Comparative assessment of changes in sagittal relationship of maxilla to mandible in class II malocclusion – a cephalometric study

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Abstract

A number of analyses have been done over the years with varying degrees of reliability and success in assessing the anterior-posterior jaw relationships of the jaw bases. These analyses have both advantages and inaccuracies corresponding with their use which needs to be understood.

Aim: Comparison of various cephalometric parameters to assess the sagittal relationship of maxilla to mandible in class 2 malocclusion treated cases.

Objective: To assess the changes in the sagittal relationship of maxilla to mandible after treatment of skeletal class II malocclusion and comparison of four angular and four linear cephalometric parameters.

Method: This study includes 21 subjects with class II malocclusion selected based on inclusion and exclusion criteria and with an age ranges of 18 to 25 years. Manual cephalometric tracing has been done on pre and post treatment lateral cephalograms and four angular and four linear parameters are measured.

Results: The YEN angle is a highly reliable angle and both YEN and Beta angle have significantly improved in most of the class II cases.

Conclusion: Among all the sagittal parameters that were assessed, YEN angle followed by Beta angle shows significant improvement whereas PABA shows borderline improvement after treatment cephalometrically.

Key words: Sagittal Dysplasia, Class II Malocclusion, YEN and Beta Angle.

Introduction

Sagittal dysplasia is the most common skeletal malocclusion seen routinely in orthodontic patients. The evaluation of relationship of maxilla to mandible in sagittal plane is very important before orthodontic diagnosis and treatment planning. Since the time of Angle many authors had given various criteria's to evaluate the sagittal discrepancy. However the angular & linear measurements that were given by them were affected by many factors hence it is difficult to evaluate the anterior-posterior discrepancy using a single criteria.(1)

Till date many methods for the evaluation of the anterio-posterior jaw base relationship have been introduced. Earlier the skeletal pattern was used to assess by palpating the anterior basal part of jaw bone with teeth in centric occlusion and assessing the profile clinically. After the introduction of the cephalometric, various angular and linear parameters have been studied and recorded to assess various discrepancies. Downs (1956) introduced the A-B plane angle, few years later Riedel (1952) came up with the angle ANB. The reliability of ANB as an anterior-posterior discrepancy indicator has always been questioned.(2)

The purpose of the present study is to compare the cephalometric angular measurements like YEN, BETA, PABA and FABA as well as the linear measurements which include WIT'S appraisal, AB/PP, AB/FH, AB/SN in pre and post treatment lateral cephalograms of skeletal class II malocclusion patients.

Materials & Method

The study includes 21 pre- treatment and post treatment cephalograms of the cases treated in the Department of Orthodontics, V.S Dental College and hospital, Bangalore India.

Based on the inclusion criteria the cephalograms of the selected Skeletal Class II cases are divided into 2 groups (group 1- pretreatment skeletal class II group and group 2- post treatment skeletal class II group) with an age range of 18 to 25 years. The cephalometric parameters assessed in both the groups include four angular and four linear measurements. The angular measurements are YEN angle, BETA angle, PABA angle, FABA angle and the linear measurements include WIT'S appraisal, AB/PP, AB/FH, AB/SN. Following criteria were included in our study-

1. ANB angle 4˚ or more
2. Wits appraisal greater than or equal to 3 mm
3. AB plane angle more than -9˚

Who did not meet the above criteria was not included.

Materials

1. 3H pencil
2. Matt acetate cephalometric tracing sheets.
3. X- ray viewer
4. 21pretreatment and post treatment lateral cephalograms of skeletal classII malocclusion cases. (same patient)

Methodology

1. Pretreatment and post treatment cephalograms are traced by manual method.
2. For the measurement of the linear distances, scale is used to the nearest of 0.5 mm and angles are measured to the nearest of 0.5 degree.
3. The important hard and soft tissue structures are then marked on the cephalograms.
4. Various reference points, planes and angles are drawn. These following parameters are recorded for evaluation and comparison.

Angular Parameters: following angular parameter has taken in our study-

YEN

Beta

FABA

PABA

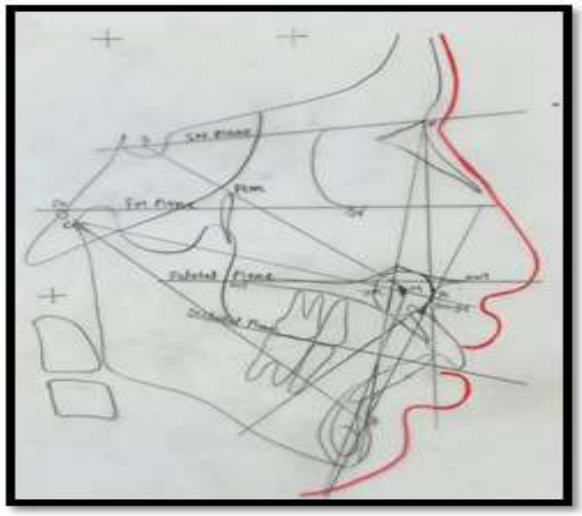
Linear Parameters: following linear parameter has taken in our study-

Wits's Appraisal

AB/PP (palatal plane)

AB/SN

AB/FH



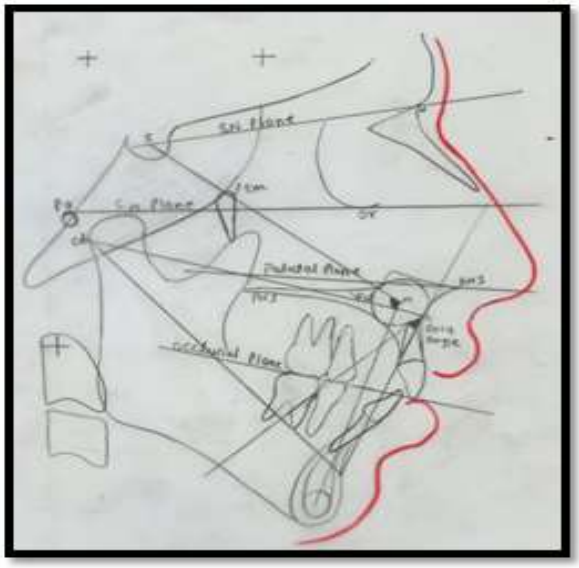


Fig. (a) Pre Treatment Cephalomtric tracing (angular and linear measurement (b): Post treatment cephalometric tracing (angular and linear measurement)

Beta Angle (2004)

Baik and Ververidou[3] suggested the Beta angle. It uses three skeletal landmarks, points A, point B, and the axis of the condyle C, to measure an angle that shows the severity and the type of skeletal dysplasia in the anterio-posterior direction. Advantage of Beta angle over ANB and Wits appraisal is that (1) it remains constant even if the jaws are rotated clockwise or counter clockwise (2) it can be used in consecutive comparisons throughout orthodontic treatment because it reflects true changes of the sagittal relationship of the jaws, which might be due to growth or orthodontic/ orthognathic intervention.

Beta angle between 27° and 35° Class I Skeletal pattern

< 27° Class II Skeletal pattern

> 35° Class III Skeletal pattern

Yen Angle (2009)

Neela et al[(4)] reported the Yen angle. It uses the following three landmarks: S, center of the sella turcica; M, center of the premaxilla; and G, center of the largest circle which is tangent to the internal inferior, anterior and posterior aspects of the mandibular symphysis. The advantage here is that it eliminates the difficulty in locating points A and B or the functional occlusal plane used in Wits and condyle axis in Beta angle analyses. YEN angle is not influenced by growth changes and it can be used in mixed dentition.

Value between 117 to 123º Class I skeletal pattern

< 117º Class II skeletal pattern

> 123º Class III skeletal pattern

FH to AB Plane Angle (FABA)

Sang and Suhr[5] (1995) suggested FH to AB angle to measure anterio-posterior dysplasia. This study has been done on 110 Korean children having normal occlusion. They found mean value for this was 80.91±2.53º with range of 10.5º. There was no statistically significant difference between males and females.

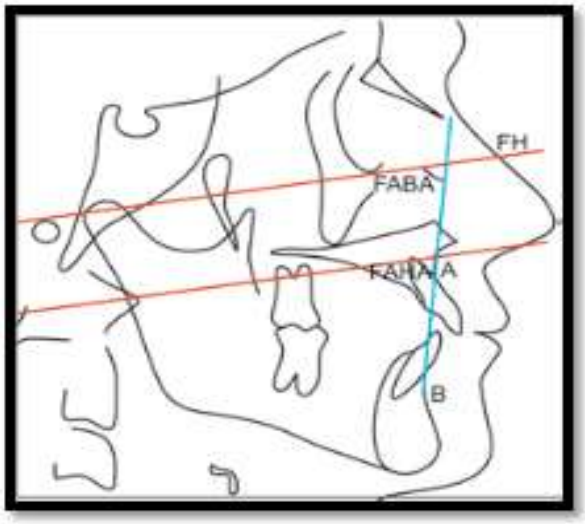


Fig. (C): FABA angle

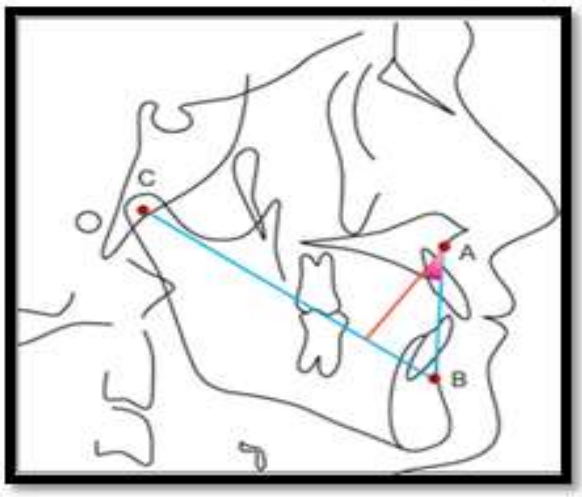


Fig. (D): Beta angle

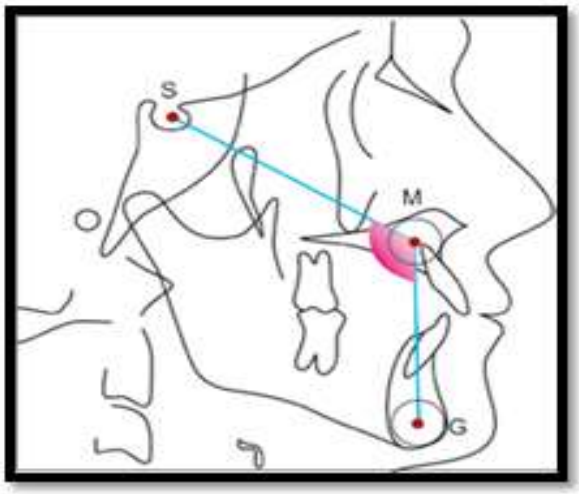


Fig. (E): YEN angle

Palatal plane to AB Plane Angle (PABA)

Kim & Vietas[6] (1978) first time measured PABA angle. This angle was measured between AB plane and palatal plane. Mean value for class II malocclusion group was found to be 75.5°.

AB-FH Distance (1987)

Chang[7] et al conducted a study on 80 young Chinese and described the AF-BF distance found by drawn the line perpendiculars from points A and B to the FH plane. The average value for male was 3.43±2.93 mm and for female, it was 3.87±2.63 mm. The AF-BF distance would be positive when point AF was ahead of point BF; and negative if point AF was located behind point BF.

Wits Appraisal of Jaw Disharmony

Jacobson[8] (1975) in order to overcome the shortcoming of ANB angle devised 'Wits' Appraisal, which was calculated as a diagnostic tool by which the severity or degree of sagittal jaw discrepancy can be measured, which is not dependent on cranial reference point, on a lateral cephalometric radiograph. The method of assessing the degree of the jaw discrepancy require drawing perpendiculars on a lateral cephalometric head film tracing from points A and B on the maxilla and mandible, respectively, onto the functional occlusal plane denoted as AO and BO respectively and measuring the distance between them. According to Jacobson, in a skeletal Class I relationship, in females, AO and BO should coincide whereas in males, BO is ahead of AO by 1 mm. Study by Bishara[9] et al showed that Wits appraisal does not change significantly with age.

Limitations of Wits Appraisal

Though the Wits appraisal does not use point N and decreases the rotational effects of jaw growth, but it determines the sagittal discrepancy by using the occlusal plane which is dental measurement. Occlusal

plane can change by tooth eruption, dental development or by orthodontic treatment.[10-12] This can greatly influence the Wits appraisal. Furthermore, accurate measurement of the occlusal plane is not always easy or accurately reproducible[13,14] especially in mixed dentition case or openbite, canted occlusal plane, multiple impactions, missing teeth, skeletal asymmetries, or steep curve of Spee.

Taylor's AB' Linear Distance (AB/SN)

Taylor[15] (1969) suggested a new parameter; the linear distance to be measured between Point A and B'. B' is the perpendicular from point B to the SN plane. Its average value was 13.2 mm. They found that there was 1mm of change from point A to perpendicular B' for each degree of change in ANB.

AB-PP Distance

Nanda and Merrill[16] (1994) suggested App-Bpp linear distance measurement based on professed advantage of palatal plan. This perpendicular projection of points A and B to palatal plane (App-Bpp) averaged 5.2±2.9 mm in white female with normal occlusions compared with 4.8±3.6 mm for white male. Value increases in Class II and decreases in Class III. This analysis avoids the uses of Nasion point is the main advantage. The palatal plane is suggested to be more stable by the authors.

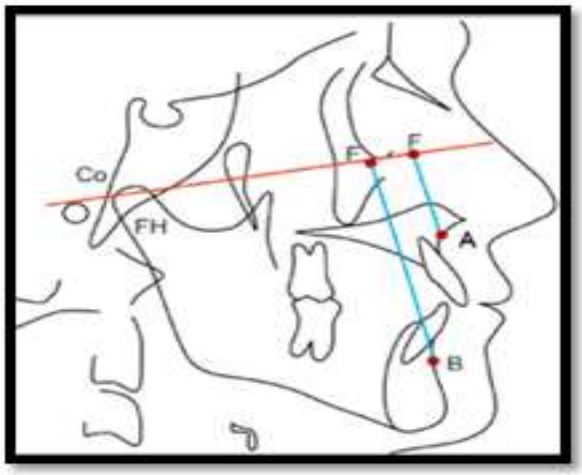


Fig. (F): AF-BF distance

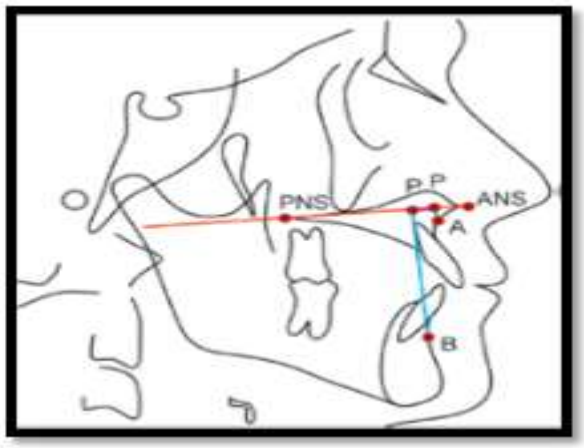


Fig. (G): APP-BPP distance

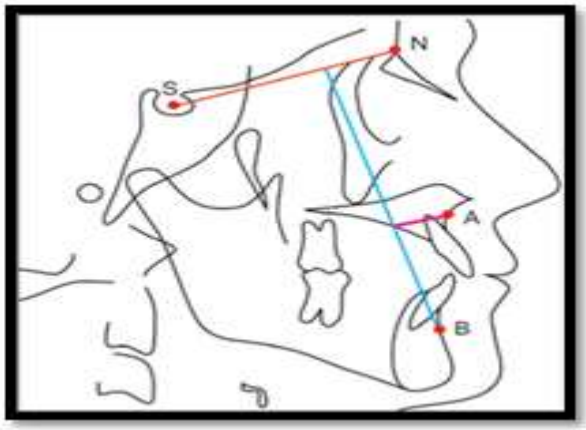


Fig. (H): Wits appraisal

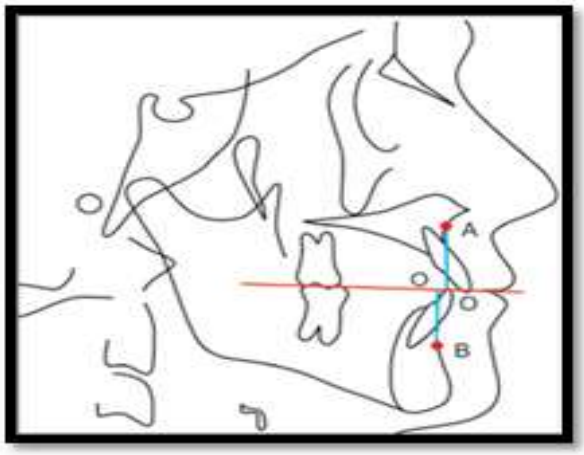


Fig. (I): Taylor's AB' distance

Statistical Analysis

The data was collected, tabulated and statistically analyzed using the SPSS 10 software.

1. Paired t-test has used to check the significant improvement in various parameters after orthodontic treatment.
2. Correlation coefficients between the various parameters were calculated using Pearson's correlation to determine which combination would produce a higher value.

Result

Our study found that YEN angle has shown significant improvement (p= 0.0036) in post treatment cephalograms followed by Beta angle (P value 0.0279) and PABA also has improved borderline. All other parameter like FABA, AB/SN, AB/FH, and AB/PP are not improved significantly.

Table 1: Measurements in Indian population with Class II Malocclusion

	Beta		Yen		PABA		FABA	
	pre	post	pre	post	pre	post	pre	post
Average	29.29	31.19	116.38	119	80.29	81.71	79.38	79.24
SD	4.45	5.22	5.77	5.19	5.22	6	5.69	7.58
Minimum angle	23	22	107	110	69	70	69	64
Maximum angle	36	40	129	132	88	94	88	92
P value		0.027*		0.003*		0.104		0.444

* indicates significant value

Table 2: Correlation between angular parameters

Correlation	Beta	Yen	PABA	FABA
Beta	1			
Yen	0.686	1		
PABA	0.591	0.399	1	
FABA	0.731	0.677	0.722	1

Table 3: Correlation between linear parameters

correlation	Wits	AB/PP	AB/SN	AB/FH
wits	1			
AB/PP	0.995	1		
AB/SN	0.996	0.998	1	
AB/FH	0.987	0.994	0.993	1

Table 4: Correlation between angular and linear parameters

correlation	Wits	AB/PP	AB/SN	AB/FH
Beta	-0.657	-0.269	-0.739	-0.696
Yen	-0.674	-0.296	-0.750	-0.694
PABA	-0.667	-0.289	-0.750	-0.691
FABA	-0.678	-0.285	-0.737	-0.665

Discussion

In cephalometrics, both angular and linear variables have been proposed to evaluate anterio-posterior jaw relationship and position. Angular measurements can be inaccurate as a result of changes in facial height, jaw inclination and total jaw prognathism. Linear parameters can be influenced by the inclination of the reference line (Baik & Ververeidou, 2004).[3] The literature reveals that, there are various ways to assess the maxillo- mandibular jaw discrepancy, but none can be universally used with authenticity.

Despite the fact that ANB angle is one of the most frequently used cephalometric parameters for representing the sagittal skeletal inter maxillary discrepancy, there are numerous studies that suggest that this angle is not reliable sufficiently enough in skeletal class diagnosis.[7,17,19] In an attempt to overcome limitations of ANB angle, a need for other indicators has emerged. However, more recent studies have shown that there is no perfect and absolutely reliable parameter for assessing sagittal skeletal relationship. In this respect, there is a clinical recommendation that several indicators should be used to determine more realistic skeletal class diagnosis. However, there should be a clear understanding about the interchangeability among the underlying factors and various jaw relationship parameters.[1]

Though widely used, the following factors have been reported to affect the ANB angle: [18]

1. The patient's age- the ANB angle has a definite liability to decrease with increasing age.
2. The change of the position of the nasion either in the vertical or sagittal direction or both.
3. The upward or downward inclination of the SN line.
4. The upward or downward rotation of the jaws.
5. The change in the angle SN to the occlusal.
6. The degree of facial prognathism.

Hence, the present study was designed to analyze different statistical and geometrical variations in cephalometric measurements which were used to indicate the anteroposterior jaw relationship in Class II malocclusion and to assess the reliability and significant improvement of YEN angle, Beta angle, PABA angle, FABA angle and linear measurement wits appraisal, AB/FH, AB/SN and AB/PP after the orthodontic treatment in class II cases.

YEN angle has been used to assess the difference between pre and post treatment sagittal improvement in class II malocclusion cases. The results were statically significant (p value 0.0036) which indicates that there was definite improvement in YEN angle and has shown the better improvement among all the other parameters. These results were similar to study done by Kavita et al[19] (2012) in which statistically significant improvement ($p < 0.001$). This is also supported by Neela et al[4] who stated that Yen angle depend on stable points S midpoint of sella turcica, M- midpoint of pre-maxilla and G- center of largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis and so it is not influenced by growth changes and can easily be used in mixed dentition.

Our study shows that Beta angle has significantly improved ($p < 0.0279$) after treatment which indicates

the good improvement in sagittal direction in most of the cases. Other similar study has done by Kavita et al[19] (2012) also showed statistically significant ($p < 0.001$) results. Biak and Ververidou[3] stated that Beta angle does not depend on cranial references or the functional occlusal plane and does not change even when the jaws are rotated. Another privilege of the Beta angle is that it can be used in successive comparisons throughout orthodontic treatment because it reveals true changes of the anterio-posterior relationship of the jaws, which can be due to growth or orthodontic intervention. But it uses point A and point B, which can be changed by orthodontic treatment and growth.

PABA angle shows border line improvement in our study and all remaining parameter like FABA angle and all linear parameters includes wit's appraisal, AB/SN and AB/FH have not significantly improved after treatment.

In this present study statistically significant correlation was found ($p< 0.001$) and highest correlation was found between FABA and BETA angle followed by FABA and PABA, YEN and Beta and lowest correlation was found between PABA and YEN. On other hand statistically significant correlation was found between all linear parameters ($p< 0.001$). For estimating their effectiveness and reliability for assessing skeletal jaw relationship, $p \leq 0.05$ was considered statistically significant. All the angular and linear parameters are in negative correlation.

Conclusion

Among all the sagittal parameters which have taken in our study YEN angle followed by Beta angle shows significant improvement whereas PABA shows borderline improvement after treatment as seen when measured cephalometrically. All other parameters are not improved significantly. Good correlation has been found between FABA and Beta followed by FABA and PABA, YEN and Beta and lowest correlation was found between PABA and YEN. Statistically significant correlation was found between all linear parameters.

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