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Distinct Indexes For Gauging Antero-posterior Disparity Cephalometrically In Skeletal Class I & Class II Dysplasia.

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ABSTRACT

Objective- Purpose of this study to check accuracy and validity of new indicators i.e SAR Angle, HBN Angle and μ Angle in subjects with Skeletal Class I & II malocclusion and also find the co-relation of ANB Angle with these new indicators. **Materials and Method-**Total 80 pretreatment lateral cephalograms of 16-25 years old individuals (40 each Class I & Class II) were collected and divided into Skeletal Class I & II on the basis of ANB Angle,Wits Appraisal and Mandibular Plane angle further subdivided into males and females (n=20). Stable landmarks were used to construct these new angles. **Results-** Mean and Standard Deviations were calculated for both the groups using Student's t test and Pearson's co-relation was used to find co-relation of ANB Angle with other angles. Mean values of SAR, HBN and μ angles for Skeletal Class I and Class II groups were 59.2 ±1.34 & 54.12±1.57, 41.37±1.46 & 34.87±1.63, 20.05±2.53 & 8.97±2.84 respectively. ANB angle had significant but negative correlation with SAR angle($r = -0.431^{**}$) & ($r = -0.341^{*}$) in Skeletal Class I & Class II groups respectively. **Conclusion-** SAR angle, HBN angle and μ-angle were statistically significant angles to assess antero-posterior disparities in Skeletal Class I & II groups. ANB angle had negative correlation with SAR angle in both groups. **Clinical Relevance-**Instead of relying on any one single parameter,these new indexes can be used along with conventional cephalometric analyses for assessment of antero-posterior jaw discrepancies

Keywords- Antero-posterior jaw discrepancies, SAR Angle, HBN Angle and μ Angle..

INTRODUCTION

Assessing antero-posterior jaw discrepancies form an integral part of orthodontic diagnosis and treatment planning. Since introduction of cephalometry, several cephalometric analyses have been developed to assess the sagittal jaw discrepancies.[1,2] The most routinely used cephalometric parameters for assessing sagittal jaw discrepancies are "ANB angle" and "Wits appraisal". ANB angle developed by Riedel [3] has been proved to be unreliable indicator to assess sagittal discrepancy. Several authors [4,5,6] have shown that the position of nasion is not fixed during growth, and any displacement of nasion will directly affect the ANB angle.[7] Furthermore, rotation of the jaws by either growth or orthodontic treatment can also change the ANB reading.[8] ANB angle related problems were resolved with the introduction of "Wits appraisal" by

Jacobson(1975) that relates points A and B to the functional occlusal plane.[8,9] However, Wits appraisal also has its own limitations. Any change in the angulation of functional occlusal plane caused profound change in the measurement reading or difficulty in identification of the occlusal plane especially patients in mixed dentition stage, open bite, skeletal asymmetries, missing teeth or multiple impactions as well as orthodontic intervention also posed additional problem.[10,11,12] Therefore, precision and reliability of both these parameters have been challenged as both "SN" and "occlusal" planes get affected by several factors. To overcome ANB Angle & Wits Appraisal related drawbacks, new indexes like **µ Angle[13], SAR Angle[14]** and **HBN Angle[15]** have been introduced , which are not dependent on cranial landmarks or dental occlusion. The aim and objective of this study was to check the accuracy and validity of these new indexes which were based on stable landmarks that measured the true apical base discrepancy in Skeletal Class I and Class II groups and also found their co-relation with ANB Angle.

MATERIAL AND METHOD

A retrospective study was conducted among patients seeking for orthodontic treatment. Total 350 pre-treatment lateral cephalograms were scrutinized among which 80 lateral cephalograms were selected on the basis of inclusion criteria. ANB Angle, Wits appraisal and Mandibular Plane Angle were measured to assign the lateral cephalograms to Skeletal Class I & II groups (n =40) which were further divided into two groups i.e male and female (n=20).

Patients with age group 16- 25 years were included in the study. Skeletal Class I & Class II pattern were indicated by ANB angle = 2-4 degree, Wits appraisal : male: -1mm, female: 0mm, MPA = 25º±2, Angle class I molar relationship and ANB angle = greater than 4 degree, Wits appraisal more than normal i.e Male >-1mm, Female > 0mm, MPA = 25º±2, Angle class II molar relationship respectively. Cephalograms with unacceptable quality , history of orthodontic intervention/ TMJ trauma cases, facial asymmetry, missing canine/ molars, end on molar relationship were excluded.

Table 1: Comparative evaluation of various cephalometric parameters in Skeletal Class I and Class II Groups.

Groups	ANB-Angle		WITS (mm)		SAR-angle		HBN Angle		µ Angle	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Class I (N=40)	1.400	1.0266	.263	1.3008	59.200	1.3436	41.375	2.5388	20.050	1.4667
Class II (N=40)	6.525	1.1764	4.588	.9993	54.125	1.5720	34.875	1.6359	8.975	2.8419
Student 't' test Value	-20.760		-16.676		15.521		13.611		21.902	

Table 2: Comparative evaluation of various cephalometric parameters between male & female subjects among Skeletal Class I Group.

Groups	ANB-Angle		WITS (mm)		SAR Angle		HBN Angle		µ Angle	
Class I	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
MALE (N=20)	1.375	1.0622	0.475	1.1973	59.50	1.1002	42.050	2.7429	20	1.5218
FEMALE (N=20)	1.425	1.0166	.050	1.3945	58.900	1.5183	40.700	2.1788	20.100	1.4473

The radiographs were exposed at 85KV/ 10mA for 1.75 second. X ray source to mid- sagittal plane of patient's head distance was 5 feet (152.4cm). Patient's mid- sagittal plan to film distance was 15cm. All lateral cephalograms were read on 0.003inches lacquered polyester tracing papers i.e acetate matte sheet using 0.35 mm lead pencil under the same illumination. All cephalograms were traced and analyzed by a single operator in a standardized manner to avoid errors due to inter-operator variations. To determine SAR Angle, HBN Angle and µ Angle, Points G and M were located using a transparent template

containing number of circles. These landmarks were utilized to represent the maxilla and mandible respectively. Each center was identified by a pinhole in the template.

Table 3: Comparative evaluation of various cephalometric parameters between male & female subjects among Skeletal Class II Group.

Groups	ANB-Angle		WITS (mm)		SAR Angle		HBN Angle		μ Angle	
Class II	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
MALE (N=20)	6.400	1.0463	4.825	.8777	54.000	1.5560	35.000	2.1521	8.400	2.7606
FEMALE (N=20)	6.650	1.3089	4.350	1.0773	54.250	1.6182	34.750	.9105	9.550	2.8741

Each film were traced by single operator and the data was suitably compiled and analyzed by using appropriate statistical method. Student's t-test was used to analyze the variation in Mean between Skeletal Class I & Class II group with a normal distribution and Pearson's Correlation was used to find co-relation of ANB Angle with SAR Angle , HBN Angle and μ Angle with ANB Angle.

To determine the μ angle, SAR angle and HBN angle following anatomic landmarks were used.

Table 4: Correlation Coefficient between various cephalometric parameters among Skeletal Class I Malocclusion Group.

Correlation Coefficient					
		ANB	SAR	HBN	μ
ANB	Pearson Correlation	1	-.431**	-.133	-.209
	Sig. (2-tailed)		.005	.414	.195
	N	40	40	40	40
SAR	Pearson Correlation	-.431**	1	.391*	.164
	Sig. (2-tailed)	.005		.013	.312
	N	40	40	40	40
HBN	Pearson Correlation	-.133	.391*	1	.229
	Sig. (2-tailed)	.414	.013		.155
	N	40	40	40	40
μ	Pearson Correlation	-.209	.164	.229	1
	Sig. (2-tailed)	.195	.312	.155	
	N	40	40	40	40
**. Correlation is significant at the 0.01 level (2-tailed).					
*. Correlation is significant at the 0.05 level (2-tailed).					

Point A: Deepest point on the midline of maxilla, which moves from base to alveolar process.[13]

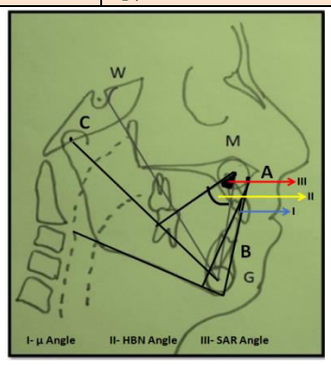
Point B: Most anterior part of base of mandible and the most posterior point of the outer contour of mandibular alveolar process in midline.[13]

Mandibular plane: Is tangential line on the lower border of the mandible.[13]

Point W (Walkers Point): The Mean intersection point of the lower contours of the anterior clinoid processes and the contour of the anterior wall of sella turcica.

Table 5: Correlation Coefficient between various cephalometric parameters among Skeletal Class II Malocclusion Group.

Correlation Coefficient					
		ANB	SAR	HNB	µ
ANB	Pearson Correlation	1	-.341*	-.152	-.165
	Sig. (2-tailed)		.031	.351	.310
	N	40	40	40	40
SAR	Pearson Correlation	-.341*	1	.505**	.024
	Sig. (2-tailed)	.031		.001	.885
	N	40	40	40	40
HNB	Pearson Correlation	-.152	.505**	1	.005
	Sig. (2-tailed)	.351	.001		.976
	N	40	40	40	40
µ	Pearson Correlation	-.165	.024	.005	1
	Sig. (2-tailed)	.310	.885	.976	
	N	40	40	40	40



Point C: Center of the condyle, found by tracing the head of the condyle, and approximating its center.[15]

µ Angle is the angle between AB line and perpendicular line from A to mandibular plane (Figure 1-I)

HBN Angle is the angle between the perpendicular line from point M to C-G line and the M- G line (Figure1-II)

SAR Angle is the angle between the perpendicular line from point M to W-G line and the M-G line (Figure1-III).

RESULT

In our study mean value of SAR angle was 59.2 ±1.34 & 54.12±1.57, HBN angle was 41.37±1.46 &34.87±1.63, µ angle was 20.05±2.53 &8.97±2.84 among Skeletal Class I & II groups respectively. There was statistically highly significant difference found for cephalometric parameters in Skeletal Class I and Class II groups. (p=0.001) (Table 1)

Mean value of SAR angle was 59.5±1.10 &58.9±1.51, HBN angle was 42.05±2.74 & 40.7±2.17, µ angle was 20±1.52 & 20.1±1.44 among male & female Skeletal Class I group respectively. There was statistically no significant difference found between male & female subjects among Skeletal Class I group. (p>0.05). (Table 2)

Mean value of SAR angle was 54.0±1.55 &54.25±1.61, HBN angle was 35.0±2.15 & 34.7±0.91, µ angle was 8.4±2.76 & 9.55±2.87 among male & female Skeletal Class II group respectively. There was statistically no significant difference found between male & female subjects among Skeletal Class II group. (p>0.05). (Table 3)

ANB Angle had significant but negative correlation with SAR angle(r = -0.431**) & (r = -0.341*) while non significant negative correlation with HBN angle (r=-0.133) & (r=-0.152) and µ angle(r=-0.209) & (r=-0.165) in Skeletal Class I & Class II groups respectively. SAR also had a significant positive correlation with HBN Angle (r= .391*) & (r= .505**) in Skeletal Class I & Class II groups respectively. (Table 4 & 5)

DISCUSSION

An accurate sagittal jaw relationships is essential in orthodontic diagnosis and treatment planning. ANB is widely used, but it is affected by numerous factors and can often be misleading. A commonly used substitute, Wits appraisal, does not depend on cranial landmarks or rotation of the jaws but still has the problem of correctly identifying the functional occlusal plane in conditions such as in mixed dentition patients or patients with open bite, severe cant of the occlusal plane, multiple impactions,

missing teeth, skeletal asymmetries or orthodontic treatments.[10,11,12]

Almost every parameter which was developed to evaluate sagittal jaw disparities have some limitations. Parameters based on stable landmarks which are easy to locate and reproduce should be used to denote sagittal jaw base discrepancy. To overcome these difficulties new indexes were introduced which were based on more stable landmarks. SAR angle uses point M, point G which have already been proved to be an advantage over locating points A and B and walkers point which was found to be stable in all periods of pubertal growth.[14] A study done by Lino *et al*[16] to evaluate the age related changes in the soft tissue profile from second to fourth decade used the Walkers point as a stable reference point for their analysis.

In the present study mean value of SAR angle was 59.2 ±1.34 & 54.125±1.57 among Skeletal Class I & II groups respectively. There was statistically highly significant difference found for cephalometric parameters in Skeletal Class I and Class II groups. (p=0.001) (Table 1) This result was in accordance with the study done by Agarwal S et al[14] in which mean value of Skeletal Class I & II groups were 55.98±2.24 & 50.18±2.70 respectively. There was statistically no significant difference found between male & female subjects of Skeletal Class I and II groups. (Table 2 & 3) ANB Angle had significant but negative correlation with SAR angle($r = -0.431^{**}$) & ($r = -0.341^{*}$) SAR also had a significant positive correlation with HBN Angle ($r= .391^{*}$) & (r= .505**) in Skeletal Class I & Class II groups respectively. (Table 4 & 5)

HBN Angle uses 3 landmarks such as the apparent axis of the condyle, M midpoint of the premaxilla, and G center of the largest circle that is tangent to the internal inferior, anterior and posterior surfaces of the mandibular symphysis.[15] The advantage of locating "C" the center of the head of the condyle versus the condylion point, as used by McNamara[17] is that very precise tracing of the contour of the condyle is not really necessary. The clinician can visualize and approximate the center with a minimum error in the HBN angle as long as that point is within 2 mm of its actual location.[15] Growth increments according to C axis up to age 14 in males and females display average yearly growth increments 1.14 mm and 1.31 mm/year, respectively. This difference is not statistically significant.[15]

In the present study mean value of HBN angle was 41.37±1.46 & 34.87±1.63 among Skeletal Class I & II groups respectively. There was statistically highly significant difference found for cephalometric parameters in Skeletal Class I and Class II groups. (p=0.001) (Table 1) this result was in accordance with the study done by Dave HB et al (2015)[15] in which mean value of Skeletal Class I & II groups were 42.88° ± 2.23° and <39° respectively. There was statistically no significant difference found between male & female subjects of Skeletal Class I and II groups.(Table 2 & 3)

In the present study mean value of µ angle was 20.05±2.53 & 8.97±2.84 among Skeletal Class I & II groups respectively. There was statistically highly significant difference found for cephalometric parameters in Skeletal Class I and Class II groups. (p=0.001) (Table 1) this result was in accordance with the study done by Dave HB et al[13] in which mean value of Skeletal Class I group was between 16.1º- 23.9º and more acute angle was for Skeletal Class II group. There was statistically no significant difference found between male & female subjects of Skeletal Class I and II groups. (Table 2 & 3)

CONCLUSION

It was concluded from the present study that SAR angle, HBN angle and µ-angle were statistically significant angles to assess anteroposterior disparities in Skeletal Class I & Class II groups. ANB angle had significant but negative correlation with SAR angle($r = -0.431^{**}$) & ($r = -0.341^{*}$) SAR also had a significant positive correlation with HBN Angle ($r= .391^{*}$) & (r= .505**) in Skeletal Class I & Class II groups respectively. Hence, instead of relying on any one single parameter, others parameters like (SAR, HBN & µ Angles) should also be checked and correlated with clinical findings.

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