

# Correlation of Wits appraisal and ANB angle to assess jaw relationship

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## Abstract

**Introduction:** The relationship of Maxillary base and Mandibular base is vital while planning an orthodontic case. While assessing the anteroposterior discrepancy the frequently used angle is ANB from the Steiner's analysis. Wits appraisal is used in conjunctions to see the agreement with the ANB angle. The purpose of this study was to determine whether there is any correlation between the ANB angle and the Wits appraisal among the three skeletal sagittal jaw relationships in our local population of Peshawar.

**Material and methods:** This cross-sectional study was conducted at the Department of Orthodontics on patients between 12-30 years of age were included in the study. Lateral cephalograms of 153 patients were obtained and the ANB angle of the Steiner's analysis and the Wits appraisal were measured. Data were analyzed using SPSS 20. Pearson correlation test was applied and p value of less than 0.05 was considered significant.

**Results:** There were 67 male (43.8 %) and 86 female patients (56.2 %). Mean age was 16.4 years  $\pm$ 3.3. Correlation analysis showed a moderate and weak correlation between the ANB angle & the Wits appraisal for skeletal class II ( $r=0.55$ ) and class III (0.40), respectively. No correlation exists between the two measurements for a class I skeletal relationship ( $p>.05$ ). The overall correlation between the two measurements is moderate.

**Conclusions:** The ANB angle & the Wits appraisal cannot substitute each other when assessing skeletal sagittal jaw relationships.

**Keywords:** Cephalometric; sagittal dimension; sagittal jaw discrepancy; Steiner analysis

## Introduction

Knowing the sagittal relationship between the maxillary base and the mandibular base is important in the diagnosis of a malocclusion and efficient case planning.<sup>1</sup>

Previously, the sagittal relationship of the jaws was assessed clinically by seating the

patient with their head in the Natural Head Position, and then observing the patient from the lateral view. The anterior contours of the basal part of the maxilla and mandible were palpated, with the teeth in centric occlusion.<sup>2</sup> However, this method had many limitations, and orthodontists were in search of a more reliable and reproducible method for accurately determining the sagittal relationship of the skeletal bases.

The diagnosis of a sagittal discrepancy was made easy and reproducible by the addition of angular and linear measurements into different cephalometric analysis.<sup>3,4</sup> The most commonly used parameters for assessment of anteroposterior jaw relationship are the

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Steiner analysis, using the ANB angle from Steiner's Analysis and the Wits appraisal.<sup>5</sup> However, the ANB angle may not always offer precise data regarding the sagittal dimension, as its reliability is reliant on the many factors, some of which are; the size of the cranial base; the vertical and anteroposterior location of subnasale and nasion; the vertical position of sella and nasion.<sup>6</sup>

Wits Analysis was introduced by Jacobson with the intent to overcome the issues related with the ANB angle. It can be used as a diagnostic aid to find out the severity and the degree of sagittal disharmony between the jaws.<sup>7</sup> However, this method also has its limitations. The shortcoming of the Wits appraisal is that the Functional occlusal plane is influenced by the dental development of teeth and later by the biomechanics during orthodontic treatment. Moreover, correctly marking the occlusal plane is not a simple task in patients with skeletal asymmetries, canted occlusion, missing teeth, open bite, multiple impacted or, deep curve of Spee.<sup>8</sup> Incorrect tracing of the occlusal plane will lead to inaccuracies in the Wits appraisal.

Jaw discrepancy is a common problem encountered by orthodontists, and needs a proper cephalometric evaluation whenever presented. The purpose of this study was to determine whether there is any correlation between the ANB angle and the Wits appraisal among the three skeletal sagittal jaw relationships in our local population of Peshawar, as no widespread studies have been done in this region.

## Material and Methods

This cross-sectional study was carried out at the Department of Orthodontics and Dentofacial Orthopedics from October 2019 to June 2020, with ethical approval taken from the ethical committee of..... in 2019 (No. 105/ADR/). Before enrollment into the research, informed written consent was obtained from all the participants.

A total of 153 patients, with the age range of 12 to 30 years, were included in the study by systematic sampling technique.

Patient undergoing orthodontic treatment at the hospital were included in the study. Patients with craniofacial defects/syndromes, those with a history of trauma, those who had undergone jaw surgeries and those who had previous orthodontic or orthopedic treatment were excluded.

The lateral cephalogram of each patient was obtained by a single operator with k 8000 C-Kodak machine model, using a film size of 10 x 14. These lateral cephalograms were manually traced and measurements were taken.

The measurement of the ANB angle was done with a protractor and was defined as the difference between the SNA (Sella-Nasion-Point A) angle and the SNB (Sella-Nasion-Point B) angle.

Wits appraisal was measured as AO-BO difference by drawing perpendicular lines from Point A on the maxilla and Point B on the mandible onto the functional occlusal plane. The functional occlusal plane was drawn where premolars and first molars cusps overlapped.<sup>2</sup> AO was taken as the point of contact of Point A on the occlusal plane; and BO was taken as the point of contact of Point B on the occlusal plane.

The classification of the skeletal jaw relationship based on the Wits appraisal was distributed as following:

- Skeletal class I jaw relationship: values of -1mm for men and 0 mm for women; included 10 patients.
- Skeletal class II jaw relationship: value greater than -1mm for men and values greater than 0 mm for women; included 101 patients.
- Skeletal class III jaw relationship: values of less than -1mm for men and less than 0mm for women; included 36 patients.

According to the ANB angle, the classification of the patients in different classes would be as follows:

Class I Skeletal base: ANB angle between  $1^{\circ}$  to  $4^{\circ}$ ; included 17.6 % of the patients.

Class II Skeletal base: ANB angle of  $5^{\circ}$  or greater; included 62.7% of the patients.

Class III Skeletal base: ANB angle of  $0^{\circ}$  or less; included 30% of the patients.

A comparison between the ANB angle and the Wits appraisal was then made. All the measurements were repeated after a 2 weeks interval with mean value being considered as the final value.

Data were analyzed by standard statistical formula using Statistical Package for the Social Sciences version 20. Continuous variables were found by Mean  $\pm$  Standard deviation, and qualitative variables were measured by percentage and frequency. To analyze the mean difference of the two measurements between the three skeletal classes, ANOVA test was applied. Pearson correlation test was applied to analyze the correlation between two measurements and p value of less than 0.05 was considered significant. To analyze the mean difference of the two measurements between the two sexes, independent sample t test was applied.

## Results

In this study, 44% of the participants were male, and the remaining 56% were female, leading to a male to female ratio of 1:1.28. Age of the patients was ranging from 12 to 30 years, mean age being 16.4 years. Male patients mean age was 15.8 years, whilst female being 16.9 years. Most of the patients were above 15 years of age (51%).

Measurements of Wits appraisal was widespread, the minimum value being -7 mm, and a maximum being 10 mm. The mean value for Wits Appraisal was  $2.0 \text{ mm} \pm 3.5$ . The mean value for males was  $2.39 \text{ mm} \pm 4.2$ . The mean value for females was  $1.69 \text{ mm} \pm 3.8$  (Table I).

Overall mean ANB angle was  $4.4 \pm 5.0$  degrees, and ranged from the lowest being  $-6^{\circ}$  to and highest being  $12^{\circ}$ . The male patient had a mean value of  $4.0^{\circ} \pm 5.5$ , and female patients had  $4.7^{\circ} \pm 4.7$  (Table II).

To analyze the mean difference of the two measurements between the two sexes, independent sample t test was applied. According to the result, gender wise, mean difference of both measurements was not statistically significant, with a p value greater than 0.05.

The participants were divided into two age groups; from 12 to 20 years and from 21 to 30 years. According to the independent-samples t test, the mean difference of both measurements among the two age groups were not statistically significant.

To analyze the mean difference of the two measurements between different skeletal classes of patients, ANOVA test was applied. According to the test the mean difference of both the measurements among different groups was highly statistically significant.

To analyze the correlation between the two measurements, Pearson correlation test was applied. For Skeletal Class I, the correlation between the two measurements was negligible and insignificant ( $r=0.09$ ,  $p=0.63$ ). For Skeletal Class II, a statistically significant but moderate positive correlation was seen between the two measurements ( $r=0.55$ ,  $p<.001$ ). For Skeletal Class III, a statistically significant but weak positive correlation was seen between the two measurements ( $r=0.4$ ,  $p=0.02$ ). The overall correlation of the two measurements, irrespective of the three groups, was statistically significant, but moderate positive ( $r=0.64$ ,  $p <.001$ ). (Table III)

**Table I. Measurements of the Wits appraisal in relation to gender.**

Gender	Participants		Values of the Wits Appraisal			
	Number	Percentage (%)	Minimum (mm)	Maximum (mm)	Mean (mm)	Standard Deviation
Male	67	43.8	-7.00	10.00	2.39	4.24
Female	86	56.2	-4.00	9.00	1.69	3.82
Total	153	100	-7.00	10.00	2.08	3.52

**Table II. Measurements of the ANB angle in relation to gender.**

Gender	Participants		Values of the ANB Angle			
	Number	Percentage (%)	Minimum (mm)	Maximum (mm)	Mean (mm)	Standard Deviation
Male	67	43.8	-8	12	4.01	5.49
Female	86	56.2	-6	11	4.76	4.71
Total	153	100	-8	12	4.43	5.06

**Table III. Correlation analysis between ANB angle & Wits analysis in different Skeletal Classes**

Skeletal Class	No. of Patients	Pearson Co-efficient	P Value
Class I	27	0.09	0.63
Class II	96	0.55	<0.001*
Class III	30	0.40	0.02*
All Classes	153	0.64	<0.001*

\* P value is significant at the 0.05 level

## Discussion

Sagittal jaw discrepancy is a commonly presenting orthodontic problem. So far, a lot of research work has been carried out and there have been many proposals on as to how to determine this relationship. The most common methods used to assist in diagnosing sagittal jaw discrepancies remain the ANB angle and the Wits appraisal. Wits appraisal is not affected by age in individuals with normal occlusion, though opposing reports exist.<sup>9,10</sup> Distance from the landmark point A to the landmark point B and the occlusal plane inclination affects the calculation of sagittal jaw positions using the Wits appraisal.<sup>11,12</sup>

This research was aimed at finding out if both measurements give similar results and if any correlation between the Wits value and the ANB angle exists when assessing the sagittal jaw positions of the patients.

Most patients included in our study had a Class II type sagittal jaw discrepancy which was in agreement with other studies.<sup>13-15</sup>

Our analysis showed that a statistically significant positive correlation exists between the ANB angle & the Wits value for skeletal class II and class III. But the correlation is moderate for class II and weak for class III.

Similar to our study, Jan et al., from Rawalpindi, found a moderate positive correlation between the ANB angle and the Wits appraisal for all three skeletal bases, with  $r=0.469$  and  $p=0.00$ . They concluded that clinically, the two measurements are interchangeable.<sup>16</sup>

Duran et al. found that an inconsistency between the ANB angle and the Wits appraisal is observed with a posterior rotation

of the mandible ( $p<.05$ ) and with changes in the inclination of the occlusal plane to the SN plane ( $p<.05$ ).<sup>17</sup>

Overall reported mean age of patients in our study was lower than that reported by Asad et al. (18.4 years), and slightly higher than that reported by Jabbar et al. (15.8 year).<sup>8,12</sup> Both the ANB angle & the Wits appraisal showed no significant relationships among different age groups and genders. These findings were supported by Asad et al. and Chandra PK et al.<sup>12,18</sup>

There can be many other important factors which were not mentioned in this study; therefore, further research is needed. For instance, in a few studies, it has been shown that the anterior facial height is the most influential parameter in ANB measurements. Geometric effects cause the occlusal plane angle to change the ANB and Wits assessments.

Further studies have been carried out to overcome the limitations of these two methods, and to discover other parameters related to sagittal assessment. But till now, the most accurate parameters to assess sagittal jaw discrepancies are the ANB angle and the Wits appraisal.<sup>8,19</sup>

## Conclusions

1. Class II sagittal jaw discrepancy is more common among the three skeletal classes.
2. There is no correlation between the ANB angle & the Wits appraisal for skeletal class I jaw relationship, suggesting that the ANB angle & the Wits appraisal are not interchangeable measurements when assessing class I sagittal jaw relationships.
3. There is moderate correlation between the ANB angle & the Wits appraisal for skeletal class II jaw relationship, suggesting that both the ANB angle & the Wits appraisal are not interchangeable measurements to assess class II sagittal jaw relationships.
4. There is low correlation between the ANB angle & the Wits appraisal for skeletal class III jaw relationship, suggesting that both

the ANB angle & the Wits appraisal are not interchangeable measurements to assess class III sagittal jaw relationships.

5. The overall correlation between the ANB angle and the Wits appraisal is moderate, suggesting that the two measurements are not interchangeable to assess the sagittal jaw relationship.

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