CORELATON OF CORRECTED ANB ANGLE WITH OTHER SAGITAL DISCREPANCY INDICATORS

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ABSTRACT

Sagital skeletal discrepancy is being evaluated Cephalometrically by using various parameters; ANB angle and the Wit's value[1,2] being the most commonly used. ANB angle is affected by various environmental factors including SN-GoMe (vertical pattern of patient) & SNA angle (antero-posterior / vertical position of nasion & point A) and Wits value is dependent on the assessment & inclination of occlusal plane, thus are not considered reliable sagital discrepancy assessment indicator. Corrected ANB angle was calculated using the formula: ANB = Original ANB angle + 0.5 x (81.5° -SNA angle) + 0.25 x (32° - SN-GoMe angle) which is considered independent of the above mentioned variables. Aim of this study was to assess the reliability of Corrected ANB angle and establishment of its correlation with ANB angle & wits value. Study was conducted using lateral cephalograms of 100 subjects age ranged 18-30 yrs and it was concluded that 1. High correlations exist among the three parameters used to assess the sagital jaw discrepancy i.e. Corrected ANB angle, ANB angle & Wits Appraisal showing that these sagital parameters could be used interchangeably, 2. Coefficient of correlation (r) confirmed ANB angle dependence on SN-GoMe & SNA & wits unpredictability. 3. Coefficient of correlation (r) confirmed that corrected ANB angle is statistically insignificantly related to SN-GoMe & SNA angle, thus is a better assessor of sagital discrepancy assessment indicator.*

Key words: *Corrected ANB Angle, Wit's Value & ANB Angle*

INTRODUCTION

Sagital jaw relationship means the relationship of maxilla to mandible in anteroposterior plane. Although assessments of anteroposterior relationships are vital for orthodontic treatment planning, they cannot be precisely achieved by current cephalometric and noncephalometric resources[1]. Different cephalometric methods have been used in the past to assess the sagital skeletal discrepancy. ANB angle and Wits value have been the most popular cephalometric measurements applied in clinical orthodontics, although they have drawbacks[2].

ANB angle[3-6] is measured by subtracting the SNB angle from the SNA angle. Normal value is 0-4° with the mean value of 2°. Normal value represents the Skeletal Class I. Value more than 4° represents Skeletal Class II while value less than 0° represents Skeletal Class III. ANB value though used routinely as sagital jaw discrepancy indicator has newer been considered as a reliable and realistic sagital skeletal discrepancy indicator and Orthodontic community has thus always been in search of factors affecting the ANB angle so that proper diagnosis can be established [7-9].

Different orthodontists / researchers have reported different environmental factors that affect the ANB angle and thus a diagnosis based on this angle [10-15].

Bjork[16-17] examined the changes with age in the relationship of the maxilla to the mandible and found that mandibular prognathism generally increased slightly during adolescence. Mitani[18], Jamison J.E et al[19] & Bishara S.E et al[20] in their respective studies found that ANB angle decreases with age. Bishara S.E in another study[21] also found significant change in the

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ANB angle from age 5 years to adulthood. For males it decreased from 4.1°± 0.5 to 2.5°± 0.5 while for females it reduced from 4.7°± 0.5 to 3.3°± 0.5.

Jacobson A[22,23], found that relative forward or backward positioning of nasion by virtue of an excessively long or short anterior cranial base (represented by line SN) or a relative posterior or anterior positioning of both jaws within the skeletal craniofacial complex directly influences the ANB reading. He also found that clockwise or counterclockwise rotation of the jaws relative to cranial reference planes radically affects the ANB angle reading.

Hussels W, Nanda RS[9] developed a mathematical formula that enabled them to study the geometric influence of angle ANB caused by the following four effects: (1) rotation of the jaws and/or occlusal plane relative to the anterior cranial base; (2) anteroposterior position of N relative to point B, (3) vertical growth (distance N to B); (4) increase in dental height (distance A to B). It was observed by them that, calculated values of angle ANB vary widely with changes in the four above mentioned controlling factors under the same skeletal Class I conditions (Wit's=0). They also gave a formula to calculate the ANB angle

$$ANB = \tan^{-1}\left(\frac{a\sin y}{b - a\cos y}\right)$$

Marinho Del Santo, Jr, recently found that ANB angle is affected by the Occlusal plane angle[2].

The variability of cranial landmarks attributed to radiographic distortion[24] also has an effect on the ANB angle, there by leading to false indication of Sagittal pattern.

Thus various environmental factors affecting the ANB angle are[25,26]: the patient's age, the change of the spatial position of the nasion, the upward or downward rotation of the SN line, the upward or downward rotation of the Jaws, the change in the angle SN to the occlusal plane, the degree of facial prognathism, and recording errors.

Because of the doubts mentioned above about the accuracy of ANB angle measurements, a number of different measurements have been developed to determine the actual relationships of the denture bases including Wits Appraisal[22,23], AFB angle[27], AF-BF distance[28], App-Bpp distance[26] and McNamara's difference[30]. Each of these methods has its own limitations, thereby limiting its use as a sole sagital discrepancy indicating method.

Moreover attempts have been made to have such an ANB angle which may not be affected by the above mentioned factors. ANB + AOBO index[31], B angle[32] & Corrected ANB angle[33] are few such attempts.

Corrected ANB angle was established with the aim that it eliminates the effect of SNA angle & vertical pattern on ANB angle and thus may be a more reliable indicator of sagital discrepancy. Aim of this study was to assess the validity of Corrected ANB angle in a selected sample so that its superiority if present over ANB value could be acclaimed and its limitations could also be assessed and to establish its correlation with other sagital discrepancy indicators.

The objectives of this study were to assess the reliability of Corrected ANB angle in assessing the sagital jaw discrepancy for the selected sample, and to establish the co-relation between the Corrected ANB angle, ANB angle and Wits value.

MATERIALS AND METHODS

The study was conducted on 100 subjects (60 females, 40 males) who reported at de'Montmorency College of Dentistry & University college of Dentistry, University of Lahore. Subjects with age range of 18-30 years were selected.

Exclusion criteria included: children with craniofacial syndrome (clefts, Apert's syndrome, Cleido-cranial dysplasia. Pier Robbins syndrome etc), children with facial asymmetry children with CO-CR shift, children with supernumerary or congenitally missing teeth, children who were already undergoing with orthodontic treatment, and children with functional mandibular shift.

Sample was collected using the non-probability convenience sampling technique.

Lateral Cephalogram was taken in natural head position for each subject. Lateral Cephalogram was then traced and analyzed for each patient. SNA, SNB, ANB, SNM, Corrected ANB & wits appraisal was then calculated.

Corrected ANB was calculated using the formula

ANB* = Original ANB angle + 0.5 x (BI°-SNA angle) + 0.25 x (32°- SN-GoMe angle)[33]

STATISTICAL METHOD

SPSS 10.0 was used for statistical evaluation.

1. Mean, Standard Deviation, Variance, Minimum & Maximum value and Range were calculated for each subject.
2. Mean, Standard Deviation, Variance, Minimum & Maximum value and Range were calculated for males & females

3. Correlation coefficients between the various parameters were calculated using Pearsons correlation.
4. Correlation coefficients between the various parameters were calculated for both males & females as well using Pearsons correlation.
5. Paired t test was used to assess method error by retracing 25 Cephalograms and comparing original values with retraced values.

RESULTS

The chronological age range of the sample was 18-30 years, with the mean age of 23.09 ± 3.39 years. The mean age of 40 male subjects was 23.90 ± 3.68 years and that of the 60 female subjects was 22.50 ± 3.07 years.

The intra-examiner errors of measurements for all parameters were statistically insignificant (p-value< 0.5). The structures located in the Lateral cephalometric analysis were generally well visualized on the cephalograms. The arithmetic means, standard deviation, standard error of mean, and range for all the quantitative variables (Sagital Discrepancy Indicators & associated measurements) were computed and presented in table 1. Descriptive statistics were also calculated for males & females as shown in table 2.

	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean		Std.	
					Statistic	Std. Error	Deviation Statistic	Variance Statistic
AGE	100	12.00	18.00	30.00	23.0920	.3393	3.3926	11.510
SNA	100	18.00	72.00	90.00	82.1300	.3721	3.7211	13.847
SNB	100	24.00	66.00	90.00	78.2200	.4162	4.1623	17.325
ANB	100	19.00	-8.00	11.00	3.9000	.3262	3.2621	10.641
WITTS	100	28.00	-17.00	11.00	.8550	.4039	4.0391	16.315
SN-GoMe	100	38.00	18.00	56.00	32.7000	.6854	6.8542	46.980
ANB*	100	15.50	-6.25	9.25	3.4300	.2835	2.8351	8.038
Valid N (listwise)	100							

TABLE 1:DESCRIPTIVE STATISTICS

	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean		Std.	
					Statistic	Std. Error	Deviation Statistic	Variance Statistic
AGE	40	12.00	18.00	30.00	23.9750	.5823	3.6829	13.563
SNAM	40	13.00	77.00	90.00	83.0375	.5736	3.6275	13.159
SNBM	40	18.00	72.00	90.00	79.1625	.6627	4.1915	17.569
ANBM	40	11.00	-1.00	10.00	3.8750	.4213	2.6645	7.099
WITTSM	40	20.00	-10.00	10.00	1.3500	.5727	3.6219	13.118
SN-GoMe M	40	32.00	18.00	50.00	30.6750	.9919	6.2732	39.353
ANB*M	40	12.50	-4.75	7.75	3.4563	.3856	2.4389	5.948
AGEF	60	11.00	18.00	29.00	22.5033	.3972	3.0768	9.466
SNAF	60	16.00	72.00	88.00	81.5250	.4762	3.6885	13.605
SNBF	60	20.00	66.00	86.00	77.5917	.5237	4.0563	16.453
ANBF	60	19.00	-8.00	11.00	3.9167	.4684	3.6280	13.162
WITTSF	60	28.00	-17.00	11.00	.5250	.5542	4.2927	18.427
SN-GoMe F	60	33.00	23.00	56.00	34.0500	.8961	6.9415	48.184
ANB*F	60	15.50	-6.25	9.25	3.4125	.3991	3.0911	9.555
Valid N (listwise)	40							

M stands for males F stands for females

TABLE 2:DESCRIPTIVE STATISTICS

TABLE 3: THE CORRELATION COEFFICIENT AMONG THE SAGITAL DISCREPANCY INDICATORS

	ANB	WITTS	SNA	SN-GoMe
ANB*	.797**	.754**	-.060	-.017
ANB		.780**	.305**	.290**
WITTS			.120	.124
SNA				-.387

** Correlation is significant at the 0.01 level (2-tailed).

TABLE 4: THE CORRELATION COEFFICIENT AMONG THE SAGITAL DISCREPANCY INDICATORS & ASSOCIATED VARIABLES MALES (N1=40

	ANBM	WITTSM	SNAM	SN-GoMeM
ANB*M	.641**	.763**	-.483**	.103
ANBM		.780**	.139	.544**
WITTSM			-.164	.341
SNAM				-.185

** Correlation is significant at the 0.01 level (2-tailed).

TABLE 5: THE CORRELATION COEFFICIENT AMONG THE SAGITAL DISCREPANCY INDICATORS & ASSOCIATED VARIABLES FEMALES(N2=60)

	ANBF	WITTSF	SNAF	SN-GoMeF
ANB*M	.858**	.756**	.153	-.071
ANBM		.789**	.399**	.190
WITTSM			.249	.059
SNAM				-.457**

** Correlation is significant at the 0.01 level.

COEFFICIENT OF CORRELATION

Statistically significant and highly correlated relationship was found between the three sagittal parameters used in the study, i.e., ANB* (Corrected ANB), ANB angle and Wits Appraisal) as shown in table 2

According to the coefficient of correlation (r), the measurement with most statistically significant and highly correlated relationship with ANB* is ANB angle followed by Wits value as shown by table 3.

More over coefficient of correlation (r), showed that corrected ANB angle has no statistically significant correlation with the SNA angle & the SN-GoMe angle (vertical pattern of patient) and thus is more reliable & predictable than ANB angle which has significant correlation with both of the above mentioned variable. However it was found that large values of SNA angle on either side of mean have negative impact on the Corrected ANB angle.

Wits value is independent of the impact of both SNA and SN-GoMe that is the vertical pattern of patient but occlusal plane assessment & orientation make it unreliable.

A correlation between above mentioned variables for males & females was also calculated and is presented in table 4.

DISCUSSION

Many papers have been published on the ANB angle and the environmental factors affecting the ANB angle[7-10,18-21,25]. Comparatively smaller number of papers has been devoted to the Wits appraisal and limited to the Corrected ANB angle.

Corrected ANB angle (ANB*) was calculated by using the formula: ANB* = Original ANB angle + 0.5 x (81.5°-SNA angle) + 0.25 x (32°- SN-GoMe angle). Corrected ANB angle was developed considering that two factors primarily affects the ANB angle

1. Vertical pattern of the patient
2. and SNA angle (antero-posterior / vertical position of nasion & point A)

Impact of vertical pattern on sagital pattern[9,27,29] of the patient when assessed by ANB angle was eliminated in the above mentioned formula by removing patients SN-GoMe angle from the ideal value of SN-GoMe i.e. 32°. Correlation Coefficient (r) between ANB* angle and SN-GoMe angle in our study confirmed that that there is statistically non-significant correlation between the two (r=-0.17). Thus ANB* is a more reliable Sagital discrepancy indicator as compared to ANB angle which showed dependence on vertical pattern as shown by statistically significant correlation between the ANB angle & SN-GoMe angle in our study (r= .290).

Impact of antero-poterior / vertical position of nasion & point A on the sagital pattern of patient when assessed by ANB angle was eliminated in the above mentioned formula by subtracting patients SNA angle from the norm i.e. SNA= 81.5° Correlation Coefficient (r) between ANB* angle and SNA angle in our study confirmed that that there is statistically non-significant correlation between the two (r=-0.60). Thus ANB* is a more reliable Sagital discrepancy indicator as compared to ANB angle which showed dependence on SNA angle as shown by statistically significant correlation between the ANB angle & SNA angle in our study (r= .305). However it was found in our study that SNA angle too high on either side of mean affects the ANB* angle reliability.

No study has been conducted which shows correlation between the Corrected ANB angle and ANB or wits value, however considerable work exists showing correlation between ANB & Wits value. The correlation coefficient between the ANB angle and the Wits appraisal in our study however is higher (r=0.780) than that found by other authors[22,23,25].

Bishara et al[21] found in their study that correlation coefficients (r) between the changes in ANB and Wits were 0.627 in males and 0.598 in females. These correlations were significant at the 0.001 level of confidence. Our study also showed strong correlation between the two parameters for males (r=0.78) and females (r=0.789) however the correlations in our study were higher.

Rothberg[34] in his study found no statistically significant correlation between ANB values and the negative wits group (r=0.08) while a statistically significant correlation was found for the positive Wits group (r=0.62). Moreover he found less statistically significant correlation for the group with a positive wits value and an ANB, greater than 4 degrees (r=0.53). However correlation between the above-mentioned variables for our group was statistically stronger.

Jarvanin S[25] in his study established correlation between ANB angle & Wits value. Correlation in his study was lesser than found in our study for the above-mentioned two variables. Richardson M[37] in his study found correlation similar to that found by Jarvanin S.

Chandra PK, Godfrey K[8] in their cephalometric study consisting of thirty-three orthodontic patients (13-15 years) calculated correlation between angle ANB and Wits appraisal (r=0.95 when mandibular plane angle is within normal limits of 32 +/- 5). This correlation was higher than found in our data (r=0.779). The reason for higher correlation fond in their data as compared to ours was that they used normal angle cases only and one of the major environmental factors affecting ANB angle is mandibular rotation.

The correlation between the Wits appraisal and the SNM angle, MMA and FMA was found to be insignificant. The findings of Gazilerli's study[35], Okaty[36] and those of Richardson[37] are also similar to this. These agree with Jacobson's claim that the Wits appraisal does not change with the rotation of the jaws.

Same is shown by our study, though Cv Coefficient of variability for Wits is very high relating to unreliability regarding assessment & orientation of occlusal plane.

Thus concluded in our study that the high correlation coefficients among three sagital parameters i.e. Corrected ANB angle, ANB angle & Wits appraisal denote that these parameters are closely related to each other and may be used interchangeably. Same conclusion was found when the correlation for these parameters was calculated separately for males and females. Moreover Corrected ANB angle is amore reliable sagital discrepancy assessment indicator than the ANB angle provided Maxilla is not the cause of skeletal malocclusion.

CONCLUSION

Following conclusions can be drawn from this study:

1. High correlations were found among the three parameters used to assess the sagital jaw discrepancy i.e. Corrected ANB angle, ANB angle & Wits Appraisal showing that these sagital parameters could be used interchangeably.

2. ANB angle is affected by the vertical pattern of patient and change in antero-posterior / vertical position of nasion and point A as suggested by its statistically significant correlation with SN-GoMe angle and SNA angle while Wits

appraisal is not dependent on the rotation of jaws or SNA angle as supported by statistically insignificant correlation with SN-GoMe & SNA angle respectively.

3. Corrected ANB angle is a better sagital discrepancy assessment indicator as shown by its statistically insignificant correlation with vertical pattern of the patient measured & statistically insignificant correlation with SNA angle of the patient provided SNA angle is not too large on either side of mean.

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