

**Reliability of E Analysis in Assessing Skeletal Class II Malocclusion in Kerala Population**

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Abstract

Aim: The objective of this study was to assess the reliability of the E analysis in subjects with skeletal class II malocclusion based on their ANB and WITS appraisal values.

Materials and Methods: This retrospective study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, A.B Shetty Memorial Institute of Dental Sciences, comprising of lateral cephalograms and case history records of 30 skeletal Class II patients (15 males and 15 females). The lateral cephalograms were traced and the ANB, Wits Appraisal and E analysis. The values were correlated using pearsons co relation test. Gender differences for the E analysis values were calculated using the unpaired t test.

Results: There was no significant difference in the mean values of E analysis variables between males and females. There was a positive correlation in all the parameters. M-HPp – D-HPp correlates statistically significant with ANB angle and Wits appraisal with a Pearson's correlation coefficient of 0.602 and 0.405.

Conclusion: Any M-HPp – D- HPp value of 2mm or more can be considered as a skeletal class II malocclusion in the kerala population. The E analysis does serve as a very stable and useful cephalometric parameter which can help us in better diagnosis and treatment planning.

Keywords : Class II, Skeletal, E analysis, Wits appraisal, ANB angle, Sagittal Discrepancy, Kerala.

1. Introduction

The evaluation and diagnosis of antero-posterior jaw relationship is one of the most important steps in diagnosis and treatment planning. This step is usually done through cephalometric analysis. In 1947, Wylie first attempted to describe the antero posterior jaw relationship and since then many cephalometric variables have been proposed to overcome the limitations that a particular parameter may have had. Despite its shortcomings, the ANB angle and the Wits appraisal are still the most commonly used parameters. (1) However, a lot of factors such as the the growth rotations of the jaw (2), stability of the point nasion (3-7) and the length of the cranial base (4) have questioned the validity of the ANB angle and the Wits appraisal. Although the Wits appraisal, overcomes some of these shortcomings,[2] it is still affected by various factors such as eruption of teeth (8,9), the curve of spee, the type of malocclusion (open bites) and is also not easily identifiable or reproducible.(10)

In 2014, a new Sagittal dysplasia indicator named The E Analysis was put forth by P J antony et al. It consists of three new linear measurements, the effective length of maxillary base (M-HPp), the effective length of mandibular base (D-HPp) and sagittal dysplasia indicator (M-HPp – D-HPp). (11) The E analysis introduced us to three new linear cephalometric variables ie; the effective length of maxillary base (M-HPp), the effective length of mandibular base (D-HPp) and sagittal dysplasia indicator (M-HPp – D-HPp).

It uses two skeletal landmarks, points M and points D which represent the maxilla and mandible respectively. Unlike points A and B, these points have the advantage of not being affected by remodelling that occurs due to dental movement. (12) The reference plane used in the E analysis is the True Horizontal Line which is obtained through natural head position and is another advantage

associated with the E analysis because it has been shown to be highly reproducible(13,14). The Frankfort horizontal plane, occlusal plane and the SN plane are the other planes that have commonly been used to assess any kind of Sagittal dysplasia. However, all of these planes have been shown to have some or the other shortcoming. (15-17) All these points make the E analysis a more stable parameter to measure the Sagittal discrepancy, However, till date, no study has checked the reliability of E analysis, and hence, the objective of this study was to assess the reliability of the E analysis in subjects with skeletal class II malocclusion based on their ANB and WITS appraisal values.

2. Materials and methods

2.1 - Source of Data

This retrospective study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, A.B Shetty Memorial Institute of Dental Sciences, comprising of lateral cephalograms and case history records of 30 skeletal Class II patients (15 males and 15 females).

Study materials were obtained from the archives of the Department of Orthodontics and Dentofacial Orthopedics, A.B Shetty Memorial Institute of Dental Sciences, comprising of pre-treatment and post-treatment lateral cephalograms, case history records and treatment logs of 30 skeletal Class II patients whose age ranged from 18- 30 years.

2.2 - Inclusion criteria

- Patients of age group 18- 30 years
- Patients who demographically belonged to Kerala
- Patients with full complement of permanent dentition
- Patients with skeletal Class II relation
- $ANB \geq 3\text{o}$ and Wits Appraisal ≥ 1.5 mm in the same individual
- Availability of pre treatment and post treatment lateral cephalograms and records.

2.3 - Exclusion criteria

- Patients with missing teeth
- An individual with ANB $\geq 3^\circ$ but Wits Appraisal < 1.5 mm
- An individual with Wits appraisal ≥ 1.5 mm but with ANB $< 4^\circ$

2.4 - Cephalometric analysis

The lateral cephalograms obtained were made under standardized conditions with the Frankfort Horizontal plane kept parallel to the floor and the mid facial plane kept in a vertical position. Once a patient fulfilled the criteria above the tracing of lateral cephalograms were done using 0.003 inch acetate paper with a 2H lead pencil. All tracings were done by the same investigator to avoid any kind of inter-operator errors.

2.5 - The anatomic points traced onto the tracing sheet.

1. Sella Turcica (S) - center of the pituitary fossa
2. Nasion (N) - The most anterior point of the fronto-nasal suture in the median line
3. Supramentale (B) - deepest point on the anterior contour of the lower alveolar arch
4. Sub Spinale (A) - deepest point of the anterior contour of the upper alveolar arch
- 5.

Pterygomaxillary (PTM) fissure—apex of the teardrop-shaped pterygomaxillary fissure.

6. Point M (M)—midpoint of premaxilla. M point is constructed at the center of the largest circle placed tangent to the anterior, superior and palatal surfaces of the premaxilla.
7. Point D (D)—point at the center of the mass of the symphysis.

2.6-Planes

1. Sella-Nasion Plane – Anteroposterior extent of the anterior cranial base
2. True vertical line (TVL)—a line drawn from the radiographic image of the vertical metallic scale in the digital lateral cephalogram.

3. True horizontal line (THL)—a line perpendicular to the true vertical line passing through the 10 mm mark in the vertical metallic scale.
4. Horizontal plane perpendicular (HPp)—a line perpendicular to THL through PTM.
5. Occlusal plane – The line connecting the intercuspation of the Upper and Lower Molars and Premolars.

2.7 - E analysis

For the linear measurements on the standardized lateral cephalograms obtained in natural head position, the THL and the HPp were used as a reference line. Several researchers have concluded that natural head position is the most reliable reference and orientation position for the evaluation of craniofacial morphology.(13,14).

All measurements were done perpendicular to the HPp.

E analysis comprised the following measurements:

- M-HPp: The effective length of maxillary base.
- D-HPp: The effective length of mandibular base.
- M-HPp – D-HPp: Sagittal dysplasia indicator

For the construction of the analysis, points PTM, M and D were located. Points PTM and D were eyeballed and point M was constructed using a template with concentric circles whose diameter increased in 1 mm increments.(11)

After classifying the groups, M-HPp, D-HPp and M-HPp–D-HPp were measured and a mean value was taken. The Thirty selected cephalograms were retraced after few days of first evaluation. Between the first and second measurement, there was no statistically significant difference.

2.8 - Statistical Analysis

Data was analysed using unpaired t test between gender for continuous data. To find the correlation between variables, Karl pearsons correlation were used. $P < 0.05$ is considered to be significant. SPSS software ,IBM SPSS

Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp was used to analyse the data.

3. Results & Discussion

3.1 - Results

The mean value for the E analysis variables, ANB and Wits appraisal in the originally selected skeletal II groups are listed in Table 1. The mean value for the effective length of maxillary base (M-HPp), the effective length of mandibular base (D-HPp) was 45.63 and 40.51 mm with a SD of 3.4 and 6.09 respectively. The mean value for sagittal dysplasia indicator (M-HPp – D-HPp) was 4.78 mm with a SD of 2.49. The mean ANB value for the samples was noted to be 5.9o with a standard deviation of 1.86/ The mean value for the Wits Appraisal was found to be 3.2 mm with a standard deviation of 1.51. (Table 1 , graph 1) The unpaired t-test showed that there was no significant difference in the mean values of E analysis variables between males and females (Table 2, graph 2)

On correlating the ANB angle, Wits appraisal and M-HPp minus D-HPp using Pearson's correlation, there was a positive correlation in all the parameters. M-HPp – D-HPp correlates statistically significant with ANB angle and Wits appraisal with a Pearson's correlation coefficient of 0.602 and 0.405. This indicates that as the ANB and Wits Increase, so does the M-HPp- D-HPp. (Table 3).

3.2 - Discussion

The E analysis introduced us to three new linear cephalometric variables ie; the effective length of maxillary base (M-HPp), the effective length of mandibular base (D-HPp) and sagittal dysplasia indicator (M-HPp – D-HPp). It uses two skeletal landmarks, points M and points D which represent the maxilla and mandible respectively. Unlike points A and B, these points have the advantage of not being affected by remodelling that occurs due to dental movement. Just like the point S (sella), points M and D also are centroid points. As the

center or the centroid of an area of an image indicates the mean point within a shape, about which it is subjected to least variation relative to non-mean anatomical points and therefore provides more stable reference points. (12)

The reference plane used in E analysis and in this study is THL which is obtained through natural head position and is another advantage associated with the E analysis. The other commonly used reference planes for assessing sagittal discrepancy are Frankfort horizontal plane and occlusal plane and the SN plane. All of these planes have been shown to have limitations.(15-17)

The parameter that is most commonly used for assessing the sagittal discrepancy is still the ANB angle, but it has shown to be affected by various factors, such as vertical growth and the length of the cranial base, the patient age, growth rotation of the jaws , which can often be misleading.(2) The Wits appraisal was introduced to try and overcome these problems,(2) Although jaw rotations do not affect the Witts appraisal , the inclination of the occlusal plane directly seems to affect Witts appraisal.(23) The recently introduced alternatives, Beta angle(24) and W angle(1) avoids the use of the functional occlusal plane and is also not affected by the rotation of the jaws. However, both these angles do not give us an idea as to which jaw is prognathic / retrognathic. E analysis was developed to overcome the limitations of the previously discussed parameters. Another advantage of using the E analysis is that by comparing the values of (M-HPp) and (D-HPp) from the norms, it can be understood if its the maxilla or the mandible that is responsible for the skeletal Sagittal discrepancy.(11) P J antony (11) showed that in a kerala population for a class I skeletal pattern, the mean value of M-HPp was 46.18 mm and D-HPp was about 45.82 mm. In our study, the mean M-HPp was 45.63 and the mean D-HPp ws 40.51, which accurately shows that the class II samples in our study had a retrognathic

mandible. PJ Antony et al (11) showed that the value of M-HPp – D-HPp above 1.75 mm could be considered as Class II skeletal malocclusion, however in our study it was observed that the Class II Skeletal Malocclusion had a minimum value of 2 mm and a mean of 4.7 mm which is in accordance to the findings of their study. Since class II malocclusion is the most commonly observed malocclusion in India, we decided to test the reliability of this new Sagittal dysplasia indicator only on skeletal class II subjects. This study proves that the E analysis can be used as an important cephalometric variable to understand the Sagittal discrepancy in skeletal class II malocclusion. This analysis can be used in conjunction with other parameters to help in accurate diagnosis and to arrive at a more efficient treatment plan for the patient. Further studies on different populations is required to arrive at norm that can be generalized. Since the population in this study and the study done by PJ Antony et al were Kerala based population, the findings of this study cannot be generalized. Further studies with a larger sample size on varied populations can help make the E analysis a commonly used cephalometric parameter to assess sagittal discrepancy.

4. Figures and Tables

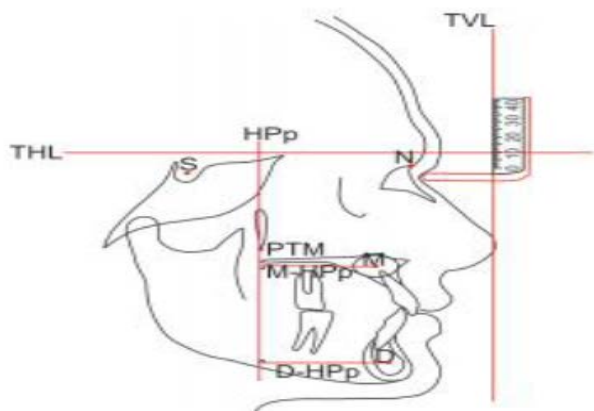
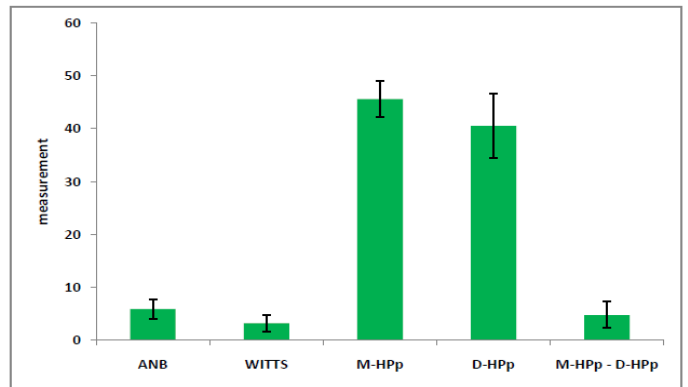
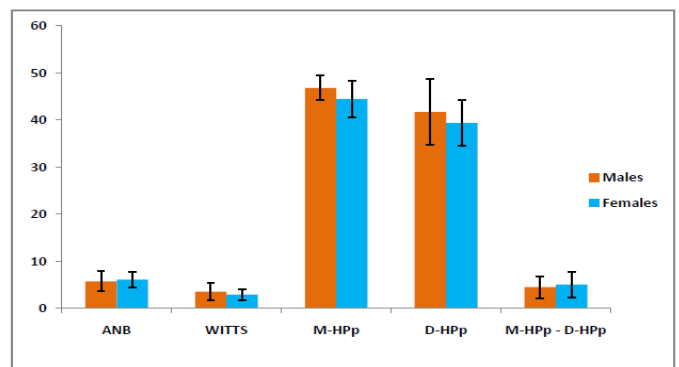


Fig 1 - E analysis and its cephalometric landmarks



Graph 1 - Mean and standard deviation of parameters.



Graph 2 – Unpaired T test values to check for differences among genders for the parameters.

	N	Minimum	Maximum	Mean	Std. Deviation
ANB	30	3.0	10.0	5.933	1.8650
WITTS	30	1.5	7.0	3.200	1.5120
M-HPp	30	36	51	45.63	3.489
D-HPp	30	23.0	49.0	40.517	6.0693
M-HPp – D-HPp	30	2.0	11.0	4.783	2.4972

Table 1 - Descriptive statistics showing Mean and standard deviation of parameters.

	group	N	Mean	Std. Deviation	Mean Difference	t	P	95% Confidence Interval of the Difference	
								Lower	Upper
ANB	Males	15	5.733	2.1118	-4.000	-.581	.566	-1.8112	1.0112
	Females	15	6.133	1.6308					
WITTS	Males	15	3.533	1.7674	.6667	1.217	.234	-4.550	1.7883
	Females	15	2.867	1.1721					
M-HPp	Males	15	46.80	2.651	2.333	1.914	.066	-.164	4.831
	Females	15	44.47	3.907					
D-HPp	Males	15	41.700	7.0554	2.3667	1.071	.293	-2.1616	6.8949
	Females	15	39.333	4.8501					
M-HPp - D-HPp	Males	15	4.500	2.3223	-.5667	-.615	.544	-2.4549	1.3215
	Females	15	5.067	2.7115					

Table 2 – Unpaired T test values to check for differences among genders for the parameters.

		ANB	WITTS	M-HPp - D-HPp
ANB	Pearson Correlation	1	0.213	0.602*
	P		0.259	0.001
	N	30	30	30
WITTS	Pearson Correlation		1	0.405*
	P			.027
	N		30	30

Table 3 – Pearson Correlation between the parameters.

5. Conclusion

Any M-HPp – D- HPp value of 2mm or more can be considered as a skeletal class II malocclusion in the kerala population. The E analysis does serve as a very stable and useful cephalometric parameter which can help us in better diagnosis and treatment planning.

6. Abbreviations

1. AP – Antero-Posterior
2. M-HPp – maxillary base
3. D-HPp – Mandibular base
4. M-HPp – D-HPp – Sagittal Dysplasia Indicator

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