] (2015), is 120° to127° in Andhra population. However, the YEN-angle range in our study is from 112° to 133°.

The pi analysis, a novel technique for evaluating the anteroposterior jaw relationship, is proposed. In skeletal class I pattern, the mean value for the Pi-angle is 3.40±2.04 degrees, and for the Pi-linear, the value is 3.40±2.20 mm, according to Kumar S et al. The range of Pi-angle and Pi linear according to Sanjeliwala et al[10] (2019) are 2.28°±0.81° and 3.03±0.74vmm, respectively in Ahmedabad population. In contrast, the ranges for Pi-angle and Pi-linear in our study are respectively 1.0° to 10.0° and 1.00 mm to 12.0 mm.

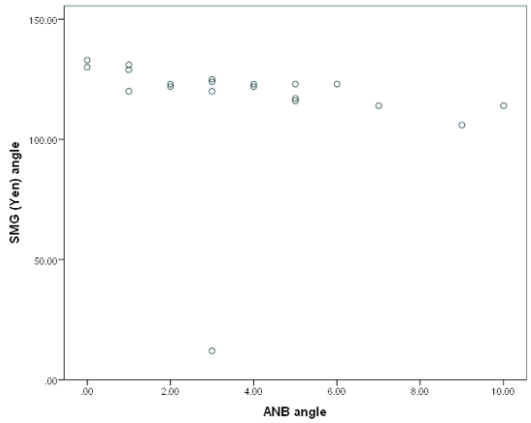
S, M, and G are used in the W-angle. W-angles with a 51° to 56° angle are categorised as class I skeletal patterns (Bhad et al). The range of W-angle is 53° to 59° in South Indian population, according to Gupta et al.[11] However, the range of the W-angle in our study is from 44.0° to 59.0°.

Table 1 shows the descriptive statistical representation for the norms for all the parameters for the sample of 40 subjects of the Central India population.

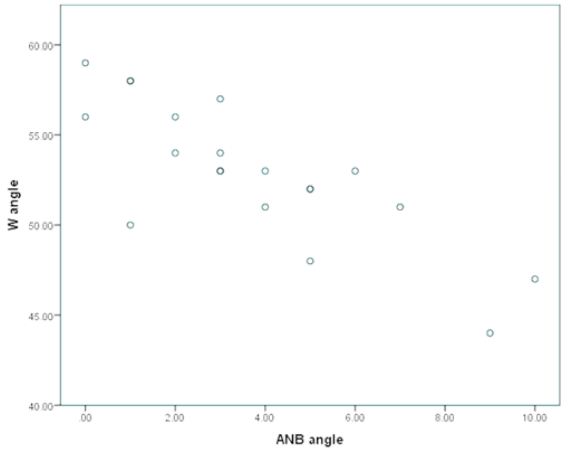
The six anteroposterior jaw dysplasia indicators are all included in Table 2 along with their Spearman's correlation coefficients for the whole sample. (Graphs 1, 2, 3, 4, 5 and 6)

5. Conclusion

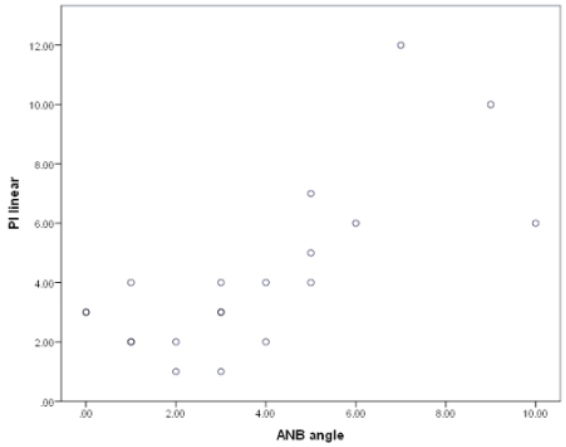
The following conclusions can be drawn from the study: ANB-angle had a significant correlation with YEN-angle, Pi-linear, and W-angle. W-angle had a significant correlation with Beta-angle and YEN-angle. Pi-angle had a significant correlation with Pi-linear. Among the angles used for the comparative evaluation for the prediction of anteroposterior jaw dysplasia, YEN-angle and W-angle had the highest accuracy, whereas Beta-angle had the least. Therefore,



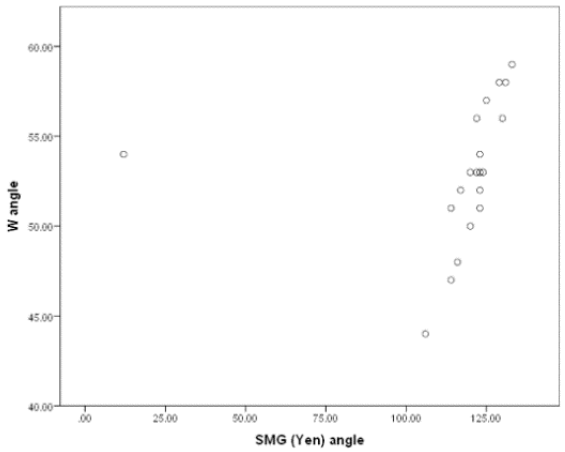
Graph 1: Correlation between YEN-angle & ANB-angle



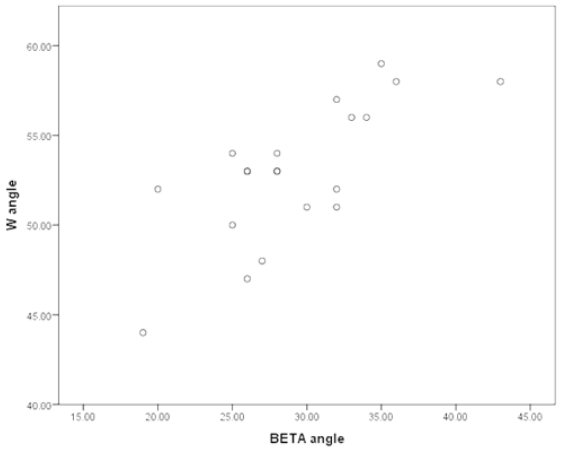
Graph 2: Correlation between ANB-angle & Pi-linear



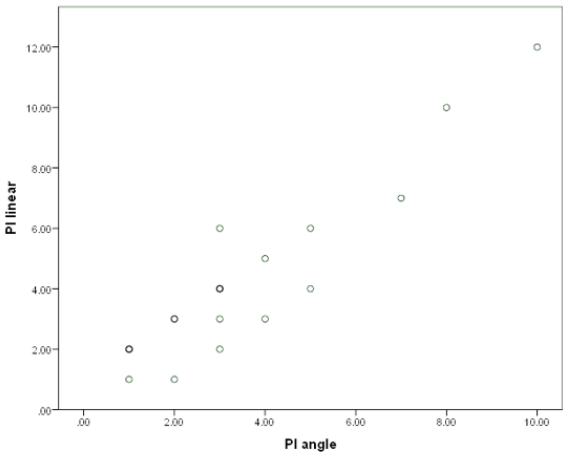
Graph 3: Correlation between W-angle & ANB-angle



Graph 4: Correlation between W-angle and BETA-angle



Graph 5: Correlation between YEN-angle & W-angle



Graph 6: Correlation between Pi-angle & Pi-linear

according to our study, YEN-angle and W-angle are reliable in our practice in the prediction of anteroposterior jaw dysplasia in the Central India population.

For the diagnosis of anteroposterior jaw dysplasia in Central Indian population, we recommend the use of the values of our study, as it has been found to have different values and Standard Deviation not only in International population groups but also in Indian sub-contiental population. Further studies involving larger multi-centric sample size and with gender segregation of subjects will be needed to provide better floating norms for this population.

6. Conflict of Interest

None.

7. Source of Funding

None.

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