Introduction and Review of Literature

Since the inception of cephalometric radiographs following introduction of the clinical use of craniostat by Broadbent,1 many analyses have been produced to assist orthodontic clinicians and research workers. Such analyses include those of Bjork,2 Wylie,3 Down,4 Ballard,5 Riedel,6 Steiner,7,8 Ricketts9 and Tweed.10,11 All of these analyses had been produced to assess skeletal and dental and soft tissue pattern. One of the most widely used and the simplest method to determine anteroposterior relationship of maxilla and mandible was ANB angle. It had been suggested by Riedel6 and used by Steiner.7,8 The interpretation of this angle was influenced by three factors: the anteroposterior position of point nasion, sella-nasion line, and the rotational effect of the jaws. To eliminate the influence of these factors, another diagnostic aid has been suggested by Jacobson12 in 1975. It was called wits appraisal (due to the University of the Witwatersrand, South Africa).

The method entails drawing perpendiculars from points A and B on the maxilla and the mandible, respectively to the occlusal plane. The occlusal plane was defined as the line drawn through the overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars (Fig. 1). Jacobson used a sample of twenty-five adult females selected on the same basis, points AO and BO generally coincided. The calculated mean reading was -0.10 mm with standard deviation 1.77 (range, -4.5 to 1.5 mm). He also found in skeletal class II jaw dysplasia, point BO would be located behind point AO (a positive reading) whereas in skeletal class III jaw disharmonies, the wits reading would be negative, namely, point BO being forward of point AO.

This study was conducted on 60 cephalometric radiographs of Saudi dental students (30 males, 30 females), aged from 22-23 years, to establish wits appraisal and to compare the results of the present study with similar studies conducted on other racial groups. All subjects were selected according to the following criteria: class I molar and incisor relationship with pleasant profile, absence of obvious craniofacial deformities, and no evidence of previous orthodontic treatment. The wits appraisal of the Saudi sample was found to be 0.82 mm ± 2.2, for males and 0.41 mm ± 2.3 for females. Comparison with other reported studies were discussed.

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The wits appraisal in a Saudi population sample

Fig. 1. Points AO and BO are the points of contact of perpendiculars dropped from points A and B, onto occlusal plane.

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Since that time, numerous studies have been conducted to establish the wits value on different races. Robertson and Pearson\textsuperscript{13} in a cephalometric study of 50 children (25 males, 25 females) of South Wales population, found the wits value of 0.1 mm $\pm$ 1.9 and 0.3 mm $\pm$ 1.7 for males and females, respectively which were similar to those values reported by Jacobson.\textsuperscript{12} Connor and Moshiri\textsuperscript{14} established the norms of 50 Black North American adults (25 males, 25 females) aged 18-50 years. They found the wits value was -0.31 mm $\pm$ 3.05 for females and 0.59 mm $\pm$ 3.84 for males. So et al.\textsuperscript{15} conducted a cephalometric study on 101 Southern Chinese (55 males, 46 females). They reported that the wits appraisal value was -4.88 mm $\pm$ 3.61 mm in males and -4.47 mm $\pm$ 4.19 in females.

The aim of this study was to establish the wits appraisal in a selected sample of Saudi males and females, and to compare the results with those reported by Jacobson and also with studies carried out in other different races.

**Materials and Methods**

The study was carried out on standardized cephalometric radiographs of a selected sample of 60 Saudi dental students (30 males, 30 females) at the College of Dentistry, King Saud University. The age range was from 22-23 years.

The sample was chosen on the basis of:
1. a class I molar and incisor relationship with pleasant profile from clinical examination
2. no obvious craniofacial deformities
3. presence of premolars in order to detect accurate functional occlusional plane
4. none of the subjects had received orthodontic treatment.

All of the lateral skull radiographs had been taken in a routine manner, with ear-rods placed in the external auditory meatus to stabilize the head. The head was adjusted so that the Frankfort plane was horizontal. Distance between the cone and mid-sagittal plane was set at 150 centimeters, giving magnification factor of 11 percent. The radiographs were traced by the author, using a sharp 3H pencil on acetate tracing paper. This was performed in a darkened room. The following landmarks: subspinale (A), supramentale (B) and occlusal plane (used by Jacobson)\textsuperscript{16} were identified and recorded.

AO and BO lines, which were defined as perpendicular lines from A point and B point to occlusal plane, were drawn. The linear distance between AO and BO was measured in millimetres and corrected for magnification and is presented as true values for comparison with other races. A total of 10 out of 60 radiographs were randomly selected and retraced with one-week interval to determine the error of the method. The Dahlberg's\textsuperscript{16} formula was used to calculate the method error.

Descriptive statistics (mean, standard deviation, range) were calculated from the observed values for each measurement. Finally, the values of both sexes were compared to each other and also compared with other studies. The t-test was used to determine the significance at the 0.05, 0.01, 0.001 and 0.0001 levels.

**Results**

The error method (using Dahlberg's\textsuperscript{16} formula) was recorded to be 0.74 mm and that was mainly created by the occlusal plane identification.

Table 1 displays the mean, standard deviation and the range of wits appraisal readings attained for the Saudi males and females, which were 0.82 mm 2.2 and 0.41 mm 2.3 respectively. The mean wits measurements were not statistically significant different between gender (p > 0.05).

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. Sex</th>
<th>Mean (mm)</th>
<th>S.D.</th>
<th>Range</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wits</td>
<td>30 Males</td>
<td>0.82</td>
<td>2.2</td>
<td>-3.5 to -6.2</td>
<td>0.567 N.S.</td>
</tr>
<tr>
<td>value</td>
<td>30 Females</td>
<td>0.41</td>
<td>2.3</td>
<td>-4.4 to -4.4</td>
<td>N.S. - not significant, p &lt; 0.05</td>
</tr>
</tbody>
</table>

Table 2. Comparison of wits values between Saudi males and other races.

<table>
<thead>
<tr>
<th>Ethnic groups</th>
<th>No.</th>
<th>Age (Years)</th>
<th>Mean (mm)</th>
<th>S.D.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi students</td>
<td>30</td>
<td>22-23</td>
<td>0.8</td>
<td>2.2</td>
<td>-</td>
</tr>
<tr>
<td>Jacobson</td>
<td>21</td>
<td>Adult</td>
<td>-1.2</td>
<td>1.9</td>
<td>0.001***</td>
</tr>
<tr>
<td>Black Americans</td>
<td>25</td>
<td>18-50</td>
<td>0.5</td>
<td>3.84</td>
<td>0.573 N.S.</td>
</tr>
<tr>
<td>Chinese</td>
<td>55</td>
<td>10-15</td>
<td>-4.88</td>
<td>3.61</td>
<td>0.0001****</td>
</tr>
<tr>
<td>British Caucasians</td>
<td>9</td>
<td>19</td>
<td>-2.9</td>
<td>3.5</td>
<td>0.0001****</td>
</tr>
</tbody>
</table>

N.S. - not significant, p < 0.001***, p < 0.0001****

### Table 2

Comparison of wits values between Saudi males and other races.

<table>
<thead>
<tr>
<th>Ethnic groups</th>
<th>No.</th>
<th>Age (Years)</th>
<th>Mean Mm</th>
<th>S.D.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Students</td>
<td>30</td>
<td>22-23</td>
<td>0.4</td>
<td>2.3</td>
<td>-</td>
</tr>
<tr>
<td>Jacobson</td>
<td>25</td>
<td>Adult</td>
<td>-0.1</td>
<td>1.7</td>
<td>0.265 N.S.</td>
</tr>
<tr>
<td>Black Americans</td>
<td>25</td>
<td>18-50</td>
<td>-0.3</td>
<td>3.05</td>
<td>0.122 N.S.</td>
</tr>
<tr>
<td>Chinese</td>
<td>46</td>
<td>10-15</td>
<td>-4.4</td>
<td>4.1</td>
<td>0.0001****</td>
</tr>
<tr>
<td>British Caucasians</td>
<td>10</td>
<td>19</td>
<td>-2.5</td>
<td>3.2</td>
<td>0.0001****</td>
</tr>
</tbody>
</table>

N.S. - not significant, p < 0.0001****

Table 2 demonstrates a high significant difference between the wits mean values of the Saudi males and the other mean values established by Jacobson (p < 0.001); Chinese (p < 0.0001) and British Caucasian (p < 0.0001). No significant difference was observed between the Saudi males and the Black American males (p > 0.05).

Table 3 shows no significant difference when comparing the wits value of the Saudi females and other reported values; except in Chinese (p < 0.0001) and British Caucasian (p < 0.0001).

### Discussion

The most commonly used measurement for jaw dysplasia is ANB angle. It is based on cranial reference plane involving other factors resulting in a satisfactory interpretation which sometimes was not obtained. These factors are the:

1. anteroposterior position of point nasion relative to the jaws;
2. rotational effect of the jaw relative to the cranial plane;
3. and therotational effect of the sella nasion line relative to the jaws.

Another measurement which provides the anteroposterior skeletal disharmony of the jaw is wits appraisal. The reference plane used is neither cranial nor extra cranial plane, but it is a common plane to both dentures, namely the occlusal plane. In earlier published studies, the occlusal plane was defined as the functional occlusal plane of the masticatory area. Jacobson used the term occlusal plane with the same definition as in earlier studies. This plane was noted to be concave in many subjects. That observation led Jacobson to recommend that the most suitable and convenient method of standardizing the plane of occlusion was to join the midpoint of overlap of the mesiobuccal cusps of the first molars and the buccal cusps of the first premolars.

The wits appraisal for the Saudi males and females in the present study were 0.82 mm ± 2.2 and 0.41 mm ± 2.3, respectively. However, there were no sex differences between both sexes although the males exhibited a greater value than the females. This finding does not support the existence of 1 mm discrepancy between the two sexes as reported by Jacobson.

The mean value of wits appraisal in the Saudi males was significantly greater than that of Jacobson, Chinese, and British Caucasian values. This may be due to the fact that the Saudi male has a protrusive maxilla which is one of the factors which contributed towards midfacial prominence (class II malocclusion tendency) compared to the other races (e.g. Chinese) who have a tendency to class III malocclusion. Further, the comparison between the Saudi and the Black American showed no significant differences and this may be attributed to the fact that the Black American also has a protrusive maxilla. Furthermore, although the mean value of the wits appraisal in Saudi females was greater than other races, no significant differences were observed when compared to that reported by Jacobson and Connor and Moshiri in Black Americans. However, significant difference was noticed when compared to the Chinese and British Caucasian (p < 0.0001). The wits appraisal is a linear measurement, which can be used as an adjunctive diagnostic aid in assessing the anteroposterior skeletal dysplasia, and not as a single diagnostic criterion. Its advantage is that, it overcomes the shortcoming of cranial references planes. Moreover, as pointed out by Jacobson, no single parameter in cephalometric should be relied upon as the sole absolute value.

### Conclusion

1. The wits appraisal for the Saudi sample was 0.82 mm ± 2.2 and 0.41 mm ± 2.3 for males and females, respectively.

2. No significant differences were observed between both sexes and also when compared to the data reported on Black Americans, whereas, significant difference was found with Chinese and British Caucasian data.

3. Significant difference was noted between
Jacobson's result and the Saudi males whereas no significant difference was revealed with the Saudi females.

References

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