

Assessment of Sagittal Jaws Relationship in skeletal Class I Adolescents

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الخلاصة

الأهداف: تهدف الدراسة الحالية لوضع معايير أشعة قياسات الرأس فيما يخص العلاقة الأفقية للفكين لمجموعة من المراهقين العراقيين في مدينة الموصل. **المواد والطرق:** تم أخذ أشعة قياسات الرأس الجانبية لـ 120 مراهقاً (52 صبياً، 68 فتاة) بأعمار تتراوح بين 12 إلى 15 سنة. تم أخذ قياس Wits ومسافة App-Bpp ومسافة AF-BF لكل أشعة رأس. **النتائج:** تم الحصول على فروق معنوية بين الجنسين لقياسي Ao-Bo و APP-BPP في حين لم يتم تسجيل أي فرق معنوي فيما يخص المسافة AF-BF. **الاستنتاجات:** ثبت أن قياس AF-BF هو الأكثر ارتباطاً بالعلاقة الأفقية بين الفكين من بين القياسات الثلاثة يليه قياس APP-BPP.

ABSTRACT

Aims: To establish a cephalometric standard for sagittal jaw relationships for Iraqi adolescents in Mosul city by using three linear measurements, also to compare & correlated the three methods. **Materials and Methods:** Lateral cephalometric radiograph were taken for 120 adolescents (52 boys and 68 girls). The age range was 12-15 years with a mean of 13.4 years. Wits appraisal (Ao-Bo), App-Bpp (distance between points A&B projected to the palatal plane), and AF-BF (distance between points A and B projected to the Frankfort Horizontal plane) were measured. **Results:** Significant differences were found between boys and girls for Ao-Bo, and App-Bpp measurements. No significant difference was observed for AF-BF between girls and boys. **Conclusions:** Among the three measurements taken, the AF-BF distance appeared to be the most dependable one followed by App-Bpp distance.

Key Words: Cephalometric, Sagittal, Adolescents.

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INTRODUCTION

Anterioposterior dysplasias are the commonest malocclusions found in orthodontics. Hence, the assessment of the maxillomandibular relationship in a horizontal plane is of prime importance in orthodontic diagnosis and treatment planning. Both angular and linear measurements have been proposed in the assessment of sagittal jaw relationship.

A first step towards description of Anterioposterior jaw relationship was the introduction of points A and B by Downs⁽¹⁾, who additionally suggested the A-B plane angle, i.e. the relationship of the dental bases to each other and to the profile. Years later, Riedel⁽²⁾ introduced the ANB angle which later on becomes the most widely used and the simplest method to

determine anterioposterior relationship of maxilla and mandible. In the following years, several authors^(3,4) have shown that the position of nasion is not fixed during growth, and any displacement of nasion will directly affected the ANB angle.

Jacobson in 1975 eliminated the cranial reference points and used occlusal plane as a reference base^(5,6). It has come to be known as the Wits appraisal. The Wits' value, or Ao-Bo, is the linear measurement between the perpendiculars drawn from point A and point B to the functional occlusal plane. While the Wits' analysis has been shown to be less affected by variations in craniofacial physiognomy, variation of the occlusal plane may affected the Wits appraisal^(7,8).

To reduce the dependence of sagittal

measurements on the functional occlusal plane, Chang⁽⁹⁾ advocated a linear measurement of the distance between points A and B projected to the Frankfort horizontal plane. The points of origin of perpendiculars on the FH plane projected to points A and B were labeled AF and BF, respectively and the measurement between the points along FH was called the AF–BF distance.

Nanda and Merrill⁽¹⁰⁾ recommended palatal plane as a reference line for assessment of sagittal jaw relation and select the A to B distance on palatal plane as the best indication of sagittal jaw relation according to the observation of many other authors^(11,12), that the palatal plane remains relatively stable throughout growth. In addition, the use of a linear measurement was preferred to an angular measurement due to the fundamental fact that a linear measurement is affected by fewer variables than an angular one, which involves at least three points with six degrees of freedom⁽¹³⁾.

Many studies have been published to assess sagittal jaw relationship on Iraqi adults, but none exist on Iraqi adolescents in Mosul city. This study was therefore performed with the aim of establishing the cephalometric standards for sagittal jaw relationship of Iraqi adolescents boys and girls in Mosul city by using three linear measurements which are Wits appraisal, App–Bpp, and AF–BF distances. The other aim was to compare and correlate the three methods and to discuss the most dependable measurement.

MATERIALS AND METHODS

The sample comprised 120 adolescents (52 boys and 68 girls) in the age group of 12–15 years with a mean age of 13.4 years were selected from intermediary schools in Mosul city according to the following criteria:

1. Full complements of permanent dentition in both jaws except for the third molars.
2. Class one molar and canine relationship which is based on Angle classification.
3. No obvious craniofacial deformities.
4. Normal overjet and overbite.
5. None of the subjects had received orthodontic treatment.

Records included lateral cephalometric radiographs taken with the same cephalostat in the department of radiology, Mosul University, college of dentistry. Cephalometric landmarks (Figure 1) were identified and traced on acetate paper. All measurements were performed by the same orthodontist.

The following landmarks were identified: Point A: Subspinale, Point B: Supramentale, ANS: Anterior nasal spine, PNS: Posterior nasal spine, Or: Orbitale, Po: Porion, UI: The incisal tip of the maxillary central incisor, LI: The incisal tip of the mandibular central incisor, Um: The anterior cusp tip of the maxillary first molar, Lm: The anterior cusp tip of the mandibular first molar.

Cephalometric planes (Figure 1): Op: Occlusal plane, the line connecting the midpoint between UI and LI and the midpoint of the occlusal contact between Um and Lm⁽¹⁾. FH: Frankfort horizontal plane, the line connecting Po and Or. PP: Palatal plane, the line connecting ANS and PNS.

Linear measurements included: Wits appraisal (Jacobson⁽⁵⁾) as illustrated in Figure (2), AF–BF (Chang⁽⁹⁾), App–Bpp (Nanda and Merrill⁽¹⁰⁾) as illustrated in Figure (3). For all linear measurements a positive value indicates that point A is located anteriorly to point B, while negative value indicated that point B is located anteriorly to point A.

A total of 20 out of 120 radiographs were randomly selected and retraced with one week interval to determine the error of method according to Dahlberg's⁽¹⁴⁾ formulas. The mean error averaged less than 0.5 mm for all three linear measurement, this difference was considered acceptable.

All data were computed with SPSS software (release 11.5 SPSS). Descriptive statistics included mean, standard deviation, coefficient of variation, standard error, minimum, and maximum values were verified for each variable. The values of both sexes were compared to each other by using T–test to determine the significance at the 0.05 and 0.01 levels. Pearson product moment correlation coefficients were calculated between three linear measurements. The significance level of $p \leq 0.05$ and $p \leq 0.01$ were established.

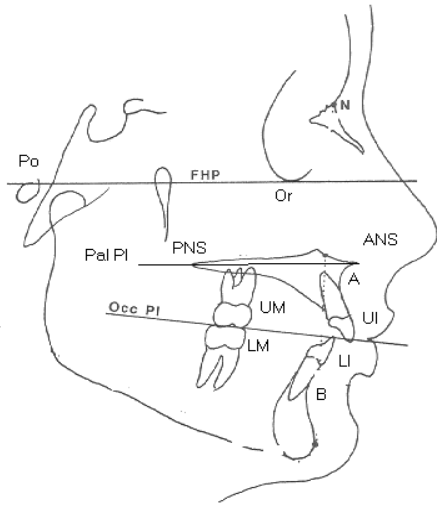


Figure (1): Cephalometric Landmarks and planes.

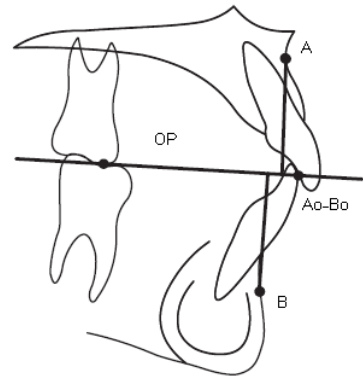


Figure (2): Wits appraisal.

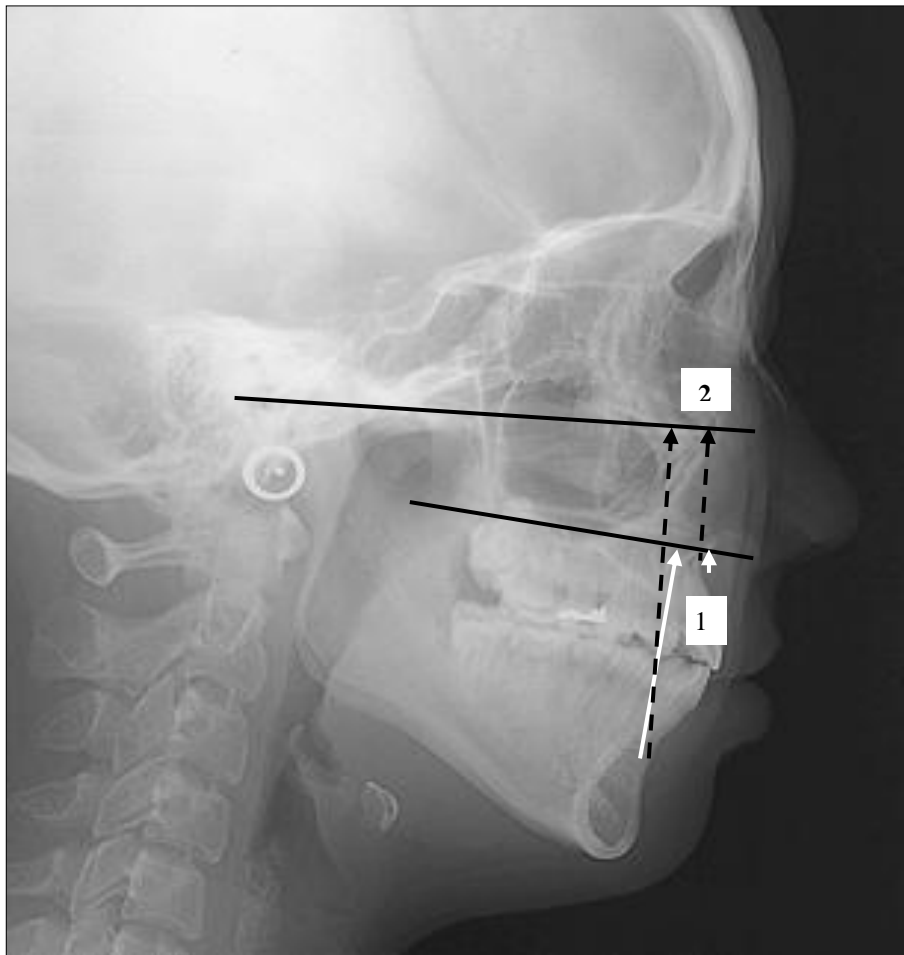


Figure (3): 1. App-Bpp distance, 2. AF-BF distance.

RESULTS

Table (1) shows mean standard deviation, minimum, maximum and coefficient of variation for three linear methods: Ao-Bo, App-Bpp, and AF-BF distances.

The coefficient of variability of the three parameters used in the assessment of

sagittal jaw relationship is quite different from each other.

According to these coefficients, the measurement with the most homogenous distribution was AF-BF followed by App-Bpp distances; least homogenous was the Wits appraisal.

Table (1): Descriptive statistics of the variables

Variable	No.	Range	Mean± SD*	Coefficient of variation
Ao-Bo	120	-2.50-6.00	0.83±1.62	194.95%
App-Bpp	120	0.50-8.50	3.30±1.72	52.1%
AF-BF	120	1.00-8.00	3.95±1.60	40.3%

*Mmeasurements in mm.

Table (2) demonstrates a high significant difference between boys and girls in the mean values of the Ao-Bo and App-Bpp measurements, the boys have larger value than girls in both measurements.

No significant difference was observed between the boys and girls in the AF-BF measurement, although the girls have lower value.

Table (2): Descriptive statistics and statistical comparison of the variables between Iraqi boys and girls.

Variable	Sex	Range	Mean ±SD★	t-value	p-value
Ao-Bo	M(52)	-2.50-5.00	0.96±1.58	2.79	0.002*
	F(68)	-3.50-6.00	0.1±1.71		
App-Bpp	M(52)	0.50-8.50	3.66±1.86	2.63	0.007*
	F(68)	0.50-7.00	2.85±1.43		
AF-BF	M(52)	1.50-8.00	4.03±1.60	0.48	0.632 NS
	F(68)	1.00-7.00	3.90±1.60		

M=male, F=female. * Significant $p \leq 0.001$, NS= not significant. ★ Measurements in mm.

Statistically significant correlations were found among the three sagittal parameters (Table 3) for total sample with p -value ≤ 0.01 . The correlation was strong between App-Bpp and AF-BF distances

($r=0.780$), whereas, there was a weak correlation between Ao-Bo and AF-BF ($r=0.381$), while the App-Bpp distance showed moderate level of correlation with Wits appraisal ($r=0.552$).

Table (3): Correlation matrix for the variables.

	Ao-Bo	App-Bpp	AF-BF
Ao-Bo	1.000	0.552**	0.381**
App-Bpp	0.552**	1.000	0.780**
AF-BF	0.381**	0.780**	1.000

** Correlation is significant at the 0.01 level.

DISCUSSION

An accurate anteroposterior measurement of jaw relationships is critically important in orthodontic treatment planning. Linear measurements have distinct advantages over angular measurements in that there are few variables to affect the

accuracy of linear measurements and there is less error of measurements^(3,15). Angular changes are complex measurements because in any angular measurement the position of three points is involved⁽¹⁶⁾. The effect of angular changes also becomes larger as you move away from the vertex of the angle being measured. For these

reasons it was decided to use linear measurements in this study.

Our findings showed that boys demonstrate significantly higher values in both Ao–Bo and App–Bpp measurement than girls. This may be attributed to the more steeply inclined palatal and occlusal planes in boys as compared to girls, as showed by other studies^(10,17). This finding supports the existence of nearly 1 mm discrepancy between two sexes as reported by Jacobson⁽⁵⁾. In contrast, this result disagree with Albarakati⁽¹⁸⁾ who showed that there were no sex differences between both sexes for Wits appraisal, also Nanda and Merrill⁽¹⁰⁾ showed that there were no sex differences for App–Bpp distance.

Comparing the findings of this study with that of previous studies shows some differences (Table 4), the mean value of Wits appraisal in the Iraqi adolescents was greater than that of Jacobson⁽⁵⁾, Chinese⁽⁹⁾, Saudis⁽¹⁸⁾ and German⁽¹⁹⁾ values; this may be due to the fact that Iraqi adolescents

have protruded maxilla⁽²⁰⁾, which is one of the factors that contribute to midfacial prominence as compared to other races. On the other hand, this study revealed no significant differences present between boys and girls in AF–BF measurement, the value is nearly similar between both sexes. Our results agree with Chang⁽⁹⁾ and Judy *et al.*,⁽²¹⁾ who showed that no statistically significant differences found for AF–BF values between both sexes either overall or at any age group. Comparing these values with the finding of the three previous studies shows some differences, while the AF–Bf means are similar, but slightly less for a Chinese population⁽⁹⁾, these are substantially lower than the values obtained for the German⁽¹⁹⁾ and American Caucasian group⁽²¹⁾. Standard deviation values obtained indicate approximately the same variation in the Iraqi sample as found in the American Caucasian and Chinese population. However, variation in the German population appeared markedly higher.

Table (4): Comparison between the present and previous studies.

Study	Sex	No.	Ao–Bo	App–Bpp	AF–BF
Present study (2008)	M	52	0.96±2.17	3.66±1.85	4.03±1.60
	F	68	0.11±1.72	2.84±1.42	3.90±1.60
Lux <i>et al.</i>, (2005)	M	10	0.09±3.49	5.33±3.22	5.55±3.32
	F	8	-0.83±2.66	3.98±4.05	4.71±4.67
Albarakati (2002)	M	30	0.8±2.2		
	F	30	0.4±2.3		
Judi <i>et al.</i>, (1995)	M	30			6.5±2.2
	F	32			5.2±2.9
Nanda & Merrill (1994)	M			5.83±2.50	
	F			4.90±2.65	
Chang (1987)	M	40	-1.03±2.14		3.43±2.93
	F	40	-1.14±2.32		3.87±2.63
Jacobson (1975)	M	21	-1.2±1.7		
	F	25	-0.1±1.7		

The second objective of this study was to found the more dependable method, however; the result showed the difference in coefficient of variability of three parameters used. The greatest coefficient of variability of the Wits appraisal (194.95) may be attributed in part to difficulties or in accuracies in identifying the occlusal plane and/ or variations in it^(5, 9, 22). In addition, it can be easily affected by the vertical dimensions of the jaws and the occlusal

plane inclination^(23–25). Erum and Fida⁽²⁶⁾ also showed more variation in the Wits appraisal than AF–BF distance, similar to the present result.

The measurement with the most homogenous distribution in this study, was AF–BF distance. Our observations don't agree with those of Chang⁽⁹⁾ who concluded that the coefficient of variability of the AF–BF measurement was higher than that of the Ao–Bo.

The results of the present study revealed that Wits appraisal weakly correlated with AF–BF and moderately correlated with App–Bpp distance. On the other hand, strong correlation was found between AF–BF and APP–Bpp distances ($r=0.780$). Erum and Fida⁽²⁶⁾ and Boskovic–Brkanovic Nikolic⁽²⁷⁾ found very strong correlation of AF–BF distance with Wits appraisal.

In this study the AF–BF and App–Bpp distances were found to be more reliable and dependable as compared to Wits appraisal because in Wits appraisal, functional occlusal plane was taken into consideration as reference plane, any amount of change in occlusal plane is liable to bring change in Ao–Bo position. Contrary to that FH plane is considered as plane of reference for measuring A–B whose consistency is established, also the proximity of palatal plane to the dentition and the apical bases in both the maxilla and the mandible allowed an evaluation of the maxillomandibular complex by relating the mandible to the maxillary plane. It is clear from the above observations and discussion that the linear measurements may offer system for reliable assessment of anteroposterior jaw relationship among individual irrespective of degree of malocclusions and the AF–BF, App–Bpp distances can be recommended for use in determining dependable apical base relationship.

CONCLUSIONS

Cephalometric standards for assessing sagittal jaw relationships by using three linear measurements showed significant differences between boys and girls in both Wits appraisal and APP–Bpp values whereas no significant differences were found between both sexes for AF–BF measurement value. Despite varying strength of association, statistically significant correlation was found among the three linear measurements studied for assessing sagittal jaw relationship. Among the three measurements, the AF–BF distance appeared to be the most dependable one followed by App–Bpp distance.

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