Comparison of ANB, Wits, β, and μ angle in differentiating antero-posterior discrepancies

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Abstract

Aim: anterio-posterior discrepancies and differentiating the involved problems make a major part of our diagnosis and treatment. The main goal of this study was to compare the

Materials and methods: In this cross sectional study, 105 pre-treatment lateral cephalograms (42 males and 63 females; 12±3 years old) The cephalograms were classified according to Angle classification. In all cephalograms, the ANB angel, Wits analysis, β angel, μ angel, Jaraback index and Bjork angels were measured.

Results: The highest accordance between clinical observation and Wits appraisal was seen in class III group. The most accordance of the ANB angel was in the class II group.The best correlation was found between μ angel and β angel (r=0.912). The correlation of ANB angel with μ angel was the weakest (r=0.769).The results showed that when μ angle is smaller than 12.7 degrees, the patient is skeletal class II and the patients whose μ angle is larger than 19.1 degrees are classified in class III group.

Conclusion All of four sagittal parameters (ANB angle, Wits, β angle and μ angle) were well-correlated. The best correlation was found between μ angel and β angel. The correlation of ANB angel with μ angel was the weakest. β angle and μ angle are proper tools to show skeletal class II and class III, but these angles cannot differentiate prognatic or retrognatic jaw.

Keywords: Antero-posterior discrepancy, ANB, β angle, μ angle, Wits Appraisal

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Evaluation of the antero-posterior relationship of jaws to each other is one of the important factors in treating orthodontic patients. There are a lot of angular and linear cephalometric measurements to evaluate the sagittal relationship of jaws.One of the most popular measurements is the ANB angel. This analysis was presented by Cecil Steiner in 1950[1] and was developed by Reidle in 1952[2].

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This analysis displays measurements in a way that emphasizes not just the individual measurements but their interrelationship into a pattern. So it is a very useful analysis in treatment planning. In this analysis, the first measurement is the angle SNA, which is used to determine the antero-posterior position of maxilla relative to the cranium. The norm of SNA is 82±2 degrees. So if the SNA were greater than 84 degrees, it shows maxillary protrusion, while SNA less than 80 degrees would be interpreted as maxillary retrusion.

In order to evaluate the antero-posterior position of mandible the SNB angel is used which its norm is 78±2 degrees. This interpretation is valid only if the inclination

of SN plane is normal to the true horizontal and the position of N is normal.

The difference between SNA and SNB, the ANB angel, shows the amount of the skeletal jaw discrepancy. The norm of this angel is 2 degrees and increase of this angel is the sign of skeletal class II and the decrease of this angel shows class III tendency.

The magnitude of the ANB angle is influenced by different factors such as: antero-posterior and supero-inferior position of point N, inclination of SN plane, cant of jaws to cranial base and changes of vertical height of the face. [3-8]

The Wits analysis is a method to overcome the limitation of the ANB. This analysis was presented by Alex Jacobson in 1975. [3] It is based on a projection of points A and B to the functional occlusal plane, along which the linear difference between these points is measured.

Since this analysis is not dependent on SN plane, displacements of Nasion do not affect it. Also, this analysis is not influenced by jaws canting. It has some disadvantages. Wits analysis is dependent on functional occlusal plane, which is drawn among maximum intercuspation of posterior teeth. If the posterior teeth are not erupted completely, determination of occlusal plane will be difficult or may be impossible. In addition, this analysis is influenced by the teeth both horizontal and vertically.

In order to overcome the limitation of ANB angel and Wits analysis, Baik and Ververidou presented β angel in 2004. [9] To draw this angel, points A, B and C (the central point of condyle) are used. This angel is formed by the connection of A-B line and a projection of point A to C-B line.

This angel is not dependent on any cranial and dental landmarks and it does not change with mandibular relation. But sometimes the head of condyle is not so clear in cephalograms and determination of point C is difficult.

μAngel is another cephalometric measurement that was introduced by Fattahi et al to eliminate shortcomings of β angel. [10] This angel is independent of cranial and dental landmarks and it is not affected by mandibular rotation. It is the angel between A-B line and a projection of point A to mandibular plane. Both the β angel and μ angel are not able to determine which jaw is responsible in class II and class III malocclusions.

The purpose of this study was to compare the four above mentioned cephalometric measurements in order to evaluate the sagittal relationship of jaws and correlation between these analyses.

Methods and materials

In this cross sectional study, 105 lateral cephalograms of orthodontic patients who were referred to the orthodontic department of Tehran University of medical sciences were selected. The cephalograms were classified into 3 groups (class I, II, III) and this classification was confirmed by an orthodontist. All the cephalograms had good quality and the condylar region was clear.

The sample included 42 males and 63 females and they were 12±3 years old. They had not received orthodontic treatment and they did not have any congenital syndromes.

In all cephalograms, the ANB angel, Wits analysis, β angel, μ angel, Jaraback index and Bjork angels were measured. (Figure 1a-d)

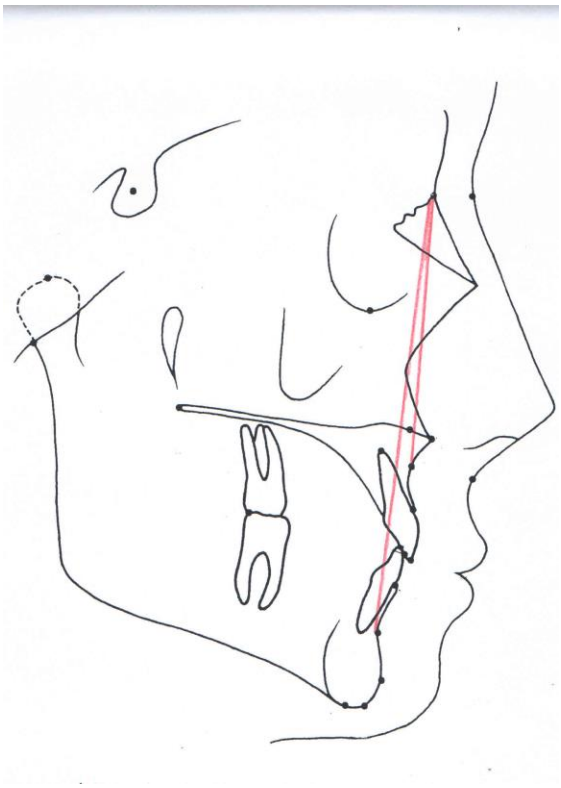

Figure 1a: ANB angle

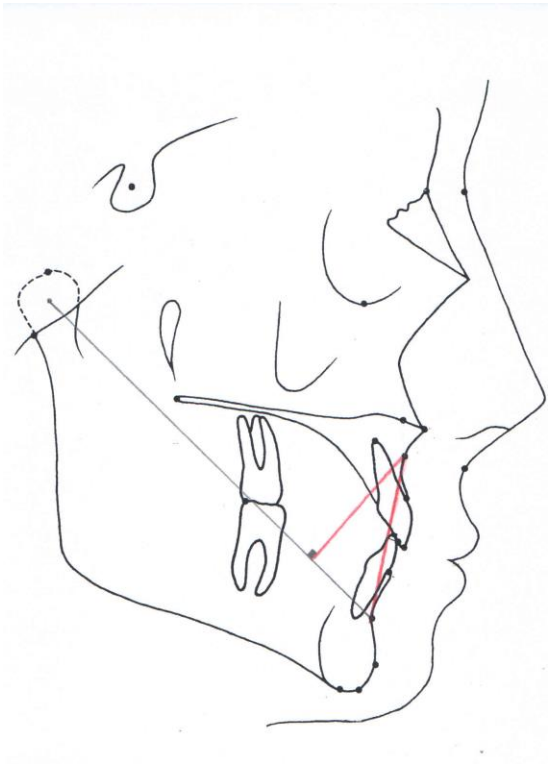

Figure 1c: β angle

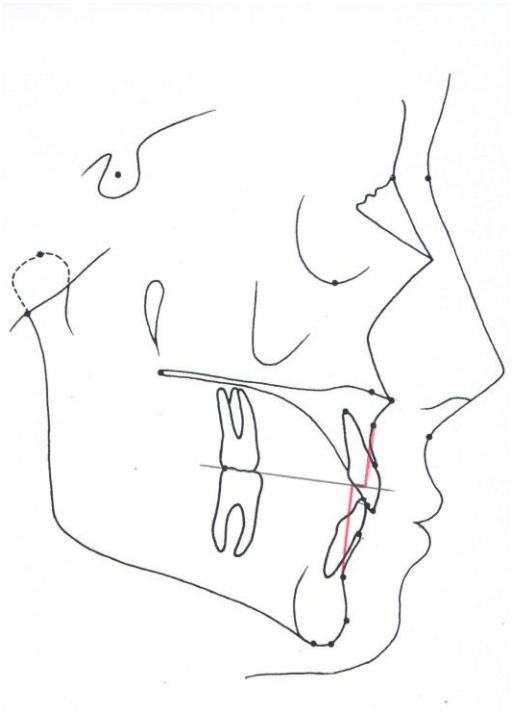

Figure 1b: Wits appraisal

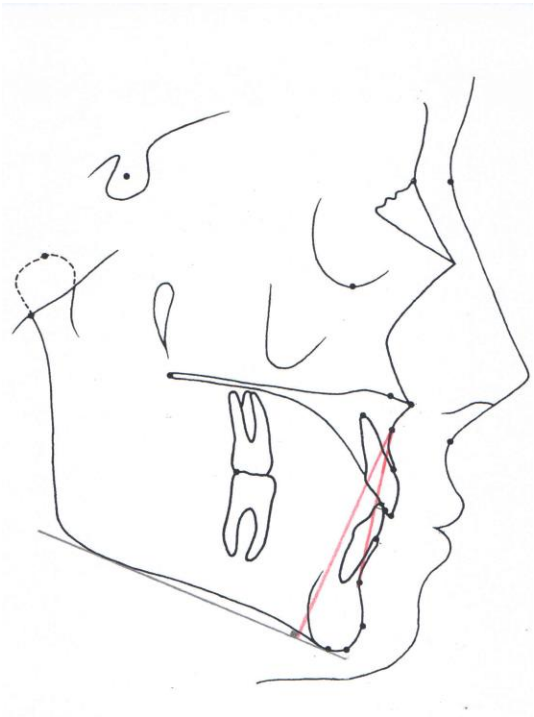

Figure 1d: μ angle

Results

Distribution of differences was shown in Table 1. The highest accordance between clinical observation and Wits appraisal was seen in class III group. The most accordance of the ANB angel was in the class II group.

All of four sagittal parameters were well-correlated (P value < 0.001) (Table 2). The best correlation was found between μ angel and β angel (r =0.912). The correlation of ANB angel with μ angel was the weakest (r =0.769).

Table 3 shows the mean of β angle in different groups. When β angel is larger than 34.8 degrees, the patient is skeletal class III and when this angel is smaller than 28.4 degrees, the patient is classified as skeletal class II

Table IV shows the mean of μ angle in different groups. The results showed that when μ angle is smaller than 12.7 degrees, the patient is skeletal class II and the patients whose μ angle is larger than 19.1 degrees are classified in class III group.

Table 2: Coefficient of correlation

		ANB	Wits	β	μ
ANB	r	1			
	p	0			
Wits	r	0.807	1		
	p	<0.001	0		
β	r	-0.785	0.825	1	
	p	<0.001	<0.001	0	
μ	r	0.769	-0.815	0.912	1
	p	<0.001	<0.001	<0.001	0

Table 1: Comparison of sagittal relations with analysis methods

Method of analysis	Number of cases in each skeletal category		
	Skeletal I n(%)	Skeletal II n(%)	Skeletal III n(%)
"ANB" Angle	39(37.7%)	54(50.9%)	12(11.3%)
"Wits" Appraisal	34(32.3%)	35(33.3%)	36(34.3%)
"β" Angle	34(32.3%)	41(39.1%)	30(28.5%)
"μ" Angle	38(36.2%)	36(34.3%)	31(29.5%)

Discussion

The sagittal relationship of jaws has an important role in orthodontic diagnosis and treatment plan. There are different linear and angular cephalometric measurements to evaluate this relationship. The most popular angular measurement is ANB angle, but this angle is affected by different factors such as the position of point N and inclination of jaws to cranial base. Wits appraisal is another measurement to evaluate the antero-posterior position of jaws. This analysis is dependent on functional occlusal plan but description of this plan is not clear yet.

β angle is a new cephalometric parameter that is not dependent on cranial landmarks and occlusal plan. This parameter is used to evaluate the progress of orthodontic treatments and it is an effective analysis to distinguish anterior posterior skeletal problems.

To draw this angle, clinician has to determine the central point of condyle on lateral cephalograms. The cephalograms should have good quality and condylar region should be clean. Defining the exact center of condyle is not necessary because if this point is determined within a circle with 2 mm radius, β angle will be affected less than 1 degree and this magnitude will not be significant.

Our results show that the mean of β angle in class III males is 39.2 degrees which is similar than Ververidou and Baik. 9 Also, according to Ververidou and Baik's study β angle in class I patients is ranged between 27 and 35 degrees and it is so close to our results. Fatahi showed that the mean of β angle for class I patients is ranged between 32.4 and 38.6 degrees10 which is different from ours. This difference is seen in the mean of μ angle and it may be due to the size of samples in these studies.

β angle and μ angle are proper tools to show skeletal class II and class III, but they are not able to determine which jaw is faulty. It means that these angles cannot differentiate prognatic or retrognatic jaw. If it is important to define which jaw has deformity, we need to use other cephalometric analyses and these angles can provide supplementary data to diagnose skeletal problems.

Conclusion

1-All of four sagittal parameters (ANB angle, Wits, β angle and μ angle) were well-correlated.

2-The best correlation was found between μ angel and β angel.

3-The correlation of ANB angel with μ angel was the weakest.

4-β angle and μ angle are proper tools to show skeletal class II and class III, but these angles cannot differentiate prognatic or retrognatic jaw.

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