

## Comparative Evaluation of Yen Angle and W Angle with ANB Angle and Wits Appraisal for Predicting Sagittal Jaw Dysplasia

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### Abstract

**Introduction:** Sagittal relation of maxilla to mandible is one of the most important diagnostic criteria in orthodontics. A number of geometric parameters, such as ANB angle, Wits appraisal have been defined and used effectively for the same. Yen angle and W angle has developed recently. It is requisite to evaluate reliability and validity of Yen angle and W angle by comparing them with ANB and Wits appraisal.

**Aim:** To assess Yen angle and W angle and compare them with ANB angle, Wits appraisal in predicting sagittal jaw dysplasia.

### Objective:

1. To compare newly introduced sagittal dysplasia indicator Yen angle and W angle with ANB angle and wits appraisal in class I malocclusion.
2. To assess the reliability and validity of the Yen angle, W angle.
3. To assess the correlation between these angles with each other in class I malocclusion.

**Materials and Methods:** Standardized pretreatment lateral cephalograms of 40 subjects with class I molar relation of orthodontic patients were collected and traced and all the four parameters i.e ANB angle, Wits appraisal, Yen angle, W angle were measured and compared. Independent t-test and Pearson's correlation coefficient were used as statistical analysis.

**Result:** Statistically significant correlations were found among all the four measures; ANB angle, Wits appraisal, Yen angle, and W angle. Yen angle W angle shows highest correlation with ANB angle.

**Conclusion:** All the four sagittal indicators show a significant correlation with each other. Yen angle and W angle show highest correlation with ANB angle and least with wits appraisal. Yen angle and W angle can be used as sagittal jaw indicators in addition to the established measures.

**Key Words:** Yen angle, W angle, sagittal jaw dysplasia, cephalometric parameters.

### 1. INTRODUCTION

After the discovery of cephalometrics in 1931, it has been adapted as an important clinical tool for assessment of jaw relationship in all three planes – anteroposterior, transverse and vertical being an integral part of orthodontic treatment planning. The sagittal relationship is usually of utmost concern to the patient and needs a critical evaluation<sup>1</sup>. There are many angular and linear measurements have been included into various cephalometric analyses which help the clinician diagnose sagittal jaw discrepancies. Previously established parameters such as ANB angle<sup>2</sup>, Wits Appraisal<sup>3</sup> have been defined and used effectively for the evaluation of anteroposterior discrepancies affecting the apical bases of jaws<sup>1</sup>.

In 1948, WB Downs<sup>4</sup> in his cephalometric analysis described the A-B plane angle, as a means to assess sagittal jaw dysplasia. The angle of convexity<sup>4</sup> also proposed by Downs (Nasion-Point A-Pogonion) is yet another measure of the protrusion of the face in profile<sup>1</sup>.

Riedel<sup>2</sup> (1952) introduced the ANB angle for evaluating the anteroposterior relationship of the maxilla to the mandible. However, it was Cecil C Steiner<sup>5</sup> who popularized this angle (mean value of 2° in adults and 2.8° in children, range 2-4°) in 1953 in his classic article, 'Cephalometrics for you and me'. This has been widely accepted as the principal method of evaluating anteroposterior jaw relationship<sup>1</sup>.

Jacobson<sup>3</sup> (1975) in order to overcome the inaccuracies of ANB angle devised 'Wits' Appraisal (Wits stands for *University of the Witwatersrand*, Johannesburg, South Africa) which was intended as a diagnostic aid whereby the severity or degree of anteroposterior jaw disharmony can be measured, independent of cranial landmarks, on a lateral cephalometric head film<sup>1</sup>.

Neela et al<sup>6</sup> reported the Yen angle, another sagittal dysplasia indicator which was developed in the Department of Orthodontics and Dentofacial Ortho-paedics, Yenepoya Dental College, Mangalore, Karnataka, India, and hence its name. It uses the following three reference points: S, midpoint of the sella turcica; M, mid-point 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<sup>1</sup>.

The other measurement W angle was developed by Bhad et al.<sup>7</sup> The points S, G and M used in Yen angle is utilised here also. Angle between a perpendicular line from point M to the S-G line and the M-G line is measured<sup>1</sup>.

Few studies have been carried out to evaluate the reliability and validity of W angle and Yen angle and this study does a reality check on these angles by comparing them to universally used – ANB angle and Wits appraisal.

### **Aim and objective**

1. To compare newly introduced sagittal dysplasia indicator Yen angle and W angle with ANB angle and wits appraisal in class I malocclusion.
2. To assess the reliability and validity of the Yen angle, W angle.
3. To assess the correlation between these angles with each other in class I malocclusion.

### **Materials and method**

Standardized pretreatment lateral cephalograms of 40 subjects with class I molar relation of orthodontic patients were collected from the Department of Oral Medicine and Radiology from Maitri college of Dentistry and Research Centre, Durg, Chhattisgarh.

The following inclusion as well as exclusion criteria was established for this study:

#### **Inclusion criteria**

- Orthodontic patient with class I molar relation.
- Permanent dentition with no missing teeth.
- Patient with no previous history of Orthodontic treatment.
- Patient with age group of 18-30 years of age.
- Cephalogram of high clarity.

#### **Exclusion criteria**

- Previous Orthodontic treatment.
- Edentulous spaces.
- History of trauma.
- Congenital deformity.
- Marked asymmetry.
- Poor quality radiograph.

### **Materials required**

1. 40 Left Lateral Cephalograms(Fig.1)
2. Tracing table (Fig.2)

3. 0.003" Lead acetate tracing paper (Fig.1)
4. 0.5mm HB lead pencil
5. Geometry box (scale, protractor, rounder, set square) (Fig.3)
6. Scotch tapes
7. Eraser

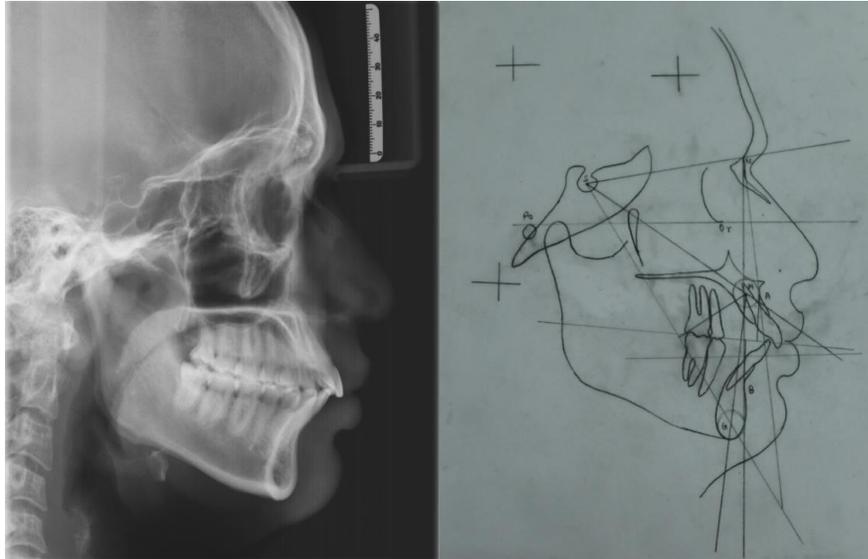


Fig. 1 Lateral Cephalogram with Class I molar relation and cephalogram traced on to 0.003 inch acetate paper.



Fig.2 Tracing table



Fig.3 Geometry Box

## Method

Standardized pretreatment lateral cephalograms of 40 subjects with class I molar relation of orthodontic patients were collected from the Department of Oral Medicine and Radiology of Maitri college of Dentistry and Research Centre, Durg, Chhattisgarh. Cephalograms were traced on to a 0.003 inch acetate paper using a 0.5 mm lead pencil under same illumination.

### Landmarks included

- Point A: Subspinale
- Point B: Supramentale
- Point N: Nasion
- Point S: Midpoint of the sella turcica
- Point M: Midpoint of the premaxilla
- Point G: Center of the largest circle, i.e., at a tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis.

### Parameters included

Four parameters were measured as follows:

#### 1. ANB Angle (Fig.4)

- To construct ANB angle, points A, B, and N (Nasion) were located.
- ANB angle is between the N–A line and the N–B line at point N.
- Class I –  $1^{\circ}$  to  $4^{\circ}$  Angle
- Class II – Angle  $> 4^{\circ}$
- Class III – Angle  $< 1^{\circ}$

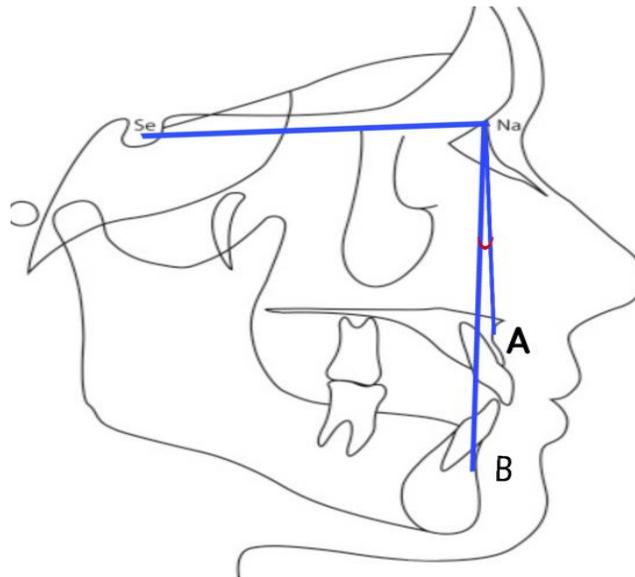


Fig. 4 ANB Angle

#### 2. Wits appraisal (Fig.5)

- AO–BO distance or Wits assessment is a linear distance between points A and B projected perpendicularly on the functional occlusal plane.
- Class I - Female: 0mm  
Male : -1mm
- Class II - BO was positioned well behind point AO (positive reading)
- Class III - BO is ahead of point AO (negative reading).

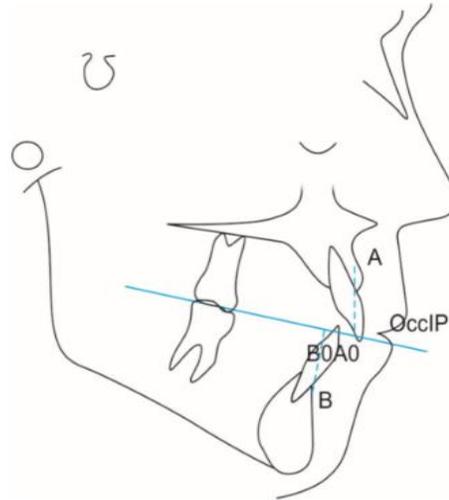


Fig. 5 Wits appraisal

3. **Yen Angle** (Fig.6)

- Reference point used:
  1. Point S
  2. Point M
  3. Point G
- The angle between lines SM and MG measured.
- Class I –  $117^\circ$  to  $123^\circ$  Angle
- Class II – Angle  $< 117^\circ$
- Class III – Angle  $> 123^\circ$

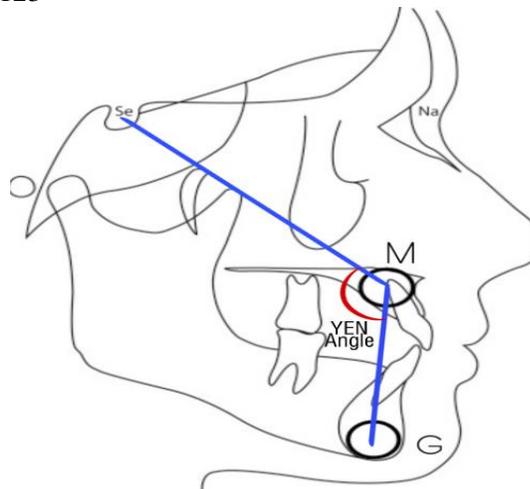


Fig. 6 Yen Angle

4. **W Angle** (Fig.7)

- It is measured by locating three points:
  1. Point S
  2. Point M
  3. Point G
- Angle between the perpendicular line from Point M to S-G line and the M-G line is measured.
- Class I –  $51^\circ$  to  $56^\circ$  Angle
- Class II – Angle  $< 51^\circ$
- Class III – Angle  $> 56^\circ$

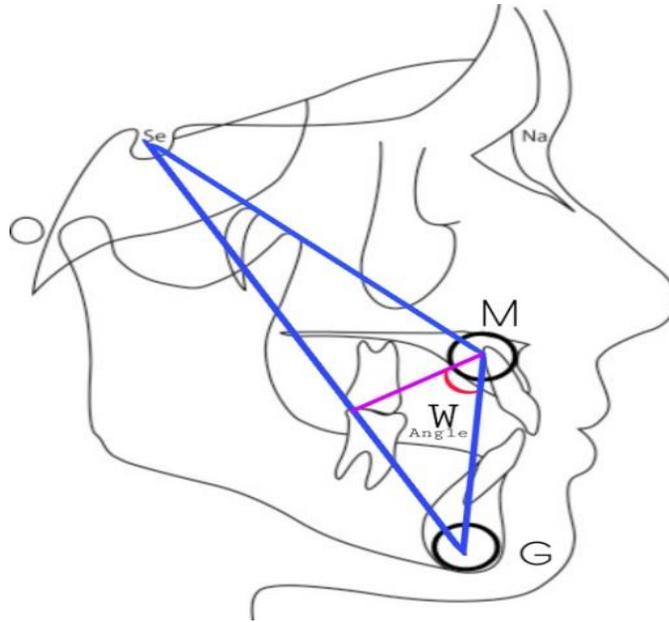


Fig.7 W angle

**Statistical analysis**

The aim of the study is to assess Yen angle and W angle and correlate them with ANB angle, Wits appraisal in predicting sagittal jaw dysplasia.

Correlation used: Pearson’s correlation

Software used: SPSS 16.0

**Results**

Descriptive statistics in Table 1 shows the mean and standard deviation of Yen angle, W angle, ANB angle and Wits appraisal. The mean and standard deviation of Yen angle was  $120.87^\circ \pm 4.71^\circ$  and that of W angle was  $54.02^\circ \pm 2.96^\circ$ .

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Yen Angle	40	111.00	131.00	120.8750	4.71869
W Angle	40	47.00	60.00	54.0250	2.96551
ANB	40	-6.00	9.00	3.4875	2.97314
Wits Appraisal	40	-6.00	11.00	1.7625	3.67421

**Table 1: Descriptive statistics of all variables**

Table 2 represents the Pearson’s correlation coefficient(r) for all four sagittal jaw indicators: Yen angle, W angle, ANB angle and Wits appraisal. It can be seen that correlation among all four parameters is highly significant.

Correlations					
		Yen Angle	W Angle	ANB	Wits Appraisal
Yen Angle	Pearson Correlation	1	.808**	-.808**	-.652**
	Sig. (2-tailed)		.001*	.001*	.001*
	N	40	40	40	40
W Angle	Pearson Correlation	.808**	1	-.622**	-.497**
	Sig. (2-tailed)	.001*		.001*	.001
	N	40	40	40	40
ANB	Pearson Correlation	-.808**	-.622**	1	.663**
	Sig. (2-tailed)	.001*	.001*		.001*
	N	40	40	40	40
Wits Appraisal	Pearson Correlation	-.652**	-.497**	.663**	1
	Sig. (2-tailed)	.001*	.001	.001*	
	N	40	40	40	40

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**Table 2: Pearson’s correlation for ANB angle, Wits appraisal, Yen angle, and W angle**

Table 3 shows value of R<sup>2</sup> for all four parameters. It can be seen that Yen angle shows best correlation with ANB angle (R<sup>2</sup>-0.653) than either with wits appraisal or W angle.

		R <sup>2</sup>			
		Yen Angle	W Angle	ANB	Wits Appraisal
ANB		0.653	0.387	-	0.440

**Table 3: coefficient of Determination (R<sup>2</sup>) for all four parameters**

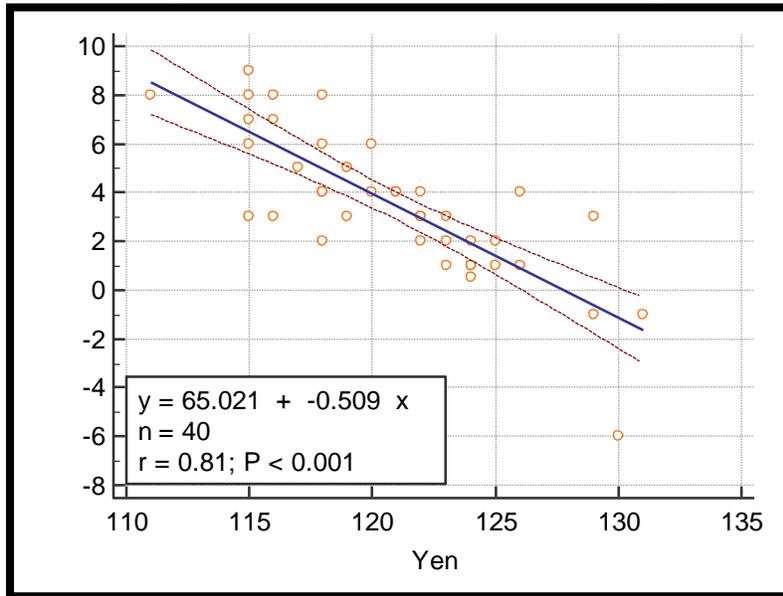
**Discussion**

ANB angle is a widely used sagittal jaw indicator but it have some disadvantages. It was mentioned by Jacobson<sup>3</sup> that ANB angle is affected by the patient’s age, growth rotation of the jaws, vertical growth, and the length of the anterior cranial base (anteroposterior position of N). Besides it is difficult to identify point A in all cephalometric radiographs. Jacobson<sup>3</sup> (1975) in order to overcome the inaccuracies of ANB angle devised ‘Wits’ appraisal where the severity or degree of anteroposterior jaw disharmony can be measured, independent of cranial landmarks, on a lateral cephalometric head film<sup>1</sup>. Though it avoids the use of N and reduces the rotational effects of jaw growth<sup>8,9,10</sup>, it uses the occlusal plane, which is a dental and not a skeletal parameter. A change of the cant of occlusion plane, for instance, with growth can lead to a different wits value. To overcome the demerits of previously discussed parameter Yen angle<sup>6</sup> was developed which is not influenced by growth changes, it can be used in mixed dentition as well. But, rotation of jaws can mask true sagittal dysplasia here also. To overcome this W angle was developed by Bhad et al<sup>7</sup> which author claims it reflects true sagittal dysplasia not affected by growth rotations.

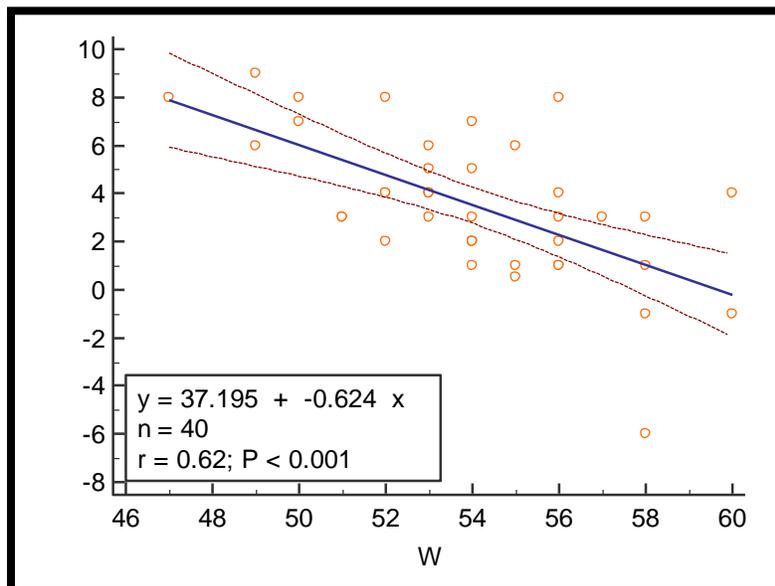
Reference planes changes with different parameters and may at times gives different values for same jaw relationship. ANB and Wits appraisal are routinely used sagittal jaw indicators and Yen angle and W angle are recently introduced in 2009 and 2013<sup>6,7</sup>. The purpose of this study was to assess the reliability and validity of recently used sagittal jaw indicators, the Yen angle and W angle and check correlation with routinely used measures that id ANB angle and Wits appraisal.

It can be seen in Table 1, mean and standard deviation(SD) values of Yen angle in this were found to be  $120.87^\circ \pm 4.71^\circ$  which is similar to the given by Neela et al<sup>6</sup> i.e  $119.79^\circ \pm 3.575$  and that of W angle was found to be  $54.02^\circ \pm 2.96^\circ$ . which is similar to that given by bhad et al<sup>7</sup> i.e.,  $54.5^\circ \pm 4.09$ . the value of mean and SD of Yen angle and W angle in our study was also found out to be similar with the findings of Romina M Kapadia et al<sup>11</sup>.

Table 2 shows the Pearson’s correlation among all four parameters where it can be seen that all show a significant correlation (<0.001) with each other, suggesting that all four parameters can be successfully used in assessing the sagittal jaw discrepancy. The findings found out to be similar with studied done by Mittal et al,<sup>12</sup> Doshi et al,<sup>13</sup> Trivedi et al,<sup>14</sup> and Alam et al.<sup>15</sup> Yen angle and W angle shows highest correlation with ANB angle(r- .808,-.622) and least with Wits appraisal (r- .652, -.497), it is because ANB angle, Yen angle, W angle use common reference “point S” for measurement. Moreover it can be seen from Table 3 and Graph 1 that Yen angle shows best correlation with ANB angle with  $R^2 = 0.653$  than either with wits appraisal or W angle. While W angle shows least correlation with ANB angle with  $R^2 = 0.387$  (Graph 2)



**Graph 1. Scatter Diagram showing Correlation between Yen angle and ANB angle**



**Graph 2. Scatter diagram showing correlation between W angle and ANB angle**

In our study it was found out that overall Yen angle performed well than W angle and that all four parameters shows good correlation with each other, so it can be asserted that Yen angle and W angle can be used as sagittal jaw indicators along with other established parameters.

### Conclusion

1. Statistically significant correlations were found among all the four measures; ANB angle, Wits appraisal, Yen angle, and W angle.
2. Yen angle and W angle show highest correlation with ANB angle and least with wits appraisal.
3. ANB angle shows best correlation with Yen angle than with any other angles.
4. Thus, Yen angle and W angle can be used to assess sagittal jaw discrepancy in addition to the established angles.

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