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Analysis of the Correlation between Yen and W Angles and Conventional Sagittal Discrepancy Indicators (ANB and Wits)

Aamir Waheed[a], Zubair Ahmed[b], Madeh ul Rehman[c], Alina Nadeem[d]

Abstract

Introduction: ANB angle has been used widely for the assessment of skeletal sagittal dysplasia. However several limitations have been associated with ANB angle. The aim of this research is thus to correlate YEN and W angles with conventional sagittal discrepancy indicators (ANB and Wits)

Methodology: Based on ANB angle, a sample of 165 participants were split up into three groups: Group 1 = Skeletal Class I, Group 2 = Skeletal class II, and Group 3 = Skeletal Class III. YEN angle and W angle was analyzed on lateral cephalogram and compared with ANB angle and Wits appraisal.

Results: Mean value of YEN angle for Class I was 123.15° ± 7.6°. Mean value of W angle for Class was 56.61°± 5.5°. Negative correlation of ANB with Yen angle, YEN ($r = -0.640$, $p < .001$), and W angle, W ($r = -0.798$, $p < .001$) and positive relationship between YEN and W angle ($r = 0.675$, $p < .001$) was found.

Conclusion: W and Yen angles can be used in patients as an alternative to ANB angle if reliability of ANB angle is questionable.

Keywords: Yen angle, W angle, ANB, Witt`s Appraisal

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Introduction

Since its discovery in 1931, cephalometry has been a crucial clinical technique for evaluating the relationships between the jaws; "anteroposterior, transverse, and vertical" is a crucial component of orthodontic treatment planning[1]. The evaluation of the anteroposterior relationship of jaws has been successfully accomplished using previously recognized criteria including ANB angle[2,5] (Fig. I), and Wits Appraisal in 1975[3]

ANB angle assessment is limited by the growth pattern of the patient; it will under estimate skeletal sagittal discrepancy in low angle cases and overestimate in high angle cases.[2] Confusing terminologies like Class I rotated to Class III and Class II rotated to Class I have been coined.[3] Cranial base length and position has also been pointed out as potential influencer on the ANB angle assessment. A forward-placed nasion can decrease the ANB angle, while a posteriorly placed nasion can increase it-leading to misinterpretation.[4] Dental Compensations can also effect the point A and Point B and thus the ANB angle.[4] Age related concerns in ANB assessment and ANB assessment in asymmetric dysplasia`s have also been raised.[5]

Jacobson postulated that angle ANB does not adequately detect differences in skeletal relationships and proposed Wits appraisal instead of angle ANB.[6] (Fig. II). Inclination of occlusal plane effect the interpretation of Wits Value.[6] Extreme vertical discrepancies distort

[a,c] BDS, FCPS(R) CIMS Dental College Multan
[b] Corresponding Author: BDS,FCPS,CMT, HoD Orthodontic department CIMS Dental College Multan.
[d] BDS, Demonstrator CIMS Dental College Multan

the occlusal plane, leading to inaccurate Wits values.[5] Age realated variability in Wits value assessment has been discussed in the literature.[5] In case of occlusal cant and asymmetries assessment by Wits appraisal is questionable.[7]

The Yen angle, a sagittal dysplasia indicator, was first presented by Neela in 2009 (Fig. III).[8] Yen angle has been literatured as associated with many advantages over the conventional methods. It is claimed as Independent of Cranial Base influence, not affected by Occlusal Plane inclination, simpler and more reproducible, useful in growing patients, better in Vertical Discrepancies and strong correlation with Skeletal Class.[9,10] Limitations of Y angle reported includes relatively new and less validated, dependent on accurate identification of Gnathion (Gn), influence by mandibular rotation and vertical discrepancies, and variability in defining the M point.[11]

In 2013, Bhad created the W angle. The W angle is computed using a straight line from the point M on the S-G lines that is perpendicular to the M-G line (Fig. IV).[12] W angle has been associated with following advantages; Independent of Cranial Base Length or Position, Stable Skeletal Landmarks, Not Affected by Occlusal Plane Inclination, Less Affected by Jaw Rotations, Consistent Across Growth Stages and Clearly Differentiates Skeletal Classes.[8,9] Limitations associated include Dependent on Accurate Landmark Identification, Relatively New Parameter, Affected by Mandibular Rotations, Limited Use in Clinical Software, Variability in Growing Patients, Not Useful in Asymmetric Cases.[13]

This study aimed to compare Yen and W angles with Witts appraisal and ANB angle in various malocclusions. The intent of the current study is to explore the connection and variations within these characteristics in order to develop a more precise predictor for sagittal discrepancy assessment.

Methodology

The conventional preliminary lateral cephalograms of patients with different sagittal dysplasia were used in this retrospective cross-sectional investigation. By placing the patient in their normal head posture and securing them on the Carestream 8100 C cephalometric equipment (72–82 kV, 10 mA, 0.5 exposure period), high-quality digital cephalograms of 165 patients were produced. Sample size was The lead investigator conducted all of the tracings. Two weeks following the initial assessment of each of the five variables by the same observer, ten randomly chosen cephalograms were retraced in order to calculate the measurement error. To rule out inter-operator bias, the co-author retraced ten more randomly chosen tracings and compared the findings with the original tracings. After obtaining approval from the Institute's ethical committee, the study proceeded. Inclusion criteria includes: Orthodontic patients of both genders between the ages of 11 and 30, ANB x<2+2>x, Complete and permanent teeth up until the second molars, No past orthodontic care, A clear digital cephalogram. Exclusion Criteria includes: History of orthodontic care, Missing teeth, Recurrent history of facial trauma, Cleft lip and or palate, Facial asymmetry and Poor quality cephalogram. ANB angle, Wits Appraisal, YEN angle and W angle were traced for each patient as shown Fig (I-IV). Data was then analyzed using SPSS 26.0 for descriptive statistics, pearson co-relation, sensitivity and specificity.

ANB Angle:

- Class I – Angle 1° to 4°
- Class II – Angle greater than 4°
- Class III – Angle under than 1°

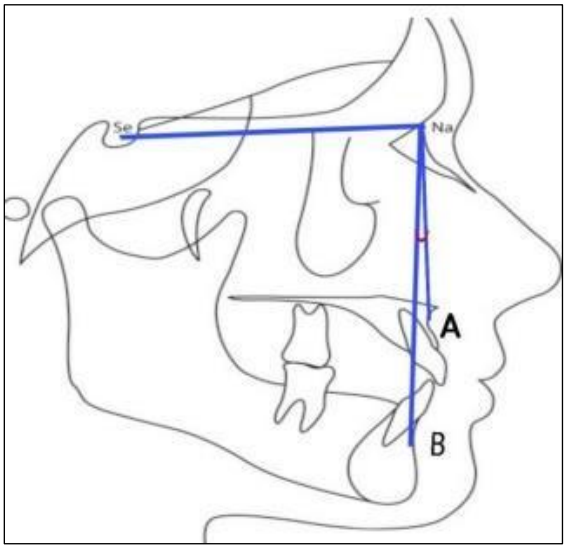

Fig. I: ANB Aangle

Wit's appraisal:

The linear distance, expressed perpendicular to on the function of the occlusal plane, among points A and B is known as the AO–BO distance or Wit's evaluation.

- Class I - The female: 0 mm Male: -1 mm.
- Class II: The positive reading for Point AO showed that it was well behind BO.
- Class III: BO (negative reading) is in front of AO.

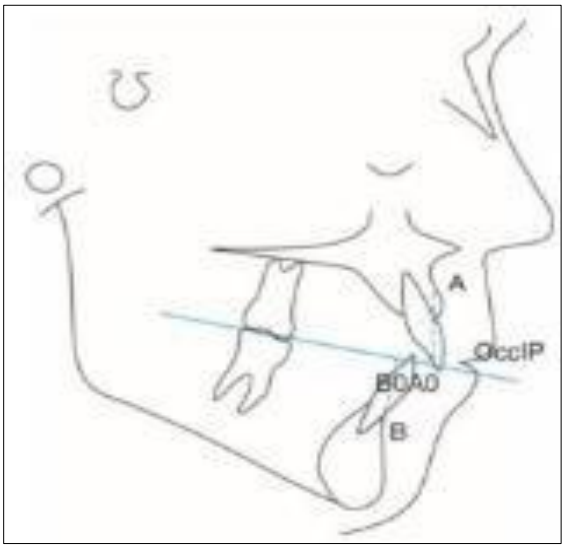

Fig. II: Wits appraisal

Yen Angle:

- Class I – Angle: 117° to 123°
- Class II – Less than 117° angle
- Class III – Angle greater than 123°

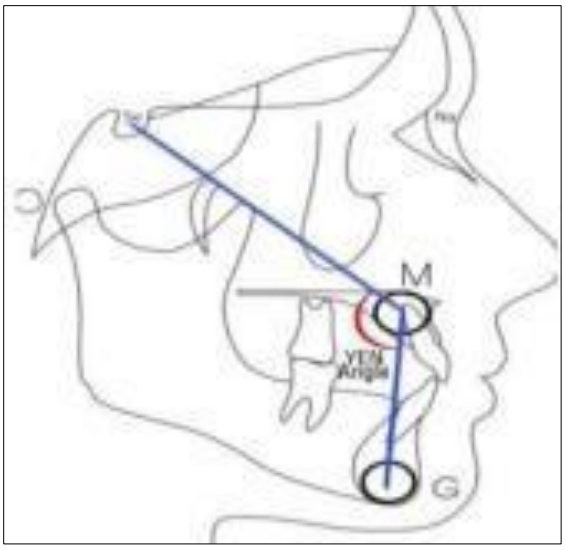

Fig. III: Yen Angle

W Angle:

- Class I – Angle 51° to 56°
- Class II – Less than 51° angle
- Class III – More than 56° of angle

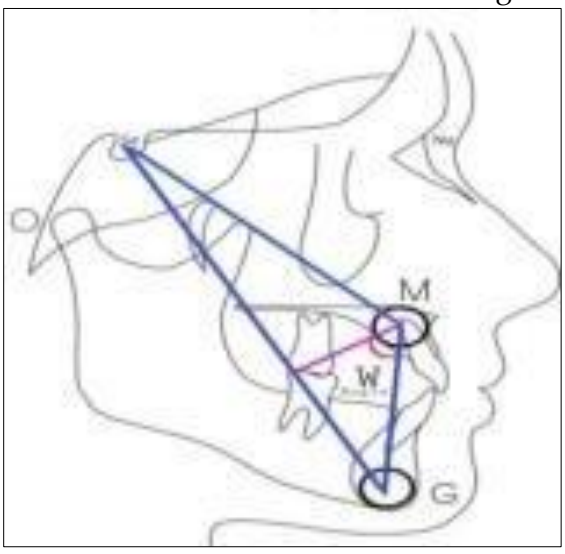

Fig. IV: W Angle

Result

Table I presents the descriptive data for the 165-person sample for age, ANB angle, Wits evaluation, Yen angle, and W angle. The mean and standard deviation (SD) of the Yen

angle were 123.15° ± 7.6°, whereas the W angle were 56.61° ± 5.5°.

Parameters	Mean	S.D ±
ANB Angle	2.38	3.96
YEN Angle	123.15	7.60
W Angle	56.61	5.51

Table I: Mean and Standard Deviation between ANB, Yen and W Angle

Table II presents the Pearson correlation coefficients between the variables ANB, YEN, W, and Witts.

Pearson Co-relation	Witt`s Value	Yen Angle	W Angle
ANB Angle	.69*	-.640**	-.798**
Witt`s Value		**-.72****	**-.77**
YEN Angle			.675**

Table II: Pearson Correlation between ANB, Wit`s, YEN and W Angle

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is moderately significant at the 0.01 level (2-tailed)

Sensitivity and Specificity Table for YEN angle and W angle have been explained in Table III & IV

Condition	Test Positive	Test Negative
Condition Positive (Yen < 117°)	**12**	**2**
Condition Negative (Yen ≥ 117°)	**5**	**13**

Table III: Sensitivity and Specificity table for Yen angle

- **Sensitivity= 0.86 or 86%**

→ The test (ANB > 4°) correctly identifies 86% of actual skeletal Class II cases.

- **Specificity = 0.72 or 72%**

→ The test correctly rules out 72% of non-Class II cases.

Condition	Test Positive (W<54°)	Test Negative (W≥54°)
Condition Positive (Yen < 117°)	**11**	**3**
Condition Negative (Yen ≥ 117°)	**3**	**135**

Table IV: Sensitivity and Specificity table for W angle

- **Sensitivity= 0.79 or 79%**

→ The test correctly identifies 79 % of actual skeletal Class II cases.

- **Specificity = 0.83 or 83%**

→ The test correctly rules out 83% of non-Class II cases.

Discussion

Assessing sagittal jaw discrepancy is an essential part of every orthodontic examination. To date, a large number of longitudinal and angle measures have been created, using various planes and reference points. Sometimes, because the reference planes change, various analyses may produce different values for the same jaw connection. ANB angle, Wits assessment, and beta angle are the three sagittal jaw markers that are most frequently used in regular orthodontic diagnosis. In order to assess the clinical usefulness and dependability of these two new angles as markers of sagittal jaw discrepancies, this study looked at how they related to the usual measurements.[1]

Table I shows that the mean and SD values for the Yen angle within this research were 123.15° ± 7.6°3, which is comparable to the values provided by Romania et al., or 120.20° ± 6.73°,[2,8,14] and the W angle was 56.61° ± 5.5°, which is nearly identical to the values provided by Bhad et al, or 52.97° ± 5.61.[12] In another study W angle was found highly predictable in diagnosing Skeletal Class III in Yemeni Population.[15] In another study ANB angle was considered the most reliable indicator.[16]

The purpose of the current investigation was to ascertain how well Yen and W angles predict various sagittal jaw discrepancies when combined with ANB and Wits appraisals. There was a significant strong association discovered between YEN and W ($r = 0.675$, $p < .001$), meaning that increases in YEN are associated with increases in W. The result here coincided with the study by Chandrika in 2020. According to its findings, the YEN angle was a more accurate indicator of class II sagittal mismatch than the ANB and beta angles. YEN angle was found to be homogeneously distributed and to exhibit the least fluctuation when compared to the other two predictors.[13]

Conclusion

- ANB, Yen, and W angles were found to have significant statistical associations, although differing degrees of connection. So, in addition to the known angles, W angle and Yen angle may be utilized to evaluate sagittaljaw discrepancy.
- The ANB angle exhibits the strongest link with Yen and W angles, while Wits evaluation shows the lowest correlation.
- When compared to the W angle, the Yen angle exhibits higher precision and efficiency values with the ANB angle.

Ethical Approval

The study was approved by the Institutional Ethical Review committee of CIMS Dental College Multan. (2133/Trg/20 MDC/CDC)

Funding Declaration

This study received no grant from any funding agency, commercial, or not-for-profit sectors.

Conflict of Interest

It is declared that the authors don't have any conflict of interest.

Authors' Contribution

AW: Write up and data collection
ZA: Re-view and data conformation
MR: Statistics analysis
AN: Tracing of Lateral Cephalogram

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