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Original Research

Comparative accuracy of W-angle and YEN angle in Solan population as an indicator for skeletal dysplasia- A Cephalometric study

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***ABSTRACT*:**
Background: Accurate anteroposterior measurement of the jaw relationship is critically important in Orthodontic(s) diagnosis and treatment planning. ANB angle, WITS analysis, and BETA angle, etc. have been defined and used in dental education but are relatively inaccurate for the evaluation of AP discrepancies due to dependency on various factors. Clinical studies/trials aiming to find one reliable indicator among these angles will help the clinician to assess any skeletal discrepancy accurately and reliably. This study aims to compare W angle and YEN angle in class I, II, and III malocclusions and to assess their comparative accuracy for measuring skeletal dysplasia. **Methods:** Lateral cephalogram of 45 subjects aged between 14-30 years were taken from the archives of the Department of Orthodontics. They were divided into Class I, Class II, and Class III skeletal subgroups based on ANB and BETA angle with 15 samples in each subgroup. W Angle and YEN angle were calculated and correlated between each other and in the three skeletal subgroups. **Results:** A significant correlation was observed between W angle and YEN angle and the highest correlation was for YEN angle followed W angle. Correlation for class II malocclusion is more compared to class I followed by class III malocclusion. **Conclusion(s):** The YEN angle was found to be the most preferred angle to be computed to assess and differentiate Class I, Class II, and Class III skeletal dysplasia.
Keywords: Orthodontic(s), Dental education, Clinical studies/trial, Clinical outcomes, Diagnostic systems, Radiography

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INTRODUCTION

For Orthodontic(s) diagnosis and treatment planning, an accurate anteroposterior(AP) measurement of the jaw relationship is very important. Various angular and linear measurements have been proposed by various clinical studies/trial to assess the sagittal discrepancy between maxilla and mandible in radiography since **Wylie's (1947)**[1] first attempt for eg. The ANB angle **(Riedel, 1952)**[2], the Wits appraisal **(Jacobson, 1975)**[3], Beta angle **(Baik and Ververidou, 2004)**[4], which could help the clinician to establish the most appropriate treatment plan and dental education. All these diagnostic systems have shortcomings, due to rotations of the jaws during growth, vertical relationships between the jaws and the reference planes, etc. leading to a lack of validity and clinical outcomes. **(Jacobson, 1975; Moyers et al., 1979; Baik and Ververidou, 2004; Nanda, 2005).**[3,5,4,6]

Although the ANB angle is extremely popular and useful, it has been demonstrated in the literature that there's often a difference between the interpretation of this angle and the actual discrepancy between the apical bases. Several authors, have shown that change in position of nasion will directly affect the ANB angle. Furthermore, the ANB reading can also change by rotation of the jaws by either growth or orthodontic treatment.

As an alternative to ANB, **Jacobson** suggested the Wits appraisal.[3] it 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 access the

maxillary/mandibular relationship. In a skeletal Class I relationship in males, BO should be 1 mm ahead of AO, whereas in females, AO and BO should coincide (**Jacobson**)[3]. The Wits appraisal avoids N and reduces the rotational effects of jaw growth, but it uses the occlusal plane, a dental parameter, to explain a skeletal characteristic. 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.[5] The cant of the occlusal plane is easily affected by tooth eruption and dental development.

In 2004, a new measurement called the Beta angle was introduced by **Baik and Ververidou**[4]. It measures an angle to indicate the severity and the form of skeletal dysplasia in the sagittal dimension by using 3 skeletal landmarks—point A, point B, and the apparent axis of the condyle (C). Its dependency on points A and B, which, according to **Holdaway**[7], change their site substantially due to treatment and growth and the difficulty in locating the center of the condyle makes beta angle difficult to use. The reproducibility of point C (apparent axis of the condyle) on lateral head films is also very limited **(Adenwalla et al., 1988; Moore et al., 1989; Ghafari et al., 1998)**.[8,9,10]

To overcome these problems, the YEN angle was developed by **Neela et al (2009)**[11] in the Department of Orthodontics and Dentofacial Orthopaedics, YENEPOYA Dental College, Mangalore, Karnataka, India. It uses three reference points: G, center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis; S, midpoint of the sella turcica; and M, midpoint of the premaxilla. Though morphological landmarks seem to be more reliable, constructed points may in some instances better represent the original nature of the underlying skeletal pattern. When S, G and M are connected, they form the YEN angle, which is measured at M.

The W angle developed by **Bhad et al. (2011)**[12] is a new measurement for assessing the skeletal discrepancy between the maxilla and the mandible in the sagittal plane. Its measurement does not depend on unstable landmarks or the functional occlusal plane. It uses three stable points — point S, point G, and point M.

Hence an accurate antero- posterior(AP) measurement of the jaw relationship is critically important in orthodontic diagnosis and treatment planning. All other AP parameters introduced over the years are affected by at least one of the factors, namely patient' s age, jaw rotations, poor reproducibility of landmarks, growth changes in reference planes, and changes due to orthodontic treatment **(Ishikawa et al., 2000)**[13].

Recently defined variables for assessing sagittal dysplasia are YEN angle and W angle. Finding one reliable indicator among these angles will help the clinician to assess any skeletal discrepancy accurately, efficiently and reliably saving precious time.

The purposes of this study were to compare W angle and YEN angle in Solan population and to find out which is more reliable amongst them to measure antero-posterior skeletal dysplasia and to assess whether any gender difference exist when comparing W angle and YEN angle and also to correlate W angle and YEN angle among themselves and in between different skeletal subgroups.

MATERIALS AND METHODS

Pre-treatment lateral cephalograms of 45 patients aged between 14-30 years living in Distt. Solan of Himachal Pradesh were taken from the archives of Department of Orthodontics and Dentofacial Orthopedics of Bhojia Dental College Hospital, Baddi. The sample was divided to 3 groups namely Classes I, II, and III skeletal pattern groups with 15 patients in each group.

For a patient to be included in the Classes I, II, or III skeletal pattern group, criteria for Beta angle along with ANB angle had to be met. A skeletal Class I relationship was indicated by an ANB of 2–4 degrees, and a Beta angle of 27–35 degrees. A skeletal Class II relationship was indicated by an ANB of greater than 4 degrees and a Beta angle less than 27 degrees. The skeletal Class III individuals were characterized by an ANB angle less than 2 degrees and a Beta angle greater than 35 degrees.

Unacceptable quality radiographs and patients with history of orthodontic intervention were excluded.

To construct the W angle, points S, G, and M were located. To locate points M and G, as suggested by **Nanda and Merrill (1994)**[6] and **Braun et al. (2004)**[14]**,** a template with concentric circles whose diameters increased in 1 mm increments was used.

Point S — midpoint of the sella turcica; Point G — centre of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis and Point M — midpoint of the premaxilla

Join the lines S-M, M-G, and S-G. W angle is the angle between the perpendicular line from point M to SG line and the M-G line **(Figure 1)**.

YEN angle uses the following three reference points: S, midpoint of the sella turcica; G, center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis and M, midpoint of the premaxilla. When S, G, and M are connected, they form the YEN angle, which is measured at M **(Figure 2).**

Statistical analysis

Data collected by the investigators were first entered to Excel (Microsoft, Redmond, Washington, USA). Collected data were screened for any missing values or outliers and for validity of distribution assumptions. To summarize the data, means and standard deviations of W angle and YEN angle in three groups were calculated.

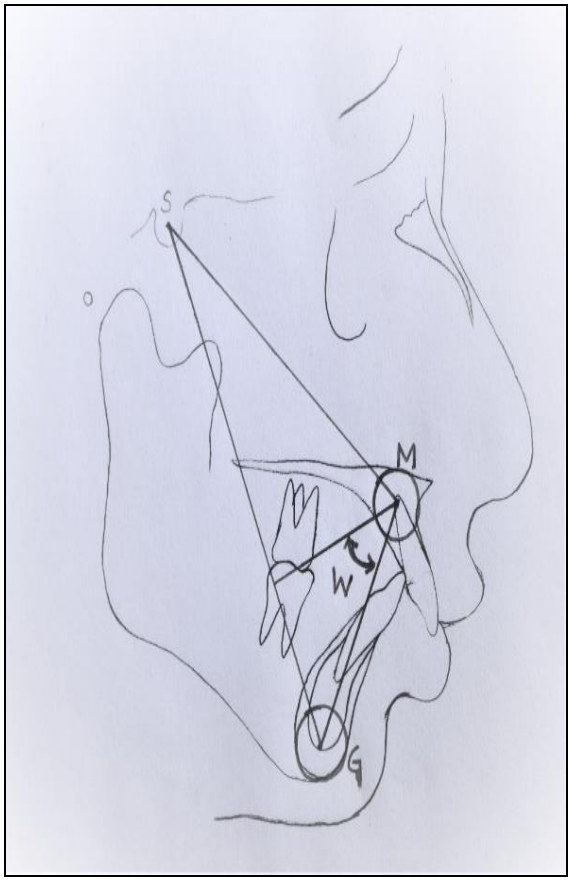

Figure 1: The construction and mode of measuring the W angle

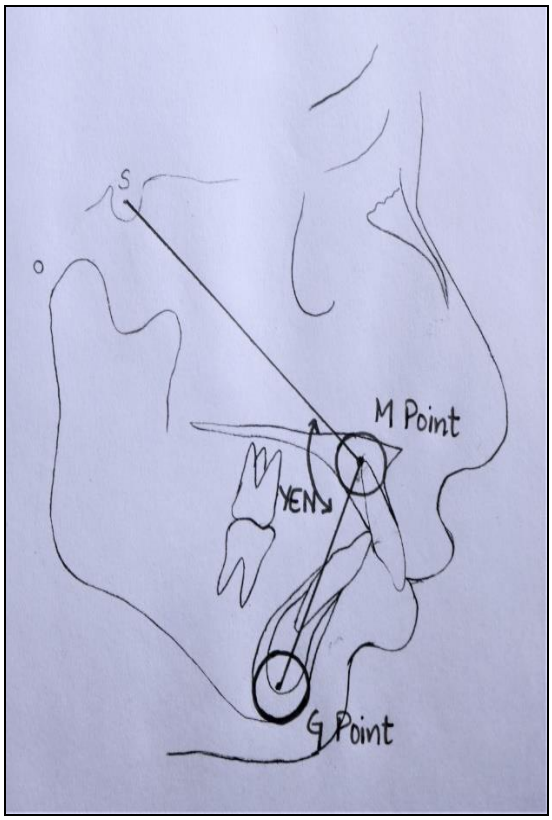

Figure 2: The construction and mode of measuring the YEN angle

The one -way analysis of variance (ANOVA) was used followed by post hoc Tukey testing to determine whether there was a statistically significant difference between the mean values W angle and YEN angle of the three groups. A P value ≤ 0.05 was considered to be statistically significant. Receiver operating characteristics curves were run to examine the sensitivity and specificity of W angle and YEN angle as a test to discriminate between the three different skeletal pattern groups. All statistics were performed in SPSS (SPSS 13, Chicago, Ill Illinois , USA)

RESULTS

A total of 45 subjects were included in the study with 15 in each group **(Figure 3).** W angle shows a mean of 54.33 (SD- 3.309) for class I, 50.93 (S- 2.7) for class II and 60.87 (SD- 2.03) for class III malocclusion. Yen angle shows a mean of 121.40 (SD- 5.38) for class I, 117.13 (SD- 3.77) for class II and 130.47 (SD- 3.35) for class III malocclusion **(Table 1).**

Significant correlation was observed between W angle and YEN angle in Post-hoc Tuckey test to assess skeletal dysplasia and it says that highest correlation is for YEN angle followed W angle. Correlation for class II malocclusion is more compared to class I followed by class III malocclusion **(Table 2).**

DISCUSSION

In orthodontic diagnosis and treatment planning, the indispensable step of evaluating the AP jaw relationship is generally determined by cephalometric analysis. ANB angle remains the most popular parameter for assessing the sagittal jaw relationship, but it is affected by various factors and can often be misleading. A popular alternative, 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 sometimes be impossible. Also, the Beta angle has certain demerits. It uses point A and point B, which can be remodelled by orthodontic treatment and growth and condylar axis that is difficult to locate.

Then, both YEN angle and W angle were introduced that have eliminated the limitations of the Beta angle as both YEN and W angles depend on points M and G which are geometric center of maxilla and mandible respectively and free from dentoalveolar protrusion that affect points A and B by remodeling due to orthodontic treatment and growth.

The present study was undertaken to compare which among W angle and YEN angle was best to assess skeletal dysplasia. Both angles were found to be significant which correlates with earlier studies done by **Kavita sachdeva et al.(2012)**[15], **Bhad et al (2011)**[12] and **Neela PK et al (2009)**[11].

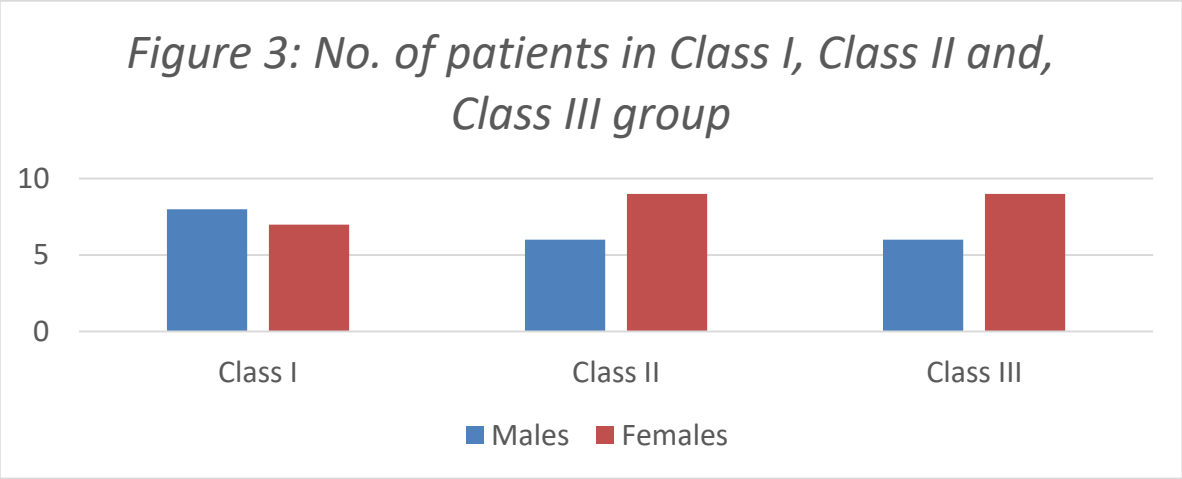

Table 1: Mean and standard deviation for YEN angle and W angle for various malocclusions

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Yen_angle	class I	15	121.40	5.383	1.390	118.42	124.38	112	131
	class II	15	117.13	3.777	.975	115.04	119.23	111	126
	Class III	15	130.47	3.357	.867	128.61	132.33	123	136
	Total	45	123.00	6.997	1.043	120.90	125.10	111	136
W_angle	class I	15	54.33	3.309	.854	52.50	56.17	50	60
	class II	15	50.93	2.738	.707	49.42	52.45	47	58
	Class III	15	60.87	2.031	.524	59.74	61.99	57	65
	Total	45	55.38	4.956	.739	53.89	56.87	47	65

Table 2: Significant correlation between YEN angle and W angle for various malocclusions

Post Hoc Tukey Test							
Dependent Variable	(I) Malocclusion	(J) Malocclusion	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Yen_angle	class I	class II	4.267*	1.556	.024	.49	8.05
		Class III	-9.067*	1.556	.000	-12.85	-5.29
	class II	class I	-4.267*	1.556	.024	-8.05	-.49

		Class III	-13.333*	1.556	.000	-17.11	-9.55
	Class III	class I	9.067*	1.556	.000	5.29	12.85
		class II	13.333*	1.556	.000	9.55	17.11
W_angle	class I	class II	3.400*	1.002	.004	.97	5.83
		Class III	-6.533*	1.002	.000	-8.97	-4.10
	class II	class I	-3.400*	1.002	.004	-5.83	-.97
		Class III	-9.933*	1.002	.000	-12.37	-7.50
	Class III	class I	6.533*	1.002	.000	4.10	8.97
		class II	9.933*	1.002	.000	7.50	12.37

*The mean difference is significant at the 0.05 level.

CONCLUSION

It can be concluded that YEN angle can be used as a routine method to assess the sagittal jaw relationship between maxilla and mandible with more accuracy and reliability, allowing clinician to save time and the need for doing a large number of tracing to compute various angles to diagnose a particular skeletal condition.

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