Assessment and predictability of ANB angle

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ABSTRACT: This cephalometric study consisting of thirty three orthodontic patients in the age group of 13 to 15 years was carried out to: 1. Evaluate the relationship between angle ANB and horizontal distance between jaws at the level of point A ($r = 0.99$); 2. Evaluate the relationship between angle ANB and Wits appraisal ($r = 0.95$ when mandibular plane angle is within normal limits of $32.5^\circ$); 3. Predict angle ANB from Wits appraisal and vice versa (which was 97 percent correct in mesofacial type and obtained by the regression equation: angle ANB = $2.31 + 1.00 \times$ Wits value); and 4. Evaluate the validity of angle ANB compared to other methods (angle ANB 78.5 percent in agreement with the standard followed by Wits 64.28 percent).


MeSH words: cephalometry
Key words: assessment, Angle ANB, predictability, Wits

INTRODUCTION
One of the most popular methods to assess the anteroposterior (sagittal) relations of the craniofacial complex has been the angle ANB method (Reidel 1952). This method was considered the best during the early fifties. Lately, it has been criticised for deficiencies of information. Jacobson (1975, 1976), Panagiotidis and Witt (1976), Ferrazzini (1976), Beatty (1975) and Taylor (1969) have pointed out the geometric problems which angle ANB method faces in assessment of craniofacial complex. They have developed methods which in their opinion are better than angle ANB.

This study was an attempt to assess angle ANB by:
1. Establishing the relationship between angle ANB and the circumference of the circle having its center at Nasion and radius NA distance.
2. Evaluating the relationship between angle ANB and horizontal distance between jaws at the level of point A.
3. Finding the relationship between angle ANB and Wits appraisal and to evaluate the modifying effects, if any, of mandibular plane angle on this relationship.
4. Predicting angle ANB from Wits appraisal and vice versa.
5. To compare the existing methods, Steiner angle ANB (Steiner 1953) individualised angle ANB (Panagiotidis and Witt 1976) and Wits Appraisal (Jacobson 1975, 1976) with a standard to obtain the diagnostic validity of these methods.

MATERIALS AND METHODS
The material of the present study comprised lateral cephalograms taken, using standardised procedure, of thirty three subjects between the ages of 13 to 15 years. The cephalograms were drawn from the patient files at the Orthodontic Clinic, Department of Preventive Dentistry, University of Sydney.

Method: Tracing method and definition of cephalometric landmarks were according to Broadbent et al. (1975) and Krogman and Sassouni (1957). The measurements recorded on each film were as follows:

ANB: The angle formed by the intersection of lines joining points A and B to Nasion.

AD: On cephalometric tracing of each case, a line was drawn connecting point Nasion and point B. Then a line perpendicular to NB line passing through point A was drawn, where this line intersected NB plane that point was marked point D. The horizontal distance between point A...
and D at the level of point A was measured. This distance was identified as AD (Figure 1).

NA: The linear distance between Nasion and point A in subjects having mandibular plane angle of 32±5. This was needed to establish a mean as it formed the radius of a circle of which angle ANB is a part of.

Wits appraisal : This distance between point AO and BO - which are the points of contact of perpendiculars drawn, from points A and B onto the occlusal plane. Mandibular Plane Angle : The angle formed by the intersection of mandibular plane with sella-nasion plane.

Correlation of the measurements ANB and AD were studied.

Wits appraisal and corresponding angle ANB measurement were divided into two separate groups using the norm 32±5 for mandibular plane angle. 19 cases were within this range and 14 cases were outside this range, both above and below.

Sixteen out of the thirty three cases comprising of Angle Class I and II who had study models in addition to cephalograms, were used by five orthodontists to judge the skeletal classification and establish the standard after seeing the models in centric occlusion and cephalograms in a limited time on separate days.

A particular case was given that diagnostic dento-skeletal classification either 1 or 2 which the majority sponsored.

The existing diagnostic methods used for comparison were:
1. Angle ANB : Steiner norm 2±2 degree was used.
2. Wits appraisal : Separate norms for male and female were used as derived by Jacobson. Female : Om±2mm Male : -1mm±2mm
3. Individualised ANB method : The regression equation used in classifying a particular case was individualised ANB = -35.16 + 0.4 (SNA) + 0.2 (MP-SN), as derived by Panagiotidis and Witt (1976).

Error Analysis: Nineteen of the radiographs used in the study were retracted three weeks later – ANB, Wits, AD, NA, MD PI angle, and SNA were all remeasured – and ‘t’ test applied to the differences between first and second measurements. The test of significance (p=0.05) was negative for all measurements.

RESULTS
The operator error tests in the tracing and measurement methods were statistically non-significant.

Table 1.
<table>
<thead>
<tr>
<th>NA distance in subjects having mandibular plane angle within normal limits of 32 ± 5 in the age group of 13-15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Error</td>
</tr>
</tbody>
</table>

Circumference of circle = \(2\pi r\)

of radius NA = \(r\)

= \(2 \times 3.14 \times 57.7\)mm

= 362.4mm

1 degree opening of the circle at distance of 57.7mm

= \(362.4 \div 360\)

= 1.00mm

Table 2

<table>
<thead>
<tr>
<th>Correlation between Angle ANB and Horizontal AD distance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size (N)</td>
</tr>
<tr>
<td>Coefficient of correlation (r)</td>
</tr>
<tr>
<td>Constant (a)</td>
</tr>
<tr>
<td>Regression coefficient (b)</td>
</tr>
</tbody>
</table>

\(t=5.60, df=31, p<0.001\) level

Figure 2. Regression line showing the scatter between two variables angle/ANB and AD measurement for the whole sample of 33 patients.
The mean, standard deviation, standard error were calculated for NA distance which is given in Table 1.

The correlation between horizontal relation of the jaws, AD, and angle ANB was \( r = 0.99 \) at \( p < 0.001 \) level (Figure 2, Table 2).

It was found that there is a correlation of \( r = 0.95 \) at \( p < 0.001 \) level between angle ANB and Wits appraisal when the mandibular plane angle is within normal limits. Table 3, Figure 3.

In the same group, it was found that Angle Class I cases, ANB angle 0 to 4 degrees corresponded with Wits appraisal ± 2mm. Readings of Wits appraisal above 2mm to 6mm corresponded with angle ANB readings of 4-5 to 8-5 degrees for Angle Class II. Values of Wits less than -4mm to -9mm corresponded with angle ANB -1-00 to -4-5 degrees for Class III cases.

There is low correlation between the two (angle ANB and Wits appraisal) variables \( r=0.35 \) which is not significant when mandibular plane angle is not within normal limits, Table 4.

Disagreement in the assignment of the Angle class in two cases (out of 16 cases) by the judging orthodontist led to their deletion. Angle ANB was in agreement with the orthodontists in 78-5 percent of the cases. This was followed by Wits appraisal 64-28 percent. The least reliable was individualised ANB which had a score of 42-6 percent, Table 5.

**DISCUSSION**

As is evident, the mean for NA measurement is 57-7mm. If a circle is drawn with a radius equal to 57-7mm. It will have a circumference of 362mm. This would mean that one degree opening equals to 1mm (see Table 1). This together with a correlation of \( r = 0.99 \) between angle ANB and AD horizontal measurement between jaws indicates that angle ANB provides a good measure of the antero-posterior relationship of jaws. This justifies its utilisation as a craniofacial indicator in Switzerland for invalid insurance schemes (Ferazzini 1976), in universal treatment priority index (Kowalski and Prahl-Anderson 1976), in differentiating between normal and Class II occlusion (Harris et al. 1972), and use in most modern cephalometric analyses (Binder 1979). Measuring AD distance could be an alternative method of evaluating angle ANB.

In our study, we found that a definite correlation exist between these two methods (angle ANB and Wits appraisal) in mesognathic subjects where the mandibular plane is within normal limits. This is also evident clinically in patients as the Wits appraisal and angle ANB coincide with each other with regards to Angle classes fairly well.

Using the regression equation from the present study (Table 3). Angle ANB = 2.31 + 1.00 x Wits value, one can calculate the value of the angle ANB from Wits appraisal.
ANB predictability — Chandra & Godfrey

Table 5
Cases not in agreement with standard, cases in agreement with standard and validity of individual methods.

<table>
<thead>
<tr>
<th></th>
<th>ANB Method</th>
<th>Wits Appraisal</th>
<th>Individualised ANB</th>
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</thead>
<tbody>
<tr>
<td>Total number of cases</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cases where the orthodontists were in agreement in regards to Angle Class designated to each case</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of cases which had to be deleted because of no agreement</td>
<td>2</td>
<td></td>
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</tr>
</tbody>
</table>

| Cases not in agreement with standard | 3 | 5 | 8 |
| Cases in agreement with standard    | 11 | 6 | |
| Method in agreement with 'subjective' observations of orthodontists group in percentage of cases | 78.5 | 64.28 | 42.8 |
| Method not in agreement with 'subjective' observation of orthodontists group in percentage of cases | 21.5 | 35.72 | 57.20 |

appraisal provided the mandibular plane angle is within normal limits. The coefficient of determination is 0.90. Therefore, using this equation, predicting angle ANB from Wits value is 90 percent correct and has a possible 10 percent error.

This correlation ceases to exist when the mandibular plane angle is not within normal limits in subjects of dolicho- and brachyfacial types.

This study, therefore, does not agree with Rotberg and associated (Rotberg, Fried, Kane and Shapiro, 1980) who found no strong or predictable correlation between Wits appraisal and Angle ANB. It seems that they did not evaluate sufficiently the factors which may affect angle ANB.

Jacobson (1975, 1976) claim that it is a better method than angle ANB in evaluation of apical base discrepancy is not substantiated in this study. Angle ANB method was in agreement with the orthodontists in 78.5 percent of cases, compared to Wits appraisal 64.28 percent. The occlusal plane is used as its base line in the Wits appraisal. The assumption that this appraisal was closer to the area of dental and skeletal base relation and prone to less variation when compared to angle ANB should be viewed with caution. The occlusal plane is equally affected in a case of malocclusion caused by various systemic and local etiological factors (for example oral habits, neuro muscular disorder (Graber 1972)), tooth eruption/dental development (Hussels and Nanda, 1984), or rotation during treatment and growth (Hussels and Nanda, 1984). It is a dental parameter and it could be influenced independently of skeletal changes, thereby affecting the appraisal (Hussels and Nanda, 1984), just as angle ANB is by movement of Nasion or rotation of upper and lower jaw with growth and treatment (Jacobson 1975 and 1976).

In regard to the individualised ANB method which was the least reliable in this study (42.8 percent), it is felt that the regression equation derived by Pangiotidis and Witt is only applicable in conditions where mandibular plane angle is constant at 32±5 (SNA is reliable). Should the mandibular plane angle exceed the limit of 32±5 in either direction, SNA becomes unreliable according to Jacobson (1975, 1976) making individualised angle ANB also unreliable. No example of mandibular plane angle above or below 32±5 is given by Panagiotidis and Witt (1976). They claim agreement between model analysis based on molar relation and individualised angle ANB of 83.5 percent. This is in sharp contrast to views of other researchers who claim that model analysis by itself is not at all accurate and is very misleading (Ackerman and Proffit, 1969, Brader 1965, Bjork 1947, Eastwood, 1978, Graber, 1972, Woodside, 1984). All this makes the authenticity of individualised angle ANB very doubtful.

In 21.5 percent of the cases, diagnosis using angle ANB did not match the subjective observation of orthodontic group. This finding exemplifies that no method is absolutely valid. Every method of diagnosis has some drawback, the extent of which varies.

CONCLUSIONS
The following conclusions were obtained from this study: 1. Angle ANB method is a good measure and in agreement with Clinicians' assessment of study models with general perusal of lateral cephalometric x-rays for

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anterio-posterior relation of the jaw justifying its multiple role.

2. An alternative method of evaluating angle ANB could be measuring the horizontal distance between jaws at the level of point A, using line NB.

3. A strong correlation was established between angle ANB and Wits appraisal. These variables also had a good clinical correlation among themselves with respect to Angle classes in mesofacial types.

4. The correlation ceases to exist in dolicho and brachyfacial types.

5. Using regression equation: Angle ANB \( = 2.31 + 1.90 \times \) Wits value one can calculate the value of angle ANB and this had a predictability of 90 percent.

6. Angle ANB was the most valid followed by Wits appraisal. The least valid being individualised ANB.

7. In addition, it also exemplifies that no method is absolutely valid.

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