Original Article

Comparison of ANB Angle with YEN Angle and W Angle for Assessing Sagittal Skeletal Discrepancy Among the Patients Attending in The Department of Orthodontics, BSMMU.

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Abstract

Background: Accurate assessment of sagittal jaw discrepancies is essential in orthodontic diagnosis and treatment planning. Although the ANB angle is widely used, it has limitations due to its sensitivity to positional changes of craniofacial landmarks. This study compared the ANB angle with two newer parameters, the YEN angle and W angle, across skeletal Class I, II, and III malocclusions to evaluate their reliability and diagnostic value.

Methods: A cross-sectional study was conducted on 90 patients aged 18–25 years. Lateral cephalograms were grouped into Class I, II, and III according to the ANB angle. Each radiograph was traced for SNA, SNB, ANB, YEN, and W angles. Normality was tested, and comparative analyses were performed using unpaired t-tests and ANOVA. Correlation analyses and reliability testing (Cronbach's alpha) were carried out to assess the consistency and diagnostic accuracy of the three parameters.

Results: Age distribution did not differ significantly across sexes or malocclusion groups. Statistically significant differences in SNA, SNB, ANB, YEN, and W angles were observed between skeletal classes. The ANB angle showed negative correlations with both the YEN and W angles, while W and YEN angles demonstrated strong positive correlations. Reliability testing revealed the W angle ($\alpha = 0.951$) to be the most consistent, followed by the YEN angle ($\alpha = 0.943$) and ANB angle ($\alpha = 0.836$).

Conclusion: The W angle proved to be the most reliable tool for assessing sagittal skeletal discrepancies, followed by the YEN angle. Incorporating these alongside the ANB angle can improve diagnostic accuracy in orthodontic practice.

Keywords: cephalometric analysis ANB angle, YEN angle, W angle, sagittal skeletal discrepancy.

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Introduction

Cephalometric analysis is a cornerstone in orthodontic diagnosis, widely used to assess skeletal and dental relationships in sagittal, vertical, and transverse dimensions. Of these, evaluation of sagittal jaw discrepancies is particularly important, as it provides critical information for treatment planning.

One of the earliest methods to assess sagittal discrepancies was introduced by Downs, who proposed using points A and B to define the apical base relationship.[1] Riedel later formalized this into the ANB angle, which became one of the most commonly applied parameters in clinical practice.[2] While convenient and widely accepted, the ANB angle is influenced by factors such as the position of Nasion, vertical facial growth patterns, and remodeling of the maxillary and mandibular bases. These factors can reduce its diagnostic accuracy.

To overcome these limitations, alternative landmarks and angular measurements were developed. Nanda and Merrill introduced points G and M, later adopted by Braun and colleagues, to provide more stable anatomical references.[3,4] More recently, Neela and co-workers proposed the YEN angle, which relies on points S (sella), M (premaxilla), and G (mandibular symphysis) to provide a more stable assessment of sagittal relationships.[5]Similarly, Bhad and colleagues developed the W angle, also using S, M, and G as reference points, but defined by a different geometric relationship.[6] Both YEN and W angles avoid the drawbacks associated with points A and B, making them promising tools for clinical use.

Despite the introduction of these newer parameters, the ANB angle remains widely applied in everyday orthodontics, often without consideration of its limitations. Therefore, it is important to compare the diagnostic value of ANB with YEN and W angles across different skeletal malocclusion groups. This study was designed to evaluate the predictability, correlation, and reliability of these three parameters in Class I, II, and III malocclusion patients, with the aim of identifying which provides the most consistent measure of sagittal discrepancies.

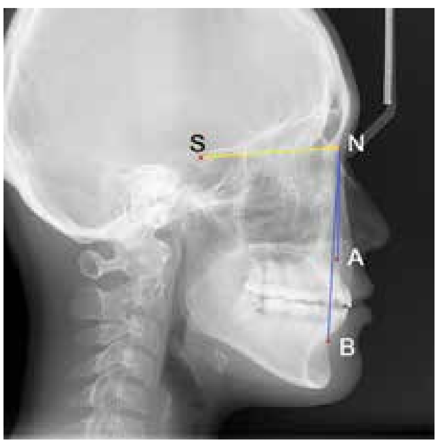

Figure: 1. SNA, SNB and ANB angle in skeletal class I occlusion

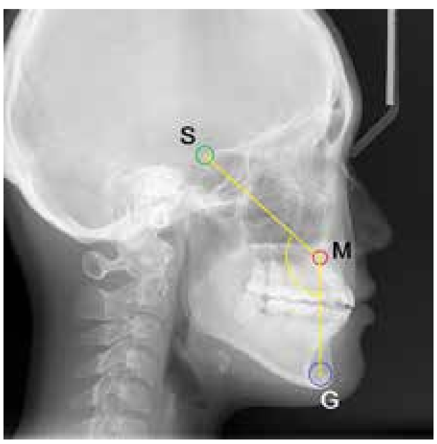

Figure 2. YEN angle

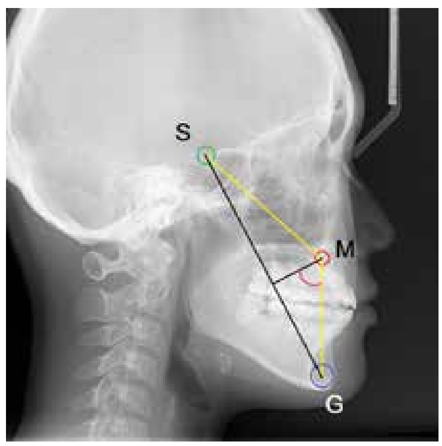

Figure 3. W angle

Methods

This research was designed as a comparative cross-sectional study and was carried out in the Department of Orthodontics at BSMMU, Dhaka. Ethical approval was obtained from the institutional review board, and informed consent was taken from all participants.

A total of **90 patients**, aged between 18 and 25 years, who had been advised to undergo fixed orthodontic treatment, were included in the study. Patients with craniofacial deformities, facial asymmetry, a history of maxillofacial trauma, previous orthodontic treatment, or the presence of impacted third molars were excluded.

Participants were divided into three groups based on their ANB angle:
- Class I: ANB = 2°–4°
- Class II: ANB > 4°
- Class III: ANB < 2°

Each group consisted of 30 subjects.Lateral cephalometric radiographs were taken using a standardized cephalometric X-ray unit, with a fixed film-to-tube distance of 165 cm and a rigid head positioning system. Subjects were positioned with the Frankfort horizontal plane parallel to the floor, teeth in centric occlusion, and lips relaxed.

All cephalograms were manually traced using a 2H pencil, and the following measurements were recorded: SNA, SNB, ANB, YEN, and W angles. Each tracing was checked carefully to minimize errors or missing data.

Data were compiled and analyzed using SPSS version 26.0 (Chicago, USA). The normality of distribution was assessed with the Kolmogorov–Smirnov test. Descriptive statistics (mean and standard deviation) were calculated. Comparisons between male and female participants were made using the unpaired t-test, while differences among the three skeletal classes were evaluated using one-way ANOVA. Correlations among ANB, YEN, and W angles were examined using Pearson's correlation coefficient. To assess reliability, Cronbach's alpha values were calculated for the three parameters. A p-value < 0.05 was considered statistically significant.

Results

A total of 90 lateral cephalograms were analyzed in this study. Tests for normality confirmed that all measured variables followed a normal distribution.

The mean age of participants in skeletal Class I was 20.73 ± 2.41 years, in Class II was 19.90 ± 2.07 years, and in Class III was 19.80 ± 2.19 years. Male patients had a mean age of 20.18 ± 2.32 years, while females had a mean age of 20.12±2.21 years. No significant differences were observed in age between sexes or malocclusion groups.

Significant differences were found across skeletal classes for SNA, SNB, ANB, W, and YEN angles. The ANB angle showed negative correlations with both the YEN and W angles, while W and YEN angles demonstrated strong positive correlations. Reliability testing revealed the W angle ($\alpha = 0.951$) to be the most consistent, followed by the YEN angle ($\alpha = 0.943$) and ANB angle ($\alpha = 0.836$).

Table 1. Distribution of age among male, female, skeletal class I, class II and class III

Distribution of Age (years)			
	Mean	SD	p*
Class I (n=30)	20.73	2.41	0.110
Class II (n=30	19.90	2.07	
Class III (n=30)	19.80	2.19	
Male (n=33)	20.18	2.32	0.886
Female (n=57)	20.12	2.21	

*p value <.05 considered as significant.

Table 2. Comparison of the mean ofangles among class I, class II and class III

Comparison of the mean of angles				
	Class I (n=30)	Class II (n=30)	Class III (n=30)	
Angle	Mean±SD	Mean±SD	Mean±SD	p*
SNA angle	78.67±2.59	77.67±3.62	82.50±2.39	<0.001
SNB angle	3.10±0.80	6.83±1.49	-2.60±2.11	<0.001
ANB angle	3.07±0.83	6.70±1.53	-2.50±2.10	<0.001
W angle	52.87±1.70	47.33±1.63	60.37±2.62	<0.001
YEN angle	119.30±2.14	114.67±4.32	127.70±2.31	<0.001

*p value <.05 considered as significant.

Table 3. Pearson's Correlation of ANB angle vs W angle and YEN angle in class I, class II and class III.

Pearson's Correlation of ANB anglevs W angle and YEN angle						
	Class I (n=30)		Class II (n=30)		Class III (n=30)	
Angle	t	p	r	p	r	p*
W angle	-.435	0.016	-.815	<0.001	-.888	<0.001
YEN angle	-.421	0.020	-.281	0.133	-.959	<0.001

*p value <.05 considered as significant.

Table 4. Pearson's Correlation between W angle vs YEN angle in class I, class II and class III.

Pearson's Correlation between W angle vs YEN angle						
	Class I (n=30)		Class II (n=30)		Class III (n=30)	
Angle	t	p	r	p	r	p*
YEN angle	+.954	<0.001*	+.272	0.146	+.909	<0.001*

*p value < .05 considered as significant.

Table 5. Cronbach's alpha reliability test among YEN angle, W angle and ANB angle

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
W angle	122.9778	9.662	.545	.951
YEN angle	55.9444	4.031	-.954	.943
ANB angle	174.0778	136.769	.769	.836

NB: Usually> 0.7 is the benchmark value for Cronbach's alpha. At this level and higher (up to 0.99), the items are sufficiently consistent to indicate the measure is reliable.

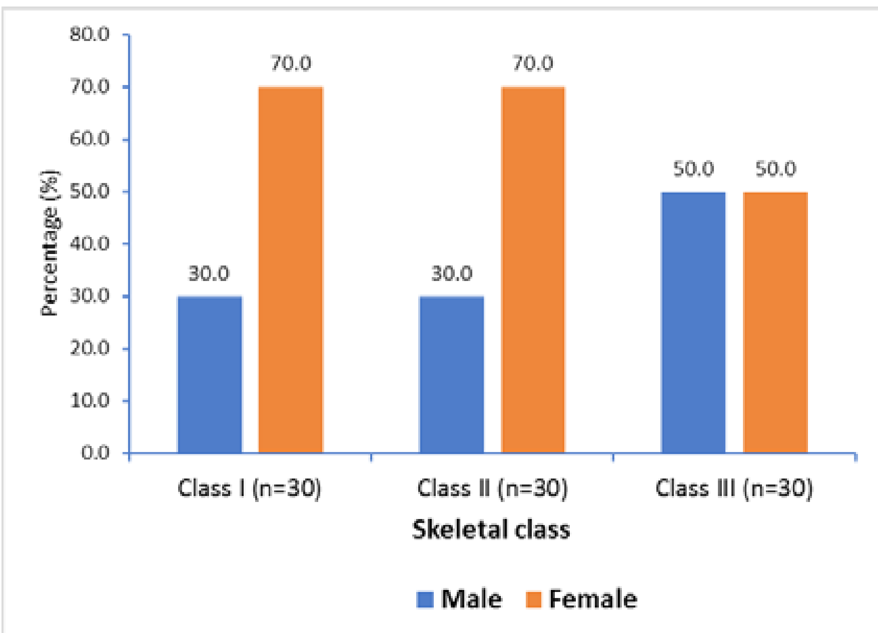

Figure 4. Sex distribution among skeletal class I, class II and class III

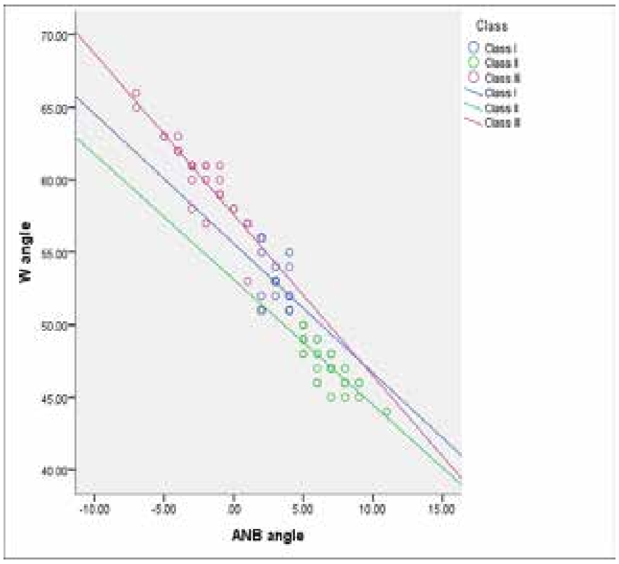

Figure 5. Correlation of ANB angle with W angle in class I, II and III

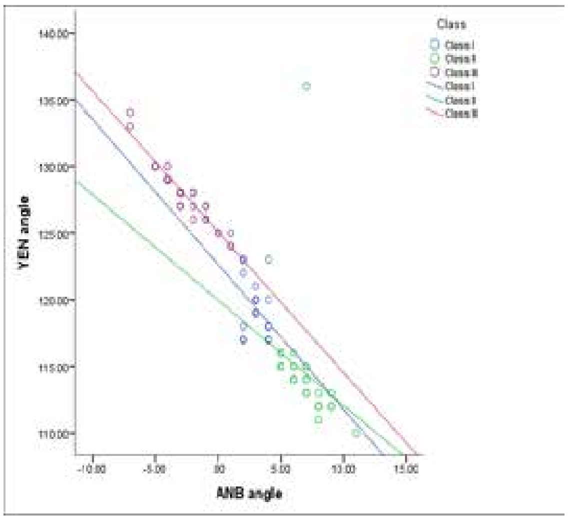

Figure 6. Correlation of ANB angle with YEN angle in class I, II and III

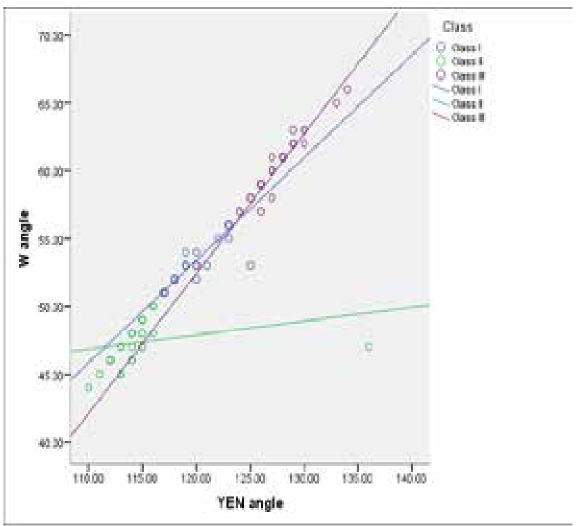

Figure 7. Correlation of YEN angle with W angle in class I, II and III

Discussion

Lateral cephalometry remains one of the most reliable diagnostic tools for evaluating skeletal discrepancies and planning orthodontic treatment. Among the various cephalometric indicators, sagittal jaw relationship assessment is considered essential. Despite the availability of several angular and linear parameters, no single method has been universally accepted.

In this study, the ANB angle values closely matched findings from previous studies such as Jajoo et al., Richardson, and Jarvinen.[7,8,9] Similarly, the W angle and YEN angle values were consistent with reports from Mittal, Bhad, and Maharjan, confirming their clinical relevance.[10,6,11]

Correlation analysis showed that the ANB angle had strong negative relationships with both W and YEN angles, especially in Class II and III malocclusions. The W and YEN angles, on the other hand, exhibited strong positive correlations in Class I and III subjects. These findings were in agreement with previous research, including studies by Mittal, Doshi, Kapadia, and Veeranarayana.[10,12,13]

From a clinical standpoint, the YEN angle offers an advantage by avoiding points A and B, which are prone to local remodeling. However, it may be influenced by rotational jaw changes during growth. The W angle, constructed from more stable landmarks, provides greater reliability and consistency. Cronbach's alpha results confirmed the W angle as the most reliable parameter, followed by the YEN angle and then the ANB angle.

Overall, combining these three angles provides a more comprehensive evaluation of sagittal skeletal discrepancies, supporting better diagnosis and treatment planning.

Conclusion

Within the limitations of this study, the W angle emerged as the most reliable parameter for evaluating sagittal skeletal discrepancies, followed by the YEN angle and the ANB angle. It is recommended that all three parameters be incorporated into cephalometric analysis, as their combined application improves diagnostic accuracy and enhances orthodontic treatment planning.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

All procedures conducted in this study complied with institutional ethical standards and the principles of the 1964 Helsinki Declaration and its later amendments.

INFORMED CONSENT

Written informed consent was obtained from all study participants prior to their inclusion in the research.

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