

Evaluation of Beta, Yen, and W Angle in Assessment of Anteroposterior Jaw Relationship in North Indian Population: A Cephalometric Study

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ABSTRACT

Aim and objective: To establish the mean value, standard deviation, and to determine statistically significant differences of Beta, Yen, and W angle for skeletal class I, skeletal class II, and skeletal class III malocclusion in North India population.

Materials and methods: The study will be carried on 90 pretreatment lateral cephalograms randomly taken from records of the Department of Orthodontics and Dentofacial Orthopedics, Genesis Institute of Dental Sciences and Research, Ferozepur. All the cephalograms will be traced using a sharp 0.5 mm pencil on 0.003-inch acetate tracing paper using an X-ray viewer. Mean values of measurements such as ANB angle and Wits appraisal will be calculated and will be divided into 3 groups of 30 samples each. Then, Beta, Yen, and W angle will be measured for all three groups. The data will then be summarized and standard statistical methods will be applied.

Results: Beta angle had a value of $31.23 \pm 3.2.99^\circ$ for skeletal class I group, $25.33 \pm 2.64^\circ$ for skeletal class II group, $40.03 \pm 3.0.05^\circ$ for skeletal class III group, YEN angle had a value of 122.57 ± 6.53 for skeletal class I group, 115.20 ± 2.49 for skeletal class II group, and 132.60 ± 3.56 for skeletal class III group, and W angle had a value of 54.90 ± 2.39 for skeletal class I group, 51.17 ± 3.21 for skeletal class II group, and 59.40 ± 1.95 for skeletal class III group.

Conclusion: A significant difference was present between the mean value of Beta, Yen, and W angle for class I, class II, and class III malocclusion.

Clinical significance: Beta, Yen, and W angle are new parameters to diagnose the skeletal relationship of both the arches and are important clinically in diagnosis and treatment planning of the patient for orthodontic treatment.

Keywords: Beta angle, Lateral cephalogram, W angle, Yen angle.

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INTRODUCTION

In orthodontics, discrepancies are described namely in three planes of space transverse, sagittal, and vertical. Of these, sagittal discrepancies are more commonly encountered in day-to-day practice. Cephalometric analysis can be employed to describe, compare, classify, and communicate the nature of orthodontic and orthopedic problems. Assessing this sagittal relationship is a challenging issue in orthodontics. To determine the sagittal denture base relationship, the A-B plane angle was introduced by Downs in 1948.¹ The ANB angle given by Steiner in 1953 has been recognized as a skeletal sagittal discrepancy indicator and has become the most commonly used measurement since then.

More recently, it has been claimed that the ANB angle is affected by several environmental factors and thus diagnosis based on this angle may give false results.² The factors that affect the ANB angle are the patient's age, the change of the spatial position of the nasion either in the vertical or anteroposterior direction or both, the upward or downward rotation of the SN plane, the upward or downward rotation of the Jaws, the change in the angle SN to the occlusal plane and the degree of facial prognathism.³⁻⁵ Due to the drawbacks of ANB angle measurement, several different, new measurements have been developed to determine the actual sagittal skeletal discrepancy.

To eliminate the influence of the anatomic variations in nasion on the sagittal relationship of the jaws, Jacobson introduced the Wits appraisal Jacobson 1975.^{6,7} In this method, perpendiculars on a lateral cephalometric head film tracing from points A and B on the

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maxilla and mandible, respectively, to the occlusal plane to obtain a measurement that was less affected by variations in craniofacial physiognomy.^{8,9} However, there were difficulties with this analysis as it was influenced by various factors.

All the above-mentioned analyses used reference planes in the cranial region or dental occlusion. Each one of the reference planes had its own limitations. Measurement independent of cranial reference planes or dental occlusion would be a desirable adjunct in determining the apical base relationship, and also a comparison of pretreatment and posttreatment sagittal relationship of the jaws. Baik and Ververidou introduced a Beta angle which does not depend on any cranial landmark or dental occlusion to assess the sagittal jaw relationship.^{10,11}

Neela et al. in 2009¹² introduced another angle called the Yen angle, to evaluate the sagittal relationship between maxilla and mandible.^{13,14} Its main advantage is that it eliminates the difficulty in locating points A and B or the functional occlusal plane. As it is not influenced by growth changes it can be used in mixed dentition as well. Bhad et al. in 2013¹⁵ introduced the W angle to assess the sagittal relationship between maxilla and mandible. According to the author, the W angle reflects true sagittal dysplasia and is not affected by growth rotations.^{16,17}

The purpose of this study is to define the mean value and the standard deviation for Beta, Yen, and W angle in the Indian population, especially in the North Indian population. The subjects selected for the study will be people with skeletal class I, class II, and class III pattern. Also, limited studies are describing the cephalometric norms for these angles in the North Indian population.

MATERIALS AND METHODS

The present study was conducted on 90 pretreatment lateral cephalograms randomly selected from the records of the Department of Orthodontics and Dentofacial Orthopedics, Genesis Institute of Dental Sciences and Research, Ferozpur Punjab. Lateral cephalograms were selected on basis of certain inclusion and exclusion criteria. Cephalometric analysis was done to evaluate ANB angle and Wits appraisal to classify the subjects into three groups of 30 each having class I, class II, or class III relationship. Beta angle, Yen angle, and W angle were then calculated for each group.

Sample Selection Criteria

The sample was selected on the following basis of inclusion and exclusion criteria.

Inclusion Criteria

- The subjects with a full complement of teeth in both the arches.
- Patients born in the Malwa region of Punjab.
- Age group—15–25 years.

Exclusion Criteria

- Patients with craniofacial deformities.
- Patients with any systemic diseases.
- History of trauma.
- Patients who have undergone orthodontic treatment.
- Poor quality of cephalograms.

MATERIALS AND METHODS

All the cephalograms were traced using a sharp 0.5 mm pencil on 0.003-inch acetate tracing paper using an X-ray viewer. For the measurement of the linear distances, scale to the nearest of 0.5 mm and angles to the nearest of 0.5° were used. Mean values of measurements such as ANB angle and Wits appraisal were calculated and divided into three groups of 30 samples each; group I—class I skeletal pattern group, group II—class II skeletal pattern group, and group III—class III skeletal pattern group.

Selection criteria for group I:

- ANB angle of 1°–3°.
- Wits appraisal between 1 and –1 mm.
- Pleasant orthognathic profile.

Selection criteria for group II:

- ANB angle of 4° or >4°.
- Wits appraisal >1 mm.
- Patients having a convex profile.

Selection criteria for group III:

- ANB angle was <1°.
- Wits appraisal <–1.
- Patient with a concave profile.

Beta, Yen, and W angle were measured for all three groups.

Beta angle was measured by joining

- Point A, the deepest point lying in the midline between the anterior nasal spine and alveolar crest between two central incisors.
- Point B, the deepest point in the midline between the alveolar crest of the mandible and the mental process.
- The apparent axis of the condyle, which the point lying on the center of the condyle.

Yen angle was measured by joining

- Point S, the midpoint of sella turcica.
- Point M, the midpoint of premaxilla.
- Point G, the center of the largest circle that is tangent to the internal interior, anterior, and posterior surfaces of the mandibular symphysis.

W angle was measured by joining

- Points S, G, and M.
- A perpendicular was drawn from point M to the S-G line.
- W angle was measured between this perpendicular line and M-G line.

All radiographs were traced and measured by a single examiner to eliminate any inter-examiner variability. To eliminate the intra-examiner bias, the sample was retraced and redigitized after an interval of 2 weeks by the same examiner. The data were gathered and analyzed statistically using SPSS software to obtain the results.

RESULTS

The present study was carried out on 90 pretreatment cephalograms divided into three groups of 30 each based on ANB angle, Wits appraisal, and profile. Beta angle, Yen angle, and W angle were calculated for each group.

The analysis of variance (ANOVA) showed that there was a significant ($p = 0.0001$) difference in ANB angle among the groups. The *post hoc* tests revealed that the ANB angle was significantly ($p = 0.0001$) different between each pair of groups.

Significant ($p = 0.0001$) difference was also seen in Wits appraisal among the groups according to the ANOVA. The *post hoc* tests revealed that Wits appraisal was significantly ($p = 0.0001$) different between each pair of groups.

Beta angle had a value of $31.23 \pm 3.2.99^\circ$ for skeletal class I group, $25.33 \pm 2.64^\circ$ for skeletal class II group, and $40.03 \pm 3.05^\circ$ for skeletal class III group. The ANOVA showed that there was a significant ($p = 0.0001$) difference in the Beta angle among the groups. The *post hoc* tests revealed that the Beta angle was significantly ($p = 0.0001$) different between each pair of groups (Table 1).

Table 1: Comparison of Beta angle among the groups

Groups	Beta angle (mean \pm SD)
Group I	31.23 \pm 2.99
Group II	25.33 \pm 2.64
Group III	40.03 \pm 3.05
<i>p</i> value ^a	0.0001 ^c
<i>p</i> value ^b	
Group I vs group II	0.0001 ^c
Group I vs group III	0.0001 ^c
Group II vs group III	0.0001 ^c

^aANOVA test^bTukey's *post hoc* tests^cSignificant**Table 2:** Comparison of Yen angle among the groups

Groups	Yen angle (mean \pm SD)
Group I	122.57 \pm 6.53
Group II	115.20 \pm 2.49
Group III	132.60 \pm 3.56
<i>p</i> value ^a	0.0001 ^c
<i>p</i> value ^b	
Group I vs group II	0.0001 ^c
Group I vs group III	0.0001 ^c
Group II vs group III	0.0001 ^c

^aANOVA test^bTukey's *post hoc* tests^cSignificant**Table 3:** Comparison of W angle among the groups

Groups	W angle (mean \pm SD)
Group I	54.90 \pm 2.39
Group II	51.17 \pm 3.21
Group III	59.40 \pm 1.95
<i>p</i> value ^a	0.0001 ^c
<i>p</i> value ^b	
Group I vs group II	0.0001 ^c
Group I vs group III	0.0001 ^c
Group II vs group III	0.0001 ^c

^aANOVA test^bTukey's *post hoc* tests^cSignificant

YEN angle had a value of 122.57 \pm 6.53 for the skeletal class I group, 115.20 \pm 2.49 for the skeletal class II group, and 132.60 \pm 3.56 for the skeletal class III group. The ANOVA showed that there was a significant ($p = 0.0001$) difference in Yen angle among the groups. The *post hoc* tests revealed that the Yen angle was significantly ($p = 0.0001$) different between each pair of groups (Table 2).

W angle had a value of 54.90 \pm 2.39 for the skeletal class I group, 51.17 \pm 3.21 for the skeletal class II group, and 59.40 \pm 1.95 for the skeletal class III group. The ANOVA showed that there was a significant ($p = 0.0001$) difference in W angle among the groups. The *post hoc* tests revealed that the W angle was significantly ($p = 0.0001$) different between each pair of groups (Table 3).

A Chi-square test was used to compare categorical variables among the groups. The one-way ANOVA test followed by Tukey's

post hoc tests was used to compare continuous variables among the groups. The p value < 0.05 was considered significant. All the analyses were carried out on SPSS 16.0 version (Chicago, Inc., USA).

DISCUSSION

In orthodontics, diagnosis, and treatment planning, there is great importance in evaluating the sagittal apical base relationship to determine angle class I, II, and III malocclusion. Various angular and linear measurements have been suggested to evaluate this relationship. But they had several shortcomings like change in position of A point due to rotation of jaws during growth, change in angulations of the occlusal plane.

The findings of the present study showed that the values for all three angles, i.e., Beta, Yen, and W angle were in accordance with their original studies.^{10,12,15}

Analysis of variance showed a statistically significant intergroup difference ($p < 0.001$). Comparison of Beta angle showed a mean difference of 5.9° between class I and class II, -8.8° between class I and class III, and -14.7° between class II and class III groups while YEN angle showed mean difference of 7.37° between class I and class II, -10.03° between class I and class III, and -17.4° between class II and class III groups and W angle showed mean difference of 3.73° between class I and class II, -4.5° between class I and class III, and -8.23° between class II and class III groups.

Based on the above evaluation, the following order of Beta, YEN, W angle values was observed in different classes: class III $>$ class I $>$ class II.

All the above differences were statistically significant ($p < 0.001$). Based on the results of this study, it can be said that Beta, YEN, and W angle can be used to assess sagittal jaw relationship with high reliability. The other sagittal parameters can also be used but one measurement should not be considered as absolute means of determining anteroposterior dysplasia. It should be checked by other parameters as they correlate with each other.

Any clinician should be aware of as many cephalometric analyses as possible but should use them cautiously and appropriately. By relying on a single parameter that was developed years ago, without periodically reevaluating it, the diagnosis might be misleading, and treatment planning based on such a diagnosis can be insufficient or even harmful.^{18,19}

Further studies can be planned on males and females separately so that any confounding of factors due to gender differences could be excluded. Also, this study used subjects with variant dentofacial characteristics. Further investigations can be conducted to evaluate the sagittal jaw relationship with samples including individuals with normal occlusion.

CONCLUSION

It can thus be concluded that the beta angle is not affected by growth pattern/jaw rotation and is a reliable treatment tool for diagnosis and treatment planning for patients with skeletal dysplasia.²⁰ Yen angle eliminates the difficulty in locating points A and B or the functional occlusal plane. As it is not influenced by growth changes, it can be used in mixed dentition as well. W angle reflects true sagittal dysplasia and is not affected by growth rotations. A significant difference was present between the mean value of beta, Yen, and W angle for class I, class II, and class III malocclusion.

CLINICAL SIGNIFICANCE

Beta, Yen, and W angle are new parameters to diagnose the skeletal relationship of both the arches and are important clinically in diagnosis and treatment planning of the patient for orthodontic treatment.²¹⁻²⁴

REFERENCES

- Downs WB. Variation in facial relationship; their significance in treatment and prognosis. *Am J Orthod Dentofac Orthop* 1948;34(10):812-840.
- Taylor CM. Changes in the relationship of nasion, point A and point B, and the effect upon ANB. *Am J Orthod Dentofac Orthop* 1969;56:143-163.
- Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. *Angle Orthod* 1952;22:142-145.
- Bishara SE, Fahl JA, Peterson LC. Longitudinal changes in the ANB angle and Wits appraisal: Clinical implications. *Am J Orthod Dentofac Orthop* 1983;84:133-139.
- Chang HP. Assessment of anteroposterior jaw relationship. *Am J Orthod Dentofac Orthop* 1987;92:17-22.
- Jacobson A. The 'Wits' appraisal of jaw disharmony. *Am J Orthod Dentofac Orthop* 1975;67:125-138.
- Jacobson A. The application of the 'Wits' appraisal. *Am J Orthod* 1976;70:179-189.
- Hussels W, Nanda RS. Analysis of factors affecting angle ANB. *Am J Orthod* 1984;85(5):411-423.
- Thayer T. Effects of functional versus bisected occlusal planes on Wits appraisal. *Am J Orthod Dentofacial Orthop* 1990;97:422-426.
- Baik CY, Ververidou M. A new approach of assessing sagittal discrepancies: The Beta angle. *Am J Orthod Dentofac Orthoped* 2004;126:100-105.
- Aparna P, Kumar DN, Prasad M, et al. Comparative assessment of sagittal skeletal discrepancy: A cephalometric study. *J Clin Diagn Res* 2015;9:38-41.
- Neela PK, Mascarenhas R, Husain A. A new sagittal dysplasia indicator: The Yen angle. *World J Orthod* 2009;10:147-151.
- Mittal A, Bohra S, Murlidhar N, et al. An evaluation of Yen and W angle in assessment of anteroposterior jaw relationship. *J Indian Orthod Soc* 2016;50:26-30.
- Jain S, Raghunath N, Murlidhar N. A comparison of W angle, Pi angle and Yen angle as an indicator for assessing anteroposterior skeletal dysplasia in various malocclusions among regional population: A cephalometric study. *Int J Dent Res Develop* 2018;8:29-40.
- Bhad WA. A new approach of assessing sagittal dysplasia-W angle. *The European Journal of Orthodontics* 2013;35:66-70.
- Kalra A, Jasoria G, Matta A, et al. Correlation between W angle and different angular and linear sagittal skeletal discrepancy indicators- A cephalometric study. *Int J Curr Res* 2017;9:52578-52581.
- Mashhadany S. The relation between W angle and other methods used to assess sagittal jaw relationship. *J Baghdad Coll Dentis* 2012;24:1-6.
- Alam M, Qamaruddin I, Muraoka R, et al. Validity of W angle and Yen angle in a sample from Pakistani and Bangladeshi populations. *J Hard Tiss Biol* 2014;2014:351-356.
- Doshi J, Trivedi K, Shyagali T, et al. Predictability of Yen angle & appraisal of various cephalometric parameters in the assessment of sagittal relationship between maxilla and mandible in Angle's class II malocclusion. *People's J Sci Re* 2012;5:1-8.
- Bhardwaj P, Kapoor DN, Rani MS. Assessment of sagittal skeletal discrepancy: A cephalometric study. *J Indian Orthod Soc* 2013;47:262-265.
- Agrawal R, Sharma L, Soni V, et al. Comparison of different angular measurements to assess sagittal jaw discrepancy in Jaipur population: a cephalometric study. *J Dent Med Sci* 2013;10:33-36.
- Bohra S, Udeshi P, Sinha S, et al. Predictability of Pie angle and comparison with ANB angle, W angle, Yen angle, Beta angle in South Indian population. *J Indian Orthod Soc* 2018;52:22-28.
- Wani K, Manerikar R, Jethi S, et al. Mean values of Beta angle and Yen angle in Maratha ethnic population and their reliability on select local population: A cephalometric observational study. *Int J Oral Health Dentis* 2017;3(1):43-49.
- Qamaruddin I, Alam M, Shahid F, et al. Comparison of popular sagittal cephalometric analyses for validity and reliability. *Saudi Dent J* 2018;30:43-46.