ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 5, Issue – 3, May - 2022, Page No. : 186 - 196

Beta Angle As A Viable Alternative To Steiner's Analysis'ANB To Identify Sagittal Discrepancies

[1]Dr. Ben Joshua, Assistant Professor, Department of Orthodontics, Yogita Dental College And Hospital, Khed.

[2]Dr. M. M. Varadarajan, Professor and Head, Department of Orthodontics, CSI college of Dental sciences and Research Madurai.

[3]Dr. Chetan Patil, Professor and Head, Department of Orthodontics, Yogita Dental College and Hospital, Khed.

[4]Dr. Aameer Parkar, Assistant Professor, Department of Orthodontics, Yogita dental college and hospital Khed. 250 Furus, Falsonda, Ratnagiri.

[5]Dr. Snehal Bhalerao, Assistant Professor, Department of Orthodontics, Yogita dental college and hospital Khed. Staff quarters, Yogita dental college and hospital Khed.

Corresponding Author: Dr. Ben Joshua, Assistant Professor, Department of Orthodontics, Yogita dental college and hospital Khed. Staff quarters, Yogita dental college and hospital Khed.

Citation of this Article: Dr. Ben Joshua, Dr. M. M. Varadarajan, Dr. Chetan Patil, Dr. Aameer Parkar, Dr. Snehal Bhalerao, "Beta Angle As A Viable Alternative To Steiner's Analysis' ANB To Identify Sagittal Discrepancies", IJDSIR- May - 2022, Vol. – 5, Issue - 3, P. No. 186 – 196.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: In orthodontic diagnosis and treatment planning a valid evaluation of an antero-posterior jaw relationship is vitally important. To assess the antero-posterior jaw discrepancy between the maxilla and the mandible, various angular and linear measurements have been suggested so as to reach an accurate diagnosis.

Aim: To compare ANB angle, Beta angle used to measure sagittal dysplasia and to find out which is the most reliable amongst them.

Materials and methods: Sample comprised of 400 pre-treatments lateral Cephalograms. The variables calculated were SNA Angle, SNB Angle, ANB Angle and the Beta Angle

Results: ANOVA test, Pearson correlation and few other statistical tests were performed and the differences, associations and correlations were found between ANB Angle and Beta Angle in all the subjects

Conclusion: It is safe to conclude that similar to the ANB angle, the Beta angle is also a significant angle to assess the sagittal jaw relationship between maxilla and mandible.

Keywords: Antero-Posterior Discrepancy, Beta Angle, ANB Angle

Introduction

The ANB angle and Wits analysis are the two most frequently used parameters for the assessment of the apical base relationship. However, the Beta Angle is

considered having greater accuracy, greater angular rangeand being unaffected by the facial forms.

In the cephalometric radiographic analysis, angle ANB is commonly used to describe skeletal discrepancies between the maxilla and the mandible. Doubts exist over the dependence on the ANB angle to establish the anterior-posterior discrepancy[1]. Any cephalometric analysis that is based on angular or linear measurements has common flaws, which are given in detail by Moyers et al. The position of nasion is not fixed during growth, and the displacement of the nasion will affect the ANB angle[2]. These measurements can be affected by various elements. For instance, the rotation of the head sideward or upward during exposure to x rays of the lateral cephalogram, could have its impact on the ANB values. The Wits appraisal avoids the use of nasion and reduces the rotational effects of jaw growth. Thus, Wit's appraisal given by Jacobson helped overcome problems related to the ANB angle.

However, it generates two major issues namely, the correct identification of the occlusal plane which is not accurately reproducible, mostly in open bite cases and, any changes in the angulation of the functional occlusal plane, due to normal development of the dentition or due to orthodontic treatment, can adversely affect the Wits appraisal. A measurement called the Beta angle was recently developed in 2004 by Baik and Ververidou which did not depend on any cranial landmarks and can be used whenever the previously established analysis failed to assess the sagittal discrepancy [2].

The debate over an ideal variable to judge the antero-posterior discrepancy has been going on for many years. The goal of our study is to view the correlation between Beta angle and ANB and to assess whether Beta angle can be used as a guide to assess the seriousness of skeletal sagittal dysplasia in subjects.

Materials and methods

This retrospective study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, CSI College of Dental Sciences and Research, Madurai.

Sample comprised of 400 pre-treatments lateral Cephalograms. The variables calculated were SNA angle, SNB angle, ANB angle and Beta Angle.

Study was done using the available pre-treatment lateral cephalograms of patients with malocclusion requiring orthodontic treatment. Patients selected were between the age group of 10–47 years and have not undergone any orthodontic treatment before.

The lateral Cephalograms that were used were exposed with jaws held in centric relation, lips placed in a relaxed position, and the head which was held in the Natural head position (NHP). The cephalograms were taken with Sirona Orthophos XG X -ray machine. (Figure 1)

All the radiographs were recorded with the same exposure parameters by the same machine. The radiographs tracings were done, and the ANB angle, Beta angle were measured to find the sagittal dysplasia and most valid angle amongst them.

The various classes of malocclusion were included in the study. The exclusion criteria for the study were patients having craniofacial anomalies and cleft palate or any history of previous orthodontic therapy.

All the lateral cephalograms of the patients were traced for angle ANB in thefollowing manner:

The following landmarks were used to measure the ANB angle

- Sella turcica (S)
- Sub spinale (A point)
- Sup ramentale (B point)

Measurement for the ANB angle was done in the following way

- The SN line which is drawn from the Sella to the nasion
- The NA line which is drawn from the nasion to the point A
- The NB line which is drawn from the nasion to point B

SNA angle is the angle which was measured between the SN line and the NA line SNB angle is angle which was measured between the SN line and the NB line

ANB angle is the angle which was calculated by measuring the difference between the SNA angle and the SNB angle.

All the patients were divided into 3 skeletal classes based on angle ANBANB ANGLE

- Class I skeletal pattern - 1° to 3°
- Class II skeletal pattern - greater than or equal to 4°
- Class III skeletal pattern - less than 1°

The Beta angle uses three skeletal landmarks, A point, B point, and the C point which is the axis of the condyle. It was used to measure an angle which explains the severity of the malocclusion in the sagittal direction.

Points

1) A point: It is the deepest midline point on the premaxilla between the ANSand the prosthion

2) B point: It is the most posterior point in the concavity between the in fradentale and the pogonion

3) C point: It is the canter of the condyle. It is established by tracing the head of the condyle and approximating its centre.

Lines

- C-B line (figure 3)
- Line which connects points A and B. (Figure 2)
- Line from A point which is perpendicular to the C-B line. (Figure 4)

Lastly, by establishing Beta angle, between the last perpendicular line and the A-Bline.

Beta angle

1. Class I skeletal pattern- 27° to 35°
2. Class II skeletal pattern- less than 27°
3. Class III Skeletal pattern -greater than 35°

Advantage of beta angle

- In cases when the jaws are rotated clockwise or counter clockwise, it remainsconstant
- As it is not affected due to growth, orthodontic or orthognathic intervention, it can be used in consecutive comparisons throughout orthodontic treatment.

Materials

1. X- ray viewer
2. Matt acetate cephalometric tracing sheets.
3. 3H pencil
4. 400 pre-treatments lateral cephalograms

Methodology

1. Pre-treatment cephalograms were traced by manual method.

2. The important hard and soft tissue structures were then traced and marking was done on the radiographs.

3. The different reference points, planes and angles were traced on the radiographs. These following parameters are recorded for evaluation and comparison.

Figure 1: Orthophos xg x-ray machine

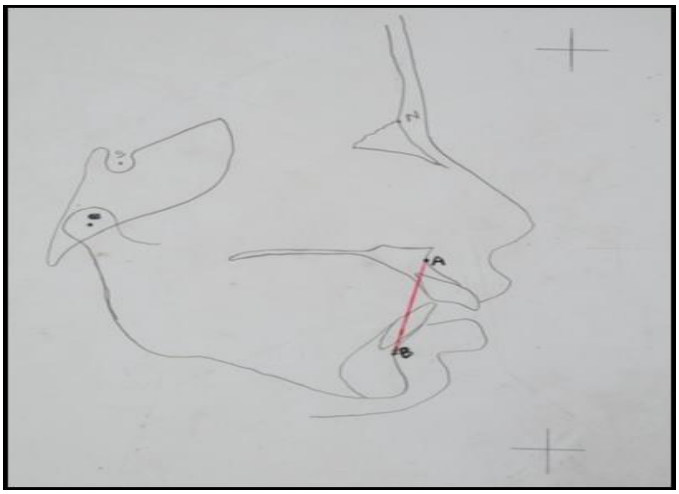

Figure 2: Ab line

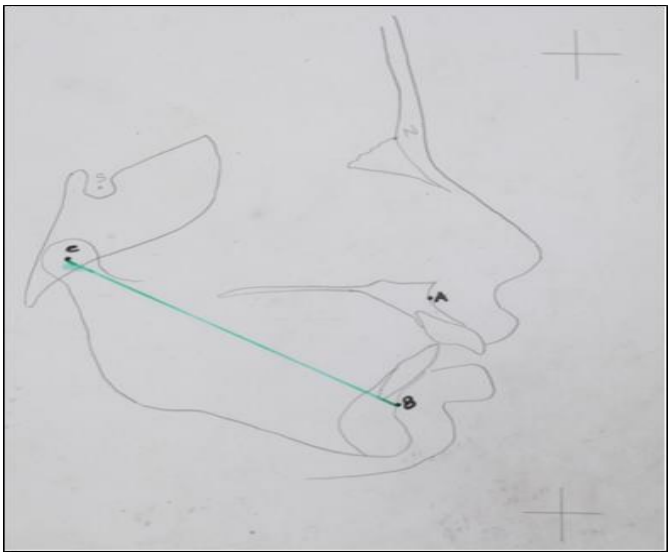

Figure 3: CB line

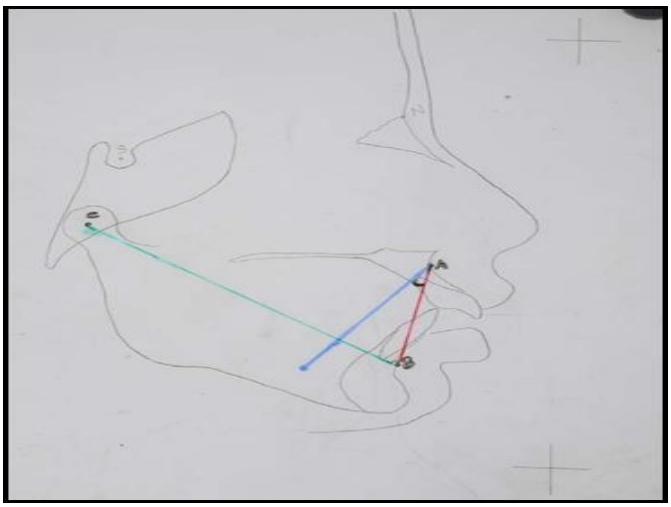

Figure 4: Line from the Point A perpendicular to the C-B line.

Results

Based on Gender (Table 1, 12)

There were a total of 173 males and 227 females. In males, the mean ANB angle was 3.08° and the mean Beta angle was 29.4°. In females, the mean ANB angle was 3.48° and the mean Beta angle was 29.3°. No statistically significant differences were found as P value>0.05

Based on Mean (Table 2)

the mean age was found to be 18 years in our study. The mean SNA angle and the SNB angle were found to be 80.9° and 77.5° respectively and the mean ANB angle and Beta angle were found to be 3.3±2.59° and 29.37±5.39° respectively showing the greater variation of beta angle.

Based on ANB angle classification (Table 3)

the 400 cephalograms were classified as

Class I-174 cases

Class II-184 cases

Class III-42 cases

Based on Beta angle classification (Table 4)

the 400cephalograms were classified as

Class I-218 cases

Class II-136 cases

Class III-46 cases

According to the Pearson Correlation coefficient (Table 5), the P value<0.05. There is a negative correlation between ANB angle and Beta angle in beta angle class I, class II and class III with the correlation coefficient -0.553, -0.33 and –

0.69 and the correlation is also statistically significant with the P value <0.05 showing that as the ANB angle increased, Beta angle decreased.

In the above table the beta values for each beta group according to the ANB classes is compared. From the above results there is an association between beta group

class I (P<0.01) and class II (P=0.0030) with ANB groups. But there is no association between beta group class III and ANB groups (P=0.0695). (Table 6)

In the above table the ANB values for each ANB group according to the Beta classes is compared. From the above results there is an association between ANB group class I (P<0.01) and class II (P<0.01) with Beta groups. (Table 7)

In the above table the ANB angle is compared between different classes and the obtained P value is <0.001 which is statistically significant. It says that there is a difference in the ANB angle means scores between the classes.

According to ANOVA analysis (Table 8), the ANB angle in class I cases, the mean was found to be 2.03°. In class II cases, the mean was found to be 5.55° and in class III cases the mean was found to be -1.26°

ANOVA showed that the P value is less than 0.05, which shows statistically significant difference between the groups.

According to ANOVA analysis (Table 9), the Beta angle in class I cases, the mean was found to be 30. 95°.In class II cases, the mean was found to be 23.65° and in class III cases the mean was found to be 38.76°

In the above table the BETA angle is compared between different classes and the obtained P value is <0.001 which is statistically significant. It says that there is a difference in the Beta angle means scores between the classes.

ANOVA showed that the P value is less than 0.05, which shows statistically significant difference between the groups.

According to classification in ANB classes (Table 10)

the Beta angle was found to have a mean of 31.61° in class I cases, 25.4° in class II cases and 37.2° in class III cases.

According to classification in Beta classes (Table 11)

the ANB angle was found to have a mean of 2.68° in class I cases, 5.61° in class II cases and -0.54° in class III cases.

In the above table the ANB angle and Beta angle were compared between males and females. The P values in the above table are 0.1281 for ANB angle and 0.7939 for Beta angle which are greater than 0.05. So there is no statistical significant difference in the two parameters between genders. (Table 12)

According to Post Hoc Scheffe's Test (TABLE 13), significant differences were found in the mean difference of the different skeletal group patterns in ANB angle and Beta angle. Post hoc Scheffe's test was done to analyze the independent variables. The lowest and highest ranges were noted in this test.

Intra class correlation (Table 14) between the two raters (student & staff) for both ANB and Beta are good correlations with the average value of 0.81 (ANB) and 0.82 (Beta). Also the P value is statistically significant, which says that there is a good correlation between the two raters.

As P value of 0.9 was deemed to be excellent correlation, our value 0.81 (ANB) and

0.82 (Beta) was considered good correlation.

Based on Table 15, it can be deduced that significant variations exist amongst the mean values of different Beta skeletal classes obtained from studies done by various authors.

Table 1: frequency table for gender.

Gender	**N (%)**
Male	173 (43.25)
Female	227 (56.75)
Total	400 (100)

Table 2: descriptive statistics for age, anb angle andbeta angle.

Variable	N	Mean (Standard deviation)	Range
Age in years	400	18.055 (5.48)	10 – 47
SNA angle	400	80.9 (4.13)	68 – 93
SNB angle	400	77.555 (4.14)	66 – 90
ANB angle	400	3.3075 (2.59)	-6 to 9
Beta angle	400	29.37 (5.39)	13 – 49

Table 3: Distribution for anb angle

ANB angle	N (%)
Class I (1,2,3)	174 (43.50)
Class II (>=4)	184 (46.00)
Class III (<=0)	42 (10.50)
Total	400 (100)

Table 4: distribution for beta angle

Beta angle	N (%)
Class I	218 (54.5)
Class II	136 (34)
Class III	46 (11.50)
Total	400 (100)

Table 5: Table for correlation

ANB angle Vs. Beta angle	N	Correlation (r) coefficient	P value ^{K}P
Beta angle Class I	218	-0.5464	<0.001
Beta angle Class II	136	-0.33	<0.001
Beta angle Class III	46	-0.69	<0.001

K- Karl Pearson correlation

Table 6: Among beta groups-association between and anbangle and beta angle

Beta group	ANB group			Total	P value
	Class I	Class II	Class III		

	N (%)	N (%)	N (%)		
Class I	140 (64.22)	62 (28.44)	16 (7.34)	218 (100)	<0.01
Class II	14 (10.29)	122 (89.71)	0	136 (100)	0.0030
Class III	20 (43.48)	0	26 (56.62)	46 (100)	0.0695
Total	174 (43.5)	184 (46)	42 (10.5)	400 (100)	

K-Kruskal Wallis test

Table 7: among anb groups-association between and betaangle and anb angle

ANB group	Beta group			Total	P value[K]P
	Class I N (%)	Class II N (%)	Class IIIN (%)		
Class I	140 (80.46)	14 (8.05)	20 (11.49)	174 (100)	<0.001
Class II	62 (33.7)	122 (66.3)	0	184 (100)	<0.001
Class III	16 (38.1)	0	26 (61.9)	42 (100)	0.0003
Total	218 (54.5)	136 (34)	46 (11.5)	400 (100)	

Table 8: comparison of anb angle between classes

Class	N	Mean (SD)	P value [A] P
Class I	174	2.03 (0.82)	<0.001
Class II	184	5.55 (1.42)	
Class III	42	-1.26 (1.68)	

A- One way ANOVA

Table 9: comparison of beta angle between classes.

Class	N	Mean (SD)	P value [A] P
Class I	218	30.95 (2.3)	<0.001
Class II	136	23.65 (2.47)	
Class III	46	38.76 (3.6)	

A- One way ANOVA

Table 10: Descriptive statistics for beta angle in anbclasses

ANB Classes	N	Mean (Std. deviation)	Range
Class I	174	31.61 (3.26)	24 - 39
Class II	184	25.44 (3.56)	13 - 33
Class III	42	37.28 (5.17)	30 - 49

Table 11: descriptive statistics for anb angle in betaclasses

Beta Classes	N	Mean (Std. deviation)	Range
Class I	218	2.68 (1.68)	-1 to 7
Class II	136	5.61 (1.67)	2 to 9
Class III	46	-0.54 (2.15)	-6 to 3

Table 12: Gender wise comparison of anb angle and betaangle

Parameter	Male		Female		P value [T]
	N	Mean (SD)	N	Mean (SD)	P
ANB angle	173	3.08 (0.21)	227	3.48 (0.16)	0.1281
Beta angle	173	29.45 (0.45)	227	29.31 (0.33)	0.7939

T-Unpaired Student's T test

Table 13: Comparison of different classes in anb angle andbeta angle using post hoc test

Dependentvariable	**(I)**	**(J)**	**Mean difference (I-J)**	**P value**	**95% Confidence Interval**
ANB angle	Class I	Class II	-3.531	0.000	-3.851, -3.211
		Class III	3.291	0.000	2.771, 3.81
	Class II	Class I	3.531	0.000	3.211, 3.851
		Class III	6.821	0.000	6.305, 7.338
	Class III	Class I	-3.291	0.000	-3.81, -2.771
		Class II	-6.821	0.000	-7.338, -6.305
Beta angle	Class I	Class II	7.299	0.000	6.616, 7.982
		Class III	-7.806	0.000	-8.821, -6.792
	Class II	Class I	-7.299	0.000	-7.982, -6.616
		Class III	-15.106	0.000	-16.172, -14.041
	Class III	Class I	7.806	0.000	6.792, 8.821
		Class II	15.106	0.000	14.041, 16.172

Table 14: comparison of beta angles between two raters.

Number of cases = 35

Number of raters = 2

Beta	ICC	[95% Conf. Interval]
Individual	.6952406	.4773684 .8330955
Average	.8202264	.6462415 .9089494

P value = 0.000

Note: ICCs estimate correlations between individual measurements and between average measurements made on the same target

Table 15: Comparision of beta anle means in differentskeletal classes amongst various studies.

Name of the study	Beta skeletalclass i mean	Beta skeletalclass ii mean	Beta skeletalclass iii mean
1) our study	30.95°±2.3°	23.65°±2.47°	38.76°±3.6°
2) maruthi (2018)	29.3°	24°	37°
3) Atul jajoo (2018)	31.7°±3.8°	24.9°±2.1°	39.2°±3.6°
4) Dhinahar (2017)	30.9°±3.2°	26.7°±6.4°	41.7°±5.4°
5) Baik (2004)	31.2°±2°	24.5°±3°	40.0° ± 4.2°
Rajesh Agarwal(2013)	32.3°	23.8°	39.8°
7) Irfan Qamruddin (2012)	30.4°±2.6°	26.9°±6°	34.7°±5.4°
8) Alam (2016)	31.04°±2.8°	24.4°±2.3°	35.2°±2.8°

Discussion

Various angular and linear measurements are used to assess the maxilla- mandibular sagittal discrepancy, which are of prime importance in diagnosis and treatment planning.

The present study showed that the beta angle had a mean value of 30.95±2.3° for skeletal Class I group, 23.65±2.47° for skeletal Class II group, 38.76±3.6° for skeletal Class III group. Similar results were found in the study done by Baik and Ververidou where the mean value for beta angle in skeletal Class I subject was 31.1°

± 2°, for skeletal Class II was 24.5° ± 3°, for skeletal Class III was 40.0° ± 4.2°. In a study done by Vick ram Maruthi[4], the beta angle for class I skeletal base was found to be 29.3°, class II skeletal base was found to be 24°, class III skeletal base was found to be 37°. Based on ANOVA analysis, there was statistically significant difference between the different classes of malocclusion in patients who reported to CSI College of dental sciences and research, Madurai for treatment.

In our study, the mean scores of ANB angle in class I skeletal pattern were 2.03° ± 0.82°, class II skeletal pattern were 5.55° ± 1.42°, and for class III skeletal pattern were –1.26° ± 1. 68°.Significant differences were found in ANB angle and beta angle for all the three skeletal groups. It should be noted that contrary to the steiner's analysis which provides a diagnosis of class II malocclusion for higher values of ANB and class III malocclusion for lower values of ANB, the Beta angle gives a diagnosis of class III for higher values (35° and above) and class II for lower values (27° and below).

Therefore an inverse proportionality exists between ANB and Beta angles where decrease in one angle reflects as an increase in the other angle.

Our results were comparable to the study conducted by Agarwal2 in Jaipur population. This study showed that the population groups showed a significant negative correlation for ANB and Beta Angle, suggesting that as ANB increased, Beta angle decreased and vice versa. This is true as in steiner's analysis it is class III, class I, class II in ascending order and in beta analysis, it is class II, class I, class III in ascending order respectively

Conclusion

Based on our study and with the given sample size, we came to a conclusion, that the range of normal Beta class I relation of 24°-39° seems to be appropriate as a representative range of class I occlusion in our population.

As can be expected, our sample size consisted of more female patients than males; no gender disparity was noted regarding various classification of malocclusion.

A significant finding which can be deduced was that an excellent correlation was seen in class II malocclusion across Beta and ANB angle.

This finding has significant ramification with regard to Beta angle being a viable alternative to the Steiner's ANB angle when it comes to confirming a diagnosis of class II malocclusions

A possible explanation for disparities in number of class I ANB and class I Beta angle could be the range of 27°-35° offered by Baik and Ververidou requiring slight modifications to suit our geographic region and racial phenotype.

Based on our study, a better representative range of class I malocclusion with regards to Beta angle can be altered to 25°-37°

References

1. Relwani P, Gowda NC, Ramegowda S. Comparative assessment of changes in sagittal relationship of maxilla to mandible in class II malocclusion–a cephalometric study. Indian Journal of Orthodontics and Dentofacial Research. 2016 Apr;2(2):77-82.

2. Baik CY, Ververidou M. A new approach of assessing sagittal discrepancies: the Beta angle. American Journal of Orthodontics and Dentofacial Orthopedics. 2004 Jul 1;126(1):100-5.

3. Jajoo A, Agarkar SS, Sharma S, Gadhiya N, Sona wane S, Narkhede S. Comparison of Beta and ANB Angles for Evaluation of Sagittal Skeletal Discrepancy: A Cephalometric Study. The journal of contemporary dental practice. 2018 Jun;19(6):739-42.

4. Maruthi V, Kandasamy S. Establishment of norms of the beta angle to assess the sagittal discrepancy for Chennai population: A prospective study. International Journal of Pedodontic Rehabilitation. 2016 Jul 1;1(2):52.

5. Agarwal R, Sharma L, Soni VK, Yadav V, Shami Soni D, Singh K. Comparison of different angular measurements to assess sagittal Jaw discrepancy in Jaipur population-A cephalometric study. IOSR Journal of Dental and Medical Sciences. 2013 Jan;10(1):33-6.

6. Agarwal S, Bhagchandani J, Mehrotra P, Kapoor S, Jaiswal RK. The SAR Angle: A Contemporary Sagittal Jaw Dysplasia Marker. Orthodontic Journal of Nepal.;4(2):16-20.

7. Ahmad SH, Jahjah YT. Comparison of Different Sagittal Dysplasia Indicators in a Sample from Syrian Population. International Journal of Biomedical Science and Engineering. 2016 Mar 17;4(2):7.

8. Ahmed M, Shaikh A, Fida M. Assessment of the facial profile: The Correlation between Various Cephalometric Analysis and the Soft Tissue Angle of Convexity. J Pak Dent Assoc 2017; 26 (2) :59-66

9. Alam MK, Qamruddin I, Basri R, Al Harun KA, bin Mat Arifin MN, binti Kamara zaman K. Cephalometric Comparison of Sagittal Analyses between Malay and Malaysian Chinese: Old and Recent Approach. International Medical Journal. 2016 Aug 1;23(4):420-3.

10. Alam MK, Qamruddin I, Basri R, Begum S, Sikder MA, Saifuddin M. Assessment of Sagittal Discrepancies in Bangladeshi Adults: Latest and Old Approaches. International Medical Journal. 2016 Aug 1;23(4):411-3.

11. Alam MK, Qamruddin I, Muraoka R, Nakano K, Okafuji N. Validity of W Angle and YEN Angle in a sample from Pakistani and Bangladeshi populations. Journal of Hard Tissue Biology. 2014;23(3):351-6.

12. Alam MK, Qamruddin I, Sidiki MN, Basri R, Al Harun KA, bin Mat Arifin MN, binti Kamara zaman K. Assessment of Sagittal Discrepancies between Malaysian Chinese and Pakistani Population: Latest and Old Approaches. International Medical Journal. 2016 Aug 1;23(4):434-7.

13. Alma rami BS, Alhammadi MS, Cao B. Three-dimensional reliability analyses of currently used methods for assessment of sagittal jaw discrepancy. Journal of clinical and experimental dentistry. 2018 Apr;10(4): e352.

14. Al-Mashhad any SM. The relation between W angle and other methods used to assess the sagittal jaw relationship. Journal of Baghdad college of dentistry. 2012;24(2):144-9.

15. Al-Mothaffar N, Toma RR. The morphology and texture of Iraqi skeletal class II young adults (Cephalometric study). Journal of Baghdad college of dentistry. 2011;23(3):137-43.

16. Anwar A, Baig MS, Bukhari SM, Pasha H, Khalid Z. Reliability of beta angle in determination of sagittal skeletal discrepancy in class II patients. Pakistan Orthodontic Journal. 2015;7(2):56-9.