A NEW SAGITTAL DYSPLASIA INDICATOR: THE YEN ANGLE

Aim: To develop a new cephalometric measurement to evaluate the sagittal relationship between the maxilla and mandible. Material and Methods: Seventy-five pretreatment lateral cephalograms (25 each of Class I, II, and III) were subdivided based on ANB, Wits appraisal, and Beta angle into skeletal Class I, II, and III. The same cephalograms were again classified into skeletal Class I, II, and III based purely on Beta angle. The new measurement is based on the landmarks S, M (midpoint of the anterior maxilla), and G (center at the bottom of the symphysis), which form the YEN angle measured at M. Results: The mean and standard deviation for the YEN angle were calculated in all three skeletal groups. After using one-way analysis of variance (ANOVA) and Newman Keuls test, receiver-operating characteristic curves were obtained for the YEN angle in both types of classifications. The results showed that a patient with a YEN angle from 117 to 123 degrees could be considered to have a Class I skeletal relationship. Conclusions: The YEN angle was developed to assess more reliably the sagittal relationship between both jaws. Subjects with a YEN angle between 117 and 123 degrees have a skeletal Class I pattern. With an angle less than 117 degrees, patients are considered to have a skeletal Class II relationship, and with an angle greater than 123 degrees, patients have a skeletal Class III. World J Orthod 2009;10:147–151.

There are numerous angular and linear measurements to assess the sagittal discrepancy between maxilla and mandible, which is of prime importance in diagnosis and treatment-planning. All these measurements have shortcomings, which Moyers et al. discussed in detail.

In 1948, Downs was the first to evaluate the anteroposterior apical base relationship cephalometrically by measuring the angle formed by AB and NPog. Positive and negative signs were used to denote relative pro-/retrusion of the mandible.

A few years later, Riedel 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 Downs’ and Riedel’s methods are subject to anteroposterior and vertical variations in N. Hence, SNA and SNB do not depict the true anteroposterior position of the maxilla and mandible.

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. According to Jacobson, in a skeletal Class I relationship, in females, AO and BO should coincide, whereas in males, BO should be 1 mm ahead of AO. Though the Wits appraisal avoids N and reduces the rotational effects of jaw growth, it uses the occlusal plane, a dental parameter, to describe a skeletal

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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. The cant of the occlusal plane can be easily affected by tooth eruption and dental development.

Kim and Vietas suggested the anteroposterior dysplasia indicator (APDI), which is a resultant of the facial angle plus or minus the AB and palatal plane angle. According to Freeman, a perpendicular line is dropped from point A to the Frankfort horizontal plane, establishing point AF (or X). A line from point AF to B forms the angle AFB (or AXB). Although AFB may not be affected by the vertical location of A, it may be influenced by a vertical displacement of B. Therefore, the AFB angle does not describe exclusively the anteroposterior relationship of both jaws.

Chang recommended measuring the distance between A and B projected onto the Frankfort horizontal plane. These projected points were labeled AF and BF, respectively, and the respective measurement is AF-BF. However, AF-BF will be affected by the inclination of the Frankfort horizontal plane.

Baik and Ververidou 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.

Because of existing problems, this study aimed to develop a new cephalometric measurement to evaluate the sagittal relationship between the jaws.

THE YEN ANGLE

The YEN angle was developed in the Department of Orthodontics and Dentofacial Orthopaedics, YENPOYA Dental College, Mangalore, Karnataka, India, hence its name. It 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.

Though morphological landmarks seem to be more reliable, constructed points may in some instances better represent the true nature of the underlying skeletal pattern.

When S, M, and G are connected, they form the YEN angle, which is measured at M (Fig 1).

MATERIALS AND METHODS

The study consisted of 75 pretreatment lateral cephalograms of 13- to 25-year-old individuals from the files of the aforementioned institution. These cephalograms were traced, and ANB, Wits appraisal, and Beta angle were measured.

To determine the combined tracing, localization, and measuring error, 20 randomly selected cephalograms were retraced 15 days after they were first evaluated. No significant difference (P > .05) was found between the first and second measurement.

To check whether the ages of the male and female groups were identical, Student’s t test was applied. This test was also used to determine whether there was a difference between the measurements of the male and female subjects.
To be included in the skeletal Class I group, a patient had to have a minimum of two of the three parameters (ANB, Wits appraisal, and Beta angle), indicating a Class I relationship. A skeletal Class I relationship was indicated by an ANB of 2 to 4 degrees, a Wits coincidence of AO and BO in females or BO 1 mm ahead of AO in males, and a Beta angle of 27 to 35 degrees. Twenty-five lateral cephalograms (17 female and eight male) that met the above criteria comprised the skeletal Class I group.

Similarly, for a patient to be classified under skeletal Class II, a minimum of two of the three parameters (ANB, Wits appraisal, and Beta angle) should indicate a skeletal Class II. A skeletal Class II relationship was indicated by an ANB of greater than 4 degrees, a Wits appraisal with AO ahead of BO in females or AO coinciding with or ahead of BO in males, and a Beta angle less than 27 degrees. Again, 25 lateral cephalograms (17 female and eight male) were collected from the screened files that met the above criteria to form the skeletal Class II group.

Respective criteria were used to define the skeletal Class III individuals characterized by an ANB less than 2 degrees, a Wits BO ahead of AO in females or BO ahead of AO by more than 1 mm in males, and a Beta angle greater than 35 degrees. Once more, 25 lateral cephalograms (17 female and eight male) were collected from the screened files. The center of the sella turcica, S, was eyeballed, whereas M, as proposed by Nanda and Merill,14 and G, as proposed by Braun et al,15 were constructed using a template with concentric circles whose diameters increased in 1-mm increments. Each of the two points was identified by a pinhole in the center of the template.

All 75 lateral cephalograms were also classified into skeletal Class I, II, and III on the basis of the only Beta angle. The skeletal Class I group consisted of 32 patients (23 female and nine male), the Class II of 20 patients (13 female and seven male), and the Class III of 23 patients (15 female and eight male).

Method error evaluation

The method error was assessed by measuring the YEN angle twice in all 75 tracings. Dahlberg’s formula, \( ME = \sqrt{\frac{\sum d^2}{2n}} \), was used to calculate the difference (d) between the two measurements \( n = \) the number of double measurements. The error of the method for the YEN angle was determined to be 0.65 degrees.

Statistical analysis

Microsoft Excel (Redmond, Washington, USA) was used to compile the data. Means and standard deviations of the YEN angle in both types of classification were calculated. SPSS 14 (SPSS, Chicago, Illinois, USA) was used for statistical analysis. The one-way analysis of variance (ANOVA) was used, followed by Newman-Keuls post-hoc testing to determine whether there was a significant difference among the mean values of the YEN angle in the three skeletal Angle Classes. A \( P \) value ≤ .05 was considered to be significant.

Receiver operating characteristics (ROC) curves were run to examine the sensitivity and specificity of the YEN angle to discriminate among the three skeletal pattern groups.

RESULTS

Classification based on ANB, Wits appraisal, and Beta angle

The mean value for the YEN angle in the originally selected Class I, II, and III skeletal pattern groups are listed in Table 1.

The ANOVA, as well as the Newman-Keuls post-hoc test, showed that the three groups were different. The unpaired \( t \) test revealed that there were no significant differences in the mean values of the YEN angle between the two sexes except in the skeletal Class III.

Receiver operating characteristics curves showed that a YEN angle less than 118.5 degrees had 92% sensitivity and 80% specificity for discriminating a Class II group from a Class I group. A YEN
angle greater than 123.5 degrees had 92% sensitivity and 96% specificity for discriminating a Class III group from a Class I group.

Classification based on Beta angle

The mean value for the YEN angle in the Class I skeletal pattern group was 120.5 degrees whereas the mean values in the Class II and III skeletal pattern groups were 113.2 degrees and 129.7 degrees, respectively (Table 2).

The ANOVA and the Newman-Keuls post hoc test showed that the three groups were significantly different. The unpaired t test revealed that there was no significant difference in the mean values of the YEN angle between the two sexes except in the skeletal Class III group.

Receiver operating characteristics curves showed that a YEN angle less than 116.5 degrees had 90% sensitivity and 95% specificity for discriminating a Class II group from a Class I group. A Yen angle less than 123.5 degrees had 96% sensitivity and 88% specificity for discriminating a Class III group from a Class I group.

DISCUSSION

ANB is still widely used but does have some demerits. As Jacobson4 noted, it is affected by the patient’s age, growth rotation of the jaws, vertical growth, and the length of the anterior cranial base (antero-posterior position of N). Moreover, point A cannot be identified in all cephalometric radiographs.

Wits appraisal was suggested to overcome the existing fallacies of ANB. Though it avoids the use of N and reduces the rotational effects of jaw growth, it uses the occlusal plane, which is a dental and not a skeletal parameter. A change of the cant of the occlusal plane, for instance, with growth5,7,16 will lead to a different Wits value. The points used to define the functional occlusal plane are close together, making plane identification difficult even under perfect conditions,17 especially in the mixed dentition after shedding of the deciduous molars but before the eruption of the premolars.

Also, the recently introduced Beta angle has certain demerits. It still depends on points A and B, which, according to Holdaway,18 change their site substantially due to both treatment and growth. The difficulty in locating the center of the condyle was already noted.

To overcome some of the deficits of the previously discussed parameters, the YEN angle was developed. It is not influenced by growth changes and can easily be used in the mixed dentition.

When the subjects were classified based on ANB, Wits appraisal, and Beta angle, the cutoff point of the YEN angle between skeletal Class I and II was 118.5 degrees, but it was 116.5 degrees when the subjects were classified on only the basis of the Beta angle. As Beta angle is more reliable than the two other parameters in assessing sagittal jaw relationship, these authors feel that the cutoff point should be taken at 116.5 degrees. As far as the cutoff point between a skeletal Class I and Class III is concerned, a YEN angle of 123.5 degrees is indicated, as both types of classification showed this value.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean (SD) values of the YEN angle in the skeletal Class I, II, and III groups according to the classification based on ANB, Wits appraisal, and Beta angle</th>
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<td>Class I</td>
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<tr>
<td>Female</td>
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SD = standard deviation.

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<tr>
<th>Table 2</th>
<th>Mean (SD) values of the YEN angle in the skeletal Class I, II, and III groups according to the classification based solely on Beta angle</th>
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<tr>
<td></td>
<td>Class I</td>
</tr>
<tr>
<td>Female</td>
<td>120.5</td>
</tr>
<tr>
<td>Male</td>
<td>120.4</td>
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<tr>
<td>Total</td>
<td>120.5 (3.1)</td>
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SD = standard deviation.
When the data was statistically analyzed, it was concluded that a YEN angle between 117 degrees and 123 degrees can be considered a skeletal Class I, a YEN angle less than 117 degrees as a skeletal Class II, and a YEN angle greater than 123 degrees as a skeletal Class III.

CONCLUSIONS

From the study, we drew the following conclusions:

1. A new parameter, the YEN angle, was developed to assess the sagittal jaw relationship between maxilla and mandible.
2. Subjects with a YEN angle between 117 to 123 degrees have a skeletal Class I pattern; an angle less than 117 degrees can be considered a Class II, and an angle greater than 123 degrees indicates a Class III relationship.

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REFERENCES