Original Article

An Evaluation of YEN Angle, W Angle, and MKG Angle in Assessment of Sagittal Skeletal Dysplasia

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Abstract

Background: Evaluation and assessment of skeletal discrepancy are always crucial in defining a treatment plan. The aim of the study is to evaluate and correlate various angular measurements for assessing sagittal skeletal dysplasia. **Materials and Methods:** One hundred and fifty pre-treatment lateral cephalograms were traced and they were divided into Class I, Class II, and Class III groups using ANB values. Further all angular measurements were made on all the lateral cephalograms. **Results:** The mean value for YEN angle in the Class I skeletal group was 125.68° ± 5.01, 119.0° ± 6.03 for Class II, and 126.83° ± 12.07 for Class III. The mean value for W angle in the Class I skeletal group was 56.65° ± 3.51, 51.81° ± 4.50 for Class II, and 57.67° ± 7.55 for Class III. Mean values for MKG angle in our study were found to be 52.55° ± 6.73 for Class I, 58.5° ± 11.004 for Class II, and 48.83° ± 6.91 for Class III. **Conclusion:** Instead of relying on a single angular measurement, we can use multiple angular measurements to have a better diagnosis and treatment planning. YEN angle was found to be comparatively a better parameter for evaluation of sagittal skeletal dysplasia in Bhopal population.

Keywords: MKG angle, W angle, Yen angle.

Introduction

Facial profile of an individual is influenced by both genetic and environmental factors, which shows complex interactions to define the form and function of craniofacial complex. The growth and development of skeletal jaw bases contribute to the overall facial esthetics. In the current scenario, majority seek better facial profile to look better and feel better.

An assessment of jaw-base relationship was first introduced by Edward H angle in 1899, taking molar relationship into consideration. It was an anteroposterior relationship based on dentition. It took more time to have a better view to the anteroposterior relationship of skeletal jaw bases.[1] Riedel used angle ANB for skeletal jaw base relationships, which later became part of various cephalometric analyses. The ANB measurement for relating jaws to cranial reference planes like Nasion presents inherent inconsistencies because of variations in craniofacial physiognomy.[2]

The clockwise or counter-clockwise rotation of the jaws relative to the cranial reference planes affects the ANB angle reading. According to Jacobson, relating the jaws to an extracranial parameter may provide an expression of anteroposterior jaw relationship which is important from an esthetic standpoint.[3]

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The aim of this study was to assess the predictability of YEN, W, and MKG angles in assessing anteroposterior skeletal dysplasia and their correlation with ANB angle in various skeletal jaw relationships in Bhopal population. The study attempted to evaluate the normal values for various angular measurements and their correlation with ANB as well, so that a more reliable parameter can be obtained for assessing anteroposterior skeletal dysplasia.

Materials and Methods

The study was conducted using 150 pre-treatment lateral cephalograms, from department of orthodontics, who had reported to the department for orthodontic treatment. Subjects were included after taking consent from them, for using their lateral cephalograms for the research work. Approval for the

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cephalometric study was obtained from the Institutional Ethics Committee. Subjects were divided based on ANB values into Class I, Class II, and Class III skeletal groups. The inclusion criteria are as follows:

- Age group: 10–40
- No congenital facial asymmetry
- No previous history of orthodontic treatment
- No history of facial trauma.

Tracings were done using 3H pencil on acetate tracing paper with help of a tracing board. All the angles (YEN, W, and MKG) were constructed and measurements were taken.

Landmarks used in the cephalometric analysis

- Sella (S): The center of the pituitary fossa of the sphenoid bone
- Nasion (N): The junction of the frontal and nasal bones, at the frontonasal suture
- A-point (A): The deepest point on the concavity at the anterior surface of the maxilla
- B-point (B): The deepest point on the concavity at the anterior surface of the mandibular symphysis
- Point M: Midpoint of premaxilla
- Point G: Centre of largest circle tangent to the internal inferior, anterior, and posterior surfaces of mandibular symphysis
- Point Key ridge (KR): Lowest point on the outline of the KR.

Yen angle makes use of three skeletal landmarks- point S (Midpoint of Sella turcica), point M (midpoint of premaxilla), and point G (center of largest circle tangent to the internal inferior, anterior, and posterior surfaces of mandibular symphysis). When these three points are connected, Yen angle (Figure 1) is formed.[4]

W angle made use of same reference points used in defining Yen angle with a different angle. W angle is the angle between the perpendicular line from point M to S-G line and M-G line.[5] (Figure 2).

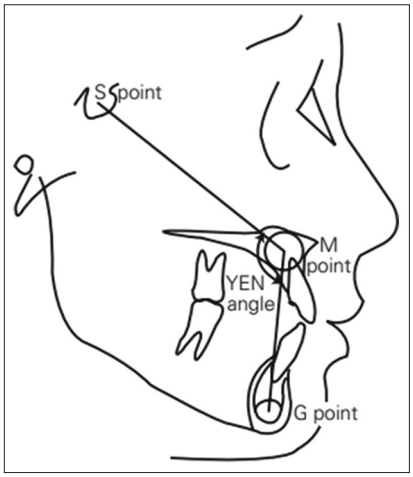

Figure 1: Yen angle

MKG angle used three skeletal reference points, that is: Point KR: Lowest point on the outline of the KR. Point M: Midpoint of the premaxilla. Point G: Center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis. The two lines that would form joining these points are: Line 1: connecting points M and KR. Line 2: connecting points KR and G. The MKG angle was constructed between lines 1 and 2 drawn from point M to point KR and point KR to point G[6] (Figure 3).

Results

A total of 150 patients were included in the present study. Around 113 patients were having Class II malocclusion, 31 having Class I and six Class III based on ANB angle.

- Overall the mean age of the patients in the present study was 21.00 ± 8.84 and it ranged from 10 to 40 years
- When observed based on the type of malocclusion, it was highest for Class I, that is, 20.61 ± 3.94 followed by 20.18 ± 4.70 for Class II and least for Class III 19.67 ± 4.27

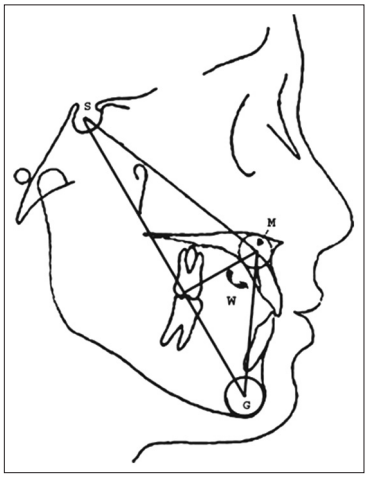

Figure 2: W angle

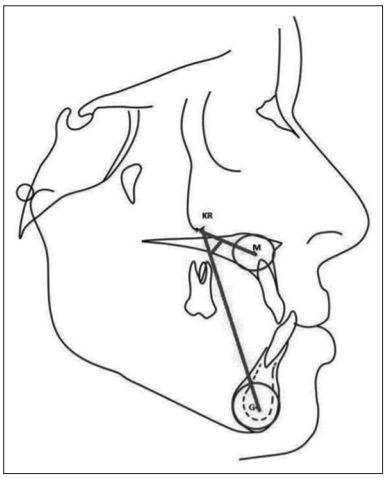

Figure 3: MKG angle

Table 1: Correlation between various angular measurements

skeletal Relation	MKG angle		W angle		ANB angle	
	Correlation coefficient	*P*-value	Correlation coefficient	*P*-value	Correlation coefficient	*P*-value
Class I						
Yen angle	−0.198	0.285	0.882	0.001*	−0.415	0.020*
W angle	0.068	0.717			−0.417	0.020*
ANB angle	0.291	0.112				
Class II						
Yen angle	−0.275	0.003*	0.803	0.001*	−0.307	0.001*
W angle	−0.042	0.660			−0.307	0.001*
ANB angle	0.381	0.001*				
Class III						
Yen angle	−0.693	0.127	0.944	0.005*	0.884	0.020*
W angle	−0.549	0.259			0.898	0.015*
ANB angle	−0.630	0.180				

*statistically significant

- However, no statistically significant difference was observed for age distribution ($P = 0.850$)
- Among the study participants, more number of females ($n = 88$) were present when compared to males ($n = 62$) in the present study
- Highest distribution of both males and females was observed in Class II malocclusion and least in Class III
- No significant association was observed for type of malocclusion and gender distribution in the present study ($P = 0.900$).

Mean and standard deviation for Yen Angle were 120.69 and 6.79 among the participants. Yen Angle was highest for Class III (126.83 ± 12.07) and least in Class II (119.0 ± 6.03). When checked for difference between the types of malocclusion, statistically significant difference was present in the present study.

- For comparison specifically between two groups, mean difference was significant between Class I, Class II, and Class III while it was not significant between Class I and Class III.

Mean and standard deviation for W Angle was 53.05 and 4.93 among the participants. W Angle was highest for Class III (57.67 ± 7.55) followed by Class I (56.65 ± 3.51) and least in Class II (51.81 ± 4.50). Overall statistically significant difference was observed for W angle.

- While assessing the difference between two groups for W Angle, mean difference was significant between Class I, Class II and Class III while it was not significant between Class I and Class III.

Mean and standard deviation for MKG Angle was 56.55 and 10.45 among the study participants. MKG Angle was highest for Class II (58.05 ± 11.004) followed by Class I (52.55 ± 6.73) and least in Class III (48.83 ± 6.91). Overall statistically significant difference was observed for MKG Angle.

- While assessing the difference between two groups for MKG Angle, mean difference was significant between Class I and Class II only
- Within Class I malocclusion, statistically significant strong correlation was observed between Yen and W angle (0.882), while negative significant moderate correlation was seen between Yen and ANB angle, W, and ANB angle
- For Class II malocclusion, statistically significant mild negative correlation was observed between Yen and MKG angle, Yen and ANB angle, and W and ANB angle
- In Class III malocclusion, statistically significant strong correlation was seen between Yen and W Angle, Yen and ANB angle, W and ANB angle (Table 1).

Discussion

Skeletal jaw relation remains as an important tool in arriving at a diagnosis and framing a proper treatment plan as it could help an orthodontist in differentiating the treatment plan. Skeletal and dental relations should be assessed properly. Orthodontic correction involves obtaining not just a well aligned dentition but also an overall acceptable facial form. Various cephalometric analyses evolved over years help us to assess sagittal skeletal discrepancy. Wylie in 1947 was the pioneer in assessing jaw relationships, who was followed by Riedel in 1952 who introduced ANB angle and subsequently many authors came up with their findings which will aid in assessing skeletal jaw relation.[7,8] Steiner emphasized the use of SN plane to be taken as the reference as its least displaced in head movements.[9]

The reliability of Point A, Point B, and Nasion was evaluated by Taylor in 1969. When there is a change in position of Nasion, then SNA value also gets changed, which masks the actual skeletal dysplasia.[10]

In our study, the mean value for YEN angle in the Class I skeletal group was 125.68° ± 5.01, 119.0° ± 6.03 for Class II, and 126.83° ± 12.07 for Class III. The mean values were found higher than the result of Neela *et al*. The predictability of Yen angle in determining sagittal skeletal dysplasia in Gulbarga population was investigated by Katti *et al*. They found that YEN angle had the lowest co efficient of variation, which made it a better angular measurement in assessing sagittal skeletal dysplasia.[11] Studies by Polina *et al*. in Andhra population

revealed slightly higher mean values for YEN angle in various skeletal groups.[12] A similar study done in Eastern Indian population by Gupta *et al*. and his colleagues revealed a slightly lower value for YEN angle.[14] We can find the values getting varied for different population chosen for the study.

In our study, the mean value for W angle in the Class I skeletal group was 56.65° ± 3.51, 51.81° ± 4.50 for Class II, and 57.67° ± 7.55 for Class III. The mean values were found higher than the result of Bhad *et al*. When checked for difference between the types of skeletal jaw relations, statistically significant difference was present in the present study. In eastern population, the value of W angle was found to be 56.080° ± 3.190°.[14] The study of Al-Mashhadany to check the relation of W angle and other methods used to assess sagittal jaw relationship showed the similar result that W angle is a reliable tool in assessing sagittal skeletal dysplasia. The mean values for W angle in Iraqi adults were found to be 54.8° for Class I, 49.6° for Class II, and 59.83° for Class III skeletal cases. A significant negative relation was found for W angle with ANB. W angle stays unaffected with vertical growth pattern or rotation of jaws. S-G line stays unaffected with rotation of jaws along with M-G line. This made W angle a stable measurement. She found a significant negative relation with ANB and a positive relation with beta angle in Iraqi adults.[15]

Soni *et al*. checked for the correlation and reliability of YEN and W angles. The mean and standard deviation of Yen angle and W angle were 120.87° ± 4.71° and 54.03° ± 2.96°, respectively. Both angular measurements exhibited strong correlation with ANB angle (r- −808, −622). They concluded that both are found as valuable tools in assessing sagittal skeletal dysplasia. Their study also supports our present study.[16] Doshi *et al*. also support Yen angle as a valuable tool in assessing jaw discrepancy as it is the most homogenously distributed angular parameter to differentiate between various skeletal groups.[17]

The original study for YEN angle was done in Karnataka population. The original study for W angle was done in Maharashtra population. We could find that both angular measurements tend to change with varying populations. The environmental changes and genetic predisposition could be the reasons behind this. As MKG angle was introduced recently, we need further lot more studies to check its reliability. Both Yen angle and W angle make use of Point S, which is an important landmark in construction of YEN and W angles. There were variances in size and shape of sella turcica in different skeletal jaw relations. A study by Chaudhary *et al*. found variances in its morphology among Class I and Class II skeletal groups, which may affect the various angular measurements as well.[18]

Mean values for MKG angle in our study were found to be 52.55° ± 6.73 for Class I, 58.5° ± 11.004 for Class II, and 48.83° ± 6.91 for Class III. The mean values were found higher than the result of Chacha *et al*.[6] When checked for difference between the types of skeletal jaw relations, statistically significant difference was present in the present study.

In our study, we found that YEN angle, MKG angle, and W angle good determinants to differentiate Class I with Class II skeletal groups. YEN angle W angle were identified as good parameters to differentiate Class II to Class III groups. We could not find any angular measurement to be good enough to differentiate between Class I and Class III cases. There was no statistically significant difference between Class I and Class III for any of the angular measurements. The present study presented that six out of 150 samples were only having Class III skeletal pattern. The present study was done in Bhopal population. The prevalence of Class III malocclusion in Bhopal population was found to be 6.7% in a study of 150 samples conducted in 2021.[19] Similar study done in Madhya Pradesh to assess the prevalence of Class III malocclusion gave a value of 3.98% only.[20] Hence, further studies with more Class III cases are required to have a better comparison with Class III cases.

Conclusion

The mean values for various angular measurements in Bhopal Population are as follows:

- The mean value for YEN angle in the Class I skeletal group was 125.68° ± 5.01, 119.0° ± 6.03 for Class II, and 126.83° ± 12.07 for Class III
- The mean value for W angle in the Class I skeletal group was 56.65° ± 3.51, 51.81° ± 4.50 for Class II, and 57.67° ± 7.55 for Class III
- Mean values for MKG angle in our study were found to be 52.55° ± 6.73 for Class I, 58.5° ± 11.004 for Class II, and 48.83° ± 6.91 for Class III
- Within Class I malocclusion, statistically significant strong correlation was observed between Yen and W angle (0.882), while negative significant moderate correlation was seen between Yen and ANB angle, W and ANB angle
- For Class II malocclusion, statistically significant mild negative correlation was observed between Yen and MKG angle, Yen and ANB angle, and W and ANB angle
- In Class III malocclusion, statistically significant strong correlation was seen between Yen and W Angle, Yen and ANB angle, W and ANB angle.

YEN angle was found to be comparatively a better parameter for evaluation of sagittal skeletal dysplasia in Bhopal Population. We should make use of various angular measurements to arrive at a proper diagnosis and treatment planning, rather than relying on one single parameter.

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