

Original Research Article

Establishing A New Anatomical Indicator For Antero-Posterior Jaw Discrepancy

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Abstract

To overcome the deficiencies, at least geometric drawbacks, associated with the most commonly available sagittal indicators (ANB, Wits), efforts were done to develop another an accurate and valuable mean for skeletal prediction. To establish the mean value of a new sagittal approach (μ angle) for the assessment of skeletal relationship in its different patterns and whether or not there is a correlation with the other cephalometric indexes. Depending on a predetermined criteria, the total study sample consist of ninety-four pretreatment lateral cephalometric radiograph of Iraqi subjects with a mean age (13.5 ± 2). Again it have been subdivided into three skeletal relations (I, II, III) according to the combined criteria of both (ANB and Wits appraisal) for each relevant class. μ angle measured from A-B line and a perpendicular on Mandibular plane from point A. The mean values of μ angle were (22.16 ± 3.04 ; 13.56 ± 3.04 ; 28.84 ± 3.52) for class I; II; III, respectively and no significant gender differences were detected. Regardless sample subgroups, a strong negative significant correlation ($P < 0.001$) was found between μ angle and both ANB and Wits indexes. It was concluded that the new μ angle can accurately be utilized in clinical assessment of sagittal jaw relationship where the other skeletal measures such as ANB angle and Wits appraisal fail to accurately assess some of jaw relations due to anatomical and occlusal factors.

Key Words: Sagittal jaw relation, μ angle, skeletal prediction.

تأسيس مؤشر تشريحي جديد لتناقض علاقة الفكين الأمامي-الخلفي

الخلاصة

للتغلب على النقص، على الأقل الهندسية منها، المرتبطة بالمؤشرات الأمامية السهمية للفكين الأكثر توفراً (ANB; Wits) جهود عملت لا ابتكار وسيلة دقيقة وقيمة للتنبؤ الهيكلي. معرفة متوسط القيم لزاوية μ لتقييم العلاقة الهيكلية في هياكلها المختلفة كذلك فيما إذا كان هناك علاقة من عدمها بينها وبين الدلائل القياسية الأخرى. اعتماداً على معايير محددة مسبقاً، عينة الدراسة تتكون من أربع وتسعين صورة اشعاعية قياسية جانبية لأشخاص عراقيين متوسط أعمارهم $\{2 \pm 13,5\}$. ومن ثم قسمت إلى ثلاث علاقات هيكلية: {الأول والثاني والثالث} على أساس المعايير المشتركة لكل من {ANB; Wits} لكل صنف منها. وقد تم قياس الزاوية من خلال رسم خطوط هندسية على الفكين على أساس نقاط هيكلية معينه مسبقاً. متوسط القيم لزاوية μ كان ($22,16 \pm 3,04$; $13,56 \pm 3,04$; $28,84 \pm 3,52$) للصنف الأول والثاني والثالث على التوالي ولا يوجد فرق إحصائي بين الجنسين. بأهمال مجاميع العينة، علاقة احصائية سالبة قوية قد وجدت بين الزاوية والدلائل القياسية الأخرى. استنتج من البحث انه زاوية μ يمكن أن تستخدم بدقة في التقييم السريري لعلاقة الفكين الأمامية الخلفية في الوقت الذي نقشل فيه المؤشرات الهيكلية الأخرى لأسباب هيكلية وأنطباقية.

الكلمات المفتاحية: زاوية μ ، علاقة الفك السهمية ، التنبؤ الهيكلي.

Introduction

Lateral cephalometric radiography, although it is a two dimensional view, is a valuable tool in orthodontic diagnosis and treatment planning. In planning for orthodontic treatment one of the most important issues is an accurate anteroposterior measurement of jaw relationship. Both angular and linear measurements have been incorporated into various cephalometric analyses to help the operator diagnose sagittal discrepancies and thereby establish the most appropriate treatment plan[1]. Since the introduction of cephalometrics by Broadbent[2], numerous cephalometric measurements have been devised. Of those Steiner[3]; Tweed[4]; Downs[5];

Jacobson[6,7]; Ricketts[8] probably have gained the widest acceptance. Any cephalometric analysis based on either angular or linear measurements has obvious shortcomings, which have been discussed in detail by Moyers *et al.*[9]. Still, sagittal jaw relationship is difficult to evaluate because of rotations of the jaws during growth, vertical relationships between the jaws and the reference planes, and a lack of validity of the various methods proposed for their evaluation. [1,6,9,10]

As a result, in special situations neither the angular (ANB, Beta, Yen) nor the linear (Wits) parameters have been utilized successfully enough in sagittal assessment of apical relationship between the maxilla and mandible. As these indexes are influenced by anatomic landmarks and dental occlusion, it is necessary to access an independent index[11]. Cephalometric norms for an Iraqi population using the μ angle till now are not published. The objectives of the present study are to evaluate the anteroposterior skeletal relation of the jaws using the μ angle for growing Iraqi sample in different facial types and to evaluate gender difference within the different groups. Also to determine whether or not there is a correlation with the other most commonly used skeletal measures of the jaws.

Materials and Methods

Ninety-four standardized pretreatment lateral cephalometric radiograph for growing Iraq sample were employed for the study with a mean age (13.5 ± 2 yrs). An AUTO CAD 2007 was used for tracing of radiographic images after their initial selection. Again it has been subdivided into three skeletal facial types (I, II, III) according to the combined criteria of both ANB angle and Wits appraisal index for each skeletal pattern. High radiographic quality, no history of previous orthodontic or orthognathic intervention and no congenital malformation of both jaws are the criteria that should be included for sample selection. Accordingly, out of (94) lateral cephalograms, there was 30(17 female, 13 male) class I, 32(17 female, 15 male) class II, and 32(18 female, 14 male) class III, were chosen in the study.

Cephalometric Bony Landmarks and lines

Three bony landmarks are utilized for this angle: Point A, point B and mandibular plane[12]:

Point A (Subspinale): The deepest midline point on the premaxilla between the Anterior Nasal Spine and Prosthion[13].

Point B (Supramentale): The deepest midline point on the mandible between Infradentale and Pogonion[13].

Mandibular line: Is a tangential line on the lower border of the mandible[14].

μ angle: is the angle between AB line and perpendicular line from A to mandibular plan

The criteria of ANB angle and Wits appraisal according to Steiner[3] and Jacobson [5] for sample classification are as follow:

A- Class I ($2 \leq \text{ANB} \leq 4$), and wits horizontal distance is (0 ± 2 female; 1 ± 2 male).

B- Class II ($\text{ANB} > 4$), and wits horizontal distance is (AO ahead of BO).

C- Class III ($\text{ANB} < 2$), and wits horizontal distance is (BO ahead of AO).

Assessment of Error

To evaluate the reliability of study results, intra-examiner calibration was done by the

same researcher.¹⁰ randomly selected radiographs were retraced and digitized after a three weeks interval. Statistically insignificant difference was found between the first and second measurements.

Data Analysis

Statistical analysis was carried out using SPSS version 17. Student t-test was used to compare means between genders.

Correlations of μ angle with ANB angle and Wits appraisal index were determined using Pearson correlation coefficient (r). A p-value of ≤ 0.05 was considered as significant.

Results

In general, Out of 94 patients 44.7% were males and 55.3% were females.

Table 1: Mean, standard deviation, and gender difference of ANB angle, Wits appraisal, μ angle for all three groups. According to t-test, there was no significance gender differences among all the classes for all study variables.

Class	Study variables	Gender	N	Mean \pm SD	t-test	P value
Class I	ANB (degree)	Male	13	3.46 \pm 0.92	1.186	0.245
		Female	17	3.11 \pm 0.69		
	WITS (mm)	Male	13	0.59 \pm 1.66	0.166	0.869
		Female	17	0.50 \pm 1.28		
	μ angle (degree)	Male	13	22.76 \pm 4.18	0.86	0.403
		Female	17	21.70 \pm 1.75		
Class II	ANB (degree)	Male	15	5.87 \pm 1.35	0.06	0.953
		Female	17	5.85 \pm 1.14		
	WITS (mm)	Male	15	4.59 \pm 2.39	-0.238	0.813
		Female	17	4.82 \pm 2.95		
	μ angle (degree)	Male	15	13.20 \pm 3.56	-0.626	0.536
		Female	17	13.88 \pm 2.57		
Class III	ANB (degree)	Male	14	-0.34 \pm 1.60	-1.152	0.258
		Female	18	0.34 \pm 1.67		
	WITS (mm)	Male	14	-5.21 \pm 3.77	-1.081	0.288
		Female	18	-4.02 \pm 2.42		
	μ angle (degree)	Male	14	29.78 \pm 3.55	1.349	0.187
		Female	18	28.11 \pm 3.42		

Table 2: Correlations of μ angle with ANB angle and Wits index for individual classes and total sample.

class	correlation (r)	P-value	correlation (r)	P-value
	μ and ANB		μ and wits	
I	0.005	0.977	-0.23	0.22
II	-0.077	0.677	-0.11	0.55
III	-0.189	0.301	-0.571	0.001
Total	-0.808	<0.001	-0.827	<0.001

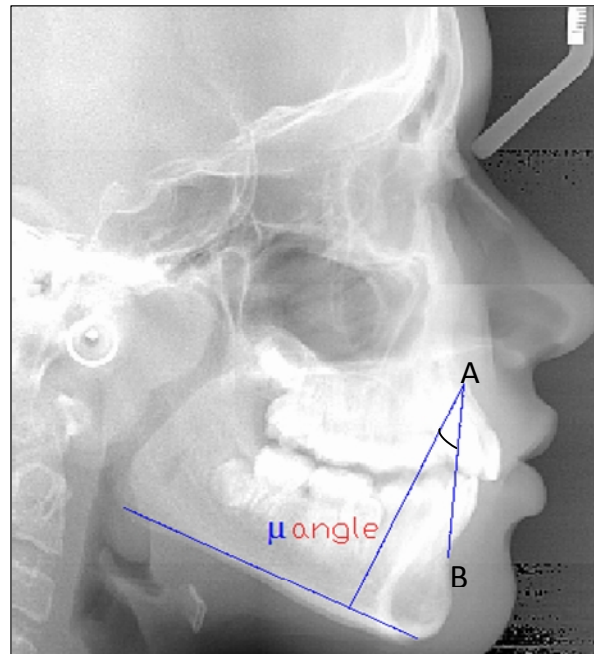


Figure 1: A study sample that represents Cephalometric tracing of μ angle.

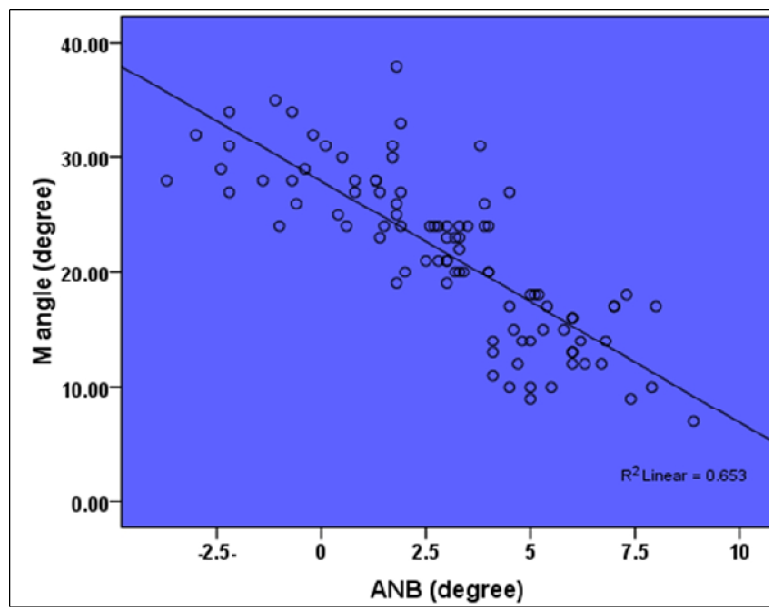


Figure 2: Correlation between ANB and μ angle among all study sample. There was a significant negative linear correlation between these two variables. ($r = -0.808$, $P = < 0.001^{**}$).

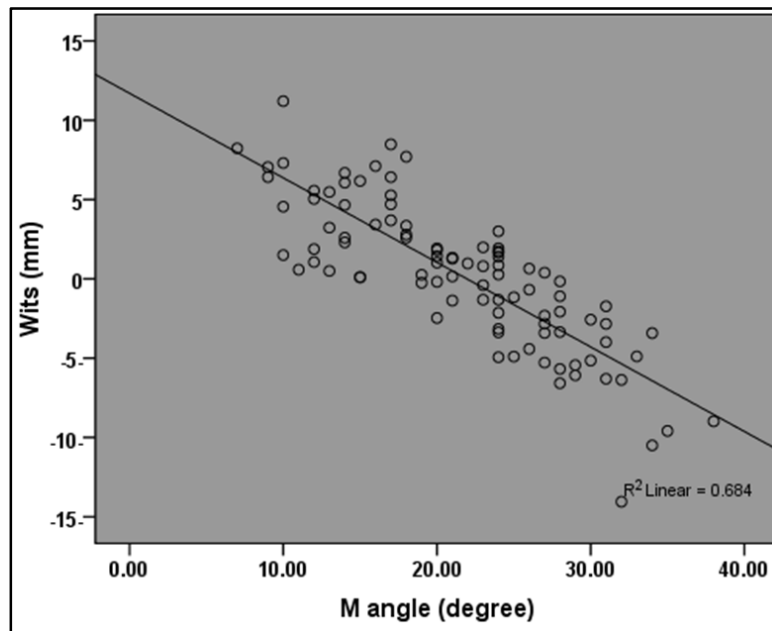


Figure 3:Correlation between μ angle and Wits index among all study sample. There was a significant negative linear correlation between these two variables. ($r = -0.827$, $P = < 0.001^{**}$).

Discussion

In orthodontic diagnosis, an accurate evaluation of sagittal jaw relationship is critically important. At present, with the modern techniques that are used for assessment of orthodontic patients, cephalometric radiography, still the most common valuable tool for orthodontic diagnosis and treatment planning. With progression of skeletal measures of malocclusion, the most common sagittal angular and linear parameters are the ANB angle and Wits appraisal[15]. Studies have been conducted to assess the accuracy and reliability of these measurements and a need has been found to establish parameters which are accurate, reproducible and independent of cranial base and dental structures[14].

Thereafter it was found that rotation of the jaws and/or line of occlusion relative to the anterior cranial base and inclination of S-N line are some of the various factors that could lead to false negative or false positive results of both parameters[16, 17]. Recently, β angle had been introduced,

which is not dependent on cranial landmarks or dental occlusion. Therefore, it is reliable index in cases that previous parameters may not be used[1]. Owing to difficulty of precise determination of the condylar center as part of its evaluation; Fattahiet *al.*[12] suggested μ angle, which is superior to the former because the determination of mandibular plane is easier and the quality of radiograph does not influence this plane. Furthermore, the μ angle does not really influenced by the rotation of the lower jaw from temporomandibular joint area or of the mandibular body as A and B points change their position, are another advantages. However, changing mandibular plane without A and B points displacement, the angle will be failed.

In present study, the mean values of μ angle were (22.16 ± 3.04 ; 13.56 ± 3.04 ; 28.84 ± 3.52) for class I; II; III, respectively. According to these values, each individual group had specific mean value differ significantly from the other. Statistically, there was no significant gender differences among all the skeletal

classes (Table 1). Also a study conducted by Fattahiet *al.*[12] was support our result. Although there was a weak negative insignificant correlation between μ and ANB angle among all the individual classes, a strong negative significant correlation ($r=-0.808$; $P<0.001$) was found between these angles by excluding sample classification. The Coefficient of determination (R^2), as a result was 65%. It suggests that proportion of variability in μ angle accounted for by the ANB angle is 65%. In other words, as μ angle is decreases by the increasing of ANB angle, mostly indicate a tendency to class II malocclusion. For class III malocclusion, the reverse is true (Table 2; Figure 2).

Similarly, the result of its correlation with Wits index was also an indirect strong significant correlation ($r = -0.827$, $P = < 0.001$) regardless sample subgroups, so 68% of proportional change for μ angle to Wits index was resulted. So that, as the μ angle reduces by the increasing of Wits reading, indicate a class II tendency. The reverse is also true for class III malocclusion (table 2; figure 3). This study result come in accordance with that obtained by Saeed *et al.* [11] with minimum difference in correlation strength among these parameters which may be due to sample size, inclusion criteria, and demographic features.

As a study result, it was concluded that a new alternative cephalometric sagittal measure of jaw relationship named (μ angle) was developed which can be utilized in clinical practice for orthodontic diagnosis and planning assessment where the other skeletal measures such as ANB angle and Wits appraisal fail to accurately assess some of jaw relations due to some anatomical and occlusal factors. Further studies are required to assess the reliability and reproducibility of μ angle for different skeletal patterns using larger sample and different age groups, and to assess its correlation with other parameters of sagittal jaw relation.

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