Original Article

Predictability of MKG Angle and Comparison with ANB Angle, W Angle, Yen Angle, Beta Angle and Pi Angle: A Cephalometric Study

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ABSTRACT

Introduction: The goal of this study was to develop a novel cephalometric estimation to assess the sagittal relationship between the maxilla and mandible.

Methodology: Fifty pre-treatment lateral cephalograms were chosen and classified into classes I, II, and III based on ANB angle, W angle, Beta angle, and Pi angle. The MKG angle was calculated by connecting the lines drawn from point M to key ridge (k) and point KR to point G. The MKG angle was measured in order to compute the mean and standard deviation.

Results: The results showed that MKG angle in the range 51º–59º can be considered to have a class I skeletal pattern. The MKG angle more than 59º indicates a class II skeletal pattern and less than 51º indicates class III skeletal pattern.

Conclusion: The MKG angle can be used as a dependable marker to assess sagittal jaw discrepancy.

Keywords: Cephalogram, Cephalometric estimation, MKG angle.

INTRODUCTION

Cephalometric analysis is essential for orthodontic diagnosis and treatment planning and a thorough examination of the antero-posterior (AP) jaw relationship is required. In orthodontic practice, simply correcting it can do wonders for appearance. Various angular and linear cephalometric measurements have been proposed so far to assess the sagittal jaw relationship or discrepancy between maxilla and mandible in order to assist orthodontic clinicians and researchers.[1] Sagittal jaw connections are difficult to analyze due to the rotation of the jaws throughout growth, the vertical relationships between the jaws and the reference planes, and the lack of validity of the numerous methods given for their evaluation.[2]

Researchers developed an accurate method for detecting sagittal base difference using linear and angular measures. To date, the following parameters have been developed: A-B plane angle, ANB angle, AXD angle, AXB angle, PABA angle, FABA angle, APDI angle, Beta angle, Wits Appraisal, AD/SN distance, AB/TH distance, and AB/FH distance.[3] Downs pioneered the use of the A-B plane angle to determine sagittal denture base attachment.[4] Riedels recommended using the SNA, SNB, and ANB angles a few years later. Since then, the ANB angle has been recognized as a skeletal sagittal discrepancy indicator and has become the most often utilized measurement.[5]

To produce a measurement that was less impacted by changes in craniofacial physiognomy, Jacobson and Harvey Jenkins drew perpendiculars on a lateral cephalometric head film tracing from points A and B on the maxilla and mandible, respectively, to the occlusal plane. The Wits assessment used the distance between the points of contact of the perpendiculars on the occlusal plane, AO and BO, as an indicator of skeletal sagittal jaw connection.[6] The beta angle was proposed by Baik and Ververidou to measure sagittal discrepancies. Points A and B determine this angle, which can be difficult to notice at times.[7] In other circumstances, the condyle is not visible. To tackle the challenge of determining locations A and B, Neela et al[8] devised the Yen angle, as well as the functional occlusal plane utilized in its evaluation and the condyle axis used in Beta angle analysis. However, in some cases, jaw rotations can hide real sagittal dysplasia.

Bhad et al[9] invented the W angle, it is indicative of genuine sagittal dysplasia and is unaffected by growth rotations. However, jaw rotation caused by growth or orthodontic treatment can compromise Yen angle accuracy. Although the W angle is unaffected by jaw rotation, it is dependent on point S, the sella turcica midway, which, as many studies have shown, is an unstable landmark.[10] Kumar et al[11] pioneered Pi analysis and found that the Pi angle would be independent of jaw rotation. But Pi angle makes use of a reference that is the true horizontal going through nasion, which changes with growth.[10] As a result, the study needed to find a place that was free of cranium yet consistent with regard to its growth. According to Atkinson, the "key ridge" (KR) is a strong buttress of bone that descends and continues forward from the zygoma to the maxillary bone and acts as a support for the maxillary first tooth.[12] Bien[13] claims that the KR remains constant in regard to the cranial bones throughout life.

This study was designed to define the mean value and the standard deviation (SD) for the MKG angle in a population with class I, class II, and class III skeletal base pattern.

METHODS

This retrospective study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, after taking the approval of the protocol review committee and institutional ethics committee (No. GIDSR/2023/224). Fifty pre-treatment lateral cephalo-grams were taken. The lateral cephalograms were traced, the parameters used for assessing anteroposterior skeletal relation were ANB angle, W angle, Beta angle, Pi angle, and Yen angle. All the films were traced and measured by the same examiner in order to eliminate the inter-examiner variability. The 50 screened lateral cephalograms were then subdivided into 3 groups that is: classes I, II, and III skeletal groups, in which 20 patients for class I malocclusion, 15 patients for class II malocclusion and 15 patients with class III malocclusion were included based on the following inclusion and exclusion criteria.

Inclusion criteria:

1. Class I: ANB angle 1º–4º, W angle 51º–56º, Beta angle 26º–33º, Pi angle 1.3–5º, Yen angle 117–123º.
2. Class II: ANB angle >4º, W angle <51º, Beta angle <26º, Pi angle >5º, Yen angle <117º.
3. Class III: ANB angle <1º, W angle >56º, Beta angle >33º, Pi angle <1º, Yen angle >123º.
4. Permanent dentition with no missing teeth.
5. No previous orthodontic treatment.
6. No history of facial trauma or medical conditions that could have altered the growth of the apical bases determined from the case history records.

Exclusion Criteria:

1. Patients with cranial or facial malformation and history of craniofacial trauma.
2. Poor quality of cephalograms.
3. Any growth abnormality which affects the condylar growth.

The MKG angle

The MKG angle is a parameter for assessing the sagittal apical base discrepancy. It uses the 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, as described in figure.

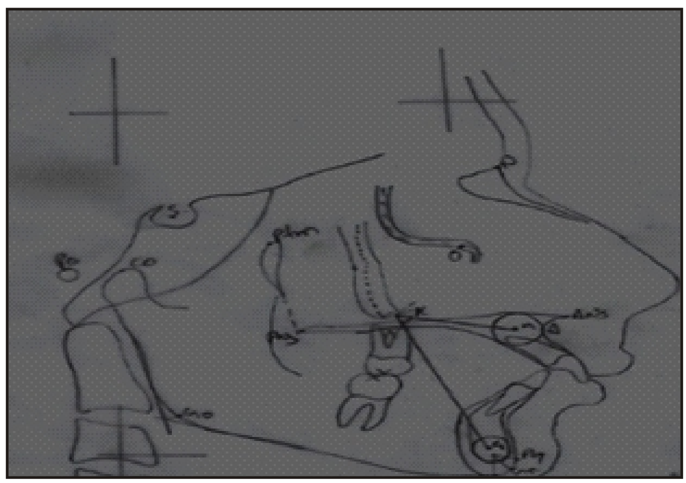

Figure: MKG angle.

The statistical analysis was carried out by the statistical software SPSS version 25.0 after the data was loaded into the Microsoft excel spreadsheet. The quantitative (numerical variables) information was presented as mean and standard deviation, while the qualitative (categorical variables) information was presented as frequency and percentage of each category.

When comparing the mean values of these groups, the student t-test was utilized, whilst the chi-square test was utilized to analyze the frequency differences between these groups. If p value was less than 0.05, then it was regarded to be statistically significant.

RESULTS

The mean value for the MKG angle in the class I skeletal pattern group was 54º, whereas the mean values in the class II and III skeletal pattern groups were 61.47º and 45.77º, respectively.

A statistically significant difference between the mean values of the MKG angle of the three groups was obtained by the student t-test, whilst the chi-square test was utilized to analyze the frequency differences between these groups (Table).

DISCUSSION

In order to evaluate the AP skeletal pattern, a new cephalometric variable that is MKG angle has been developed in this study. The maxilla and mandible are represented by points M and G, respectively, while the key ridge is represented by point K in the MKG analysis. Many authors, including Riedel (ANB angle)[5], Baik et al (Beta angle)[7], Neela et al (YEN angle)[8], Bhad (W angle)[9], and others have attempted to evaluate the sagittal skeletal connection using numerous landmarks. The ANB angle, however, is the measurement that is most frequently employed to evaluate the skeletal disparity. In typical occlusions, the ANB angle is typically 2°. A negative angle that is less than 0° shows class III jaw disharmonies, while angles larger than 2° indicate a tendency towards class II jaw disharmonies. A study demonstrated how the position of the nasion can influence the relationship between the skeletal bases, which may have an impact on the measurement of ANB due to growth or faulty assessment.[14]

The factors that could change the ANB angle, according to Oktay, include the patient's age (ANB decreases with age), the position of the nasion, the rotation of the sella-nasion (SN) line, the maxillae, and the facial prognathism.[15] Then, in order to solve some of the inadequacies of the previously mentioned factors, MKG angle was developed. The functional occlusal plane and shifting landmarks have little impact on this assessment. KR, M, and G are used as its three stable points. Contrary to points A and B, these points are not immediately impacted by local remodeling brought on by dental motions. However, a mathematically defined location within the maxillary complex and symphysis allows for a description of the natural locus of this structure rather than the imprecise downward and forward migration frequently used to describe maxillary and mandibular growth. This is true even though a complex remodeling process preserves the basic shape and proportions of the maxilla and symphysis.[16,17]

Sella and points M and G are also on the verge of becoming centroid points. In orthodontics, Johnson made the centroid point notion widely accepted.[18] This angle makes use of the skeletal landmarks G and M points to represent the mandible and maxilla. Braun[16] and colleagues marked at

Table: Values of the MKG angle in class I, class II, and class III groups in comparison with ANB, Beta, Yen, Pi, and W angle

Angle	Class	Mean ± SD	f value	p value
ANB angle	Class I	3.47 ± 1.18	76.728	< 0.001*
	Class II	5.26 ± 2.02		
	Class III	-1.38 ± 0.87		
Beta angle	Class I	29.59 ± 3.76	15.593	< 0.001*
	Class II	24.00 ± 5.43		
	Class III	37.46 ± 10.44		
W angle	Class I	51.76 ± 2.91	3.561	< 0.001*
	Class II	48.05 ± 4.16		
	Class III	56.00 ± 15.06		
Pie angle	Class I	3.24 ± 1.56	34.579	< 0.001*
	Class II	6.26 ± 3.51		
	Class III	-1.15 ± 1.34		
Yen angle	Class I	120.53 ± 2.94	25.403	< 0.001*
	Class II	116.74 ± 11.47		
	Class III	135.54 ±3.04		
MKG angle	Class I	54.00 ± 1.77	206.952	< 0.001*
	Class II	61.47 ± 2.57		
	Class III	45.77 ±1.92		

p < 0.05: Statistical significant; * p <0.001: highly significant the center of the largest circle, which is tangent to the anterior, superior (represented by the nasal floor), and palatal surfaces of the premaxilla, as well as the internal anterior, inferior, and posterior surfaces of the mandibular symphysis. Unlike points A and B, these points are not affected by local remodeling caused by dental movements. Points M and G can also be used to assess the growth vectors of the maxilla and mandible, which defines the stability of these points even during active growth periods.

The results of this study demonstrated that the values for the MKG angle were consistent with their first investigations. Based on the results of this investigation, it is possible to reliably determine the sagittal jaw relationship using the MKG angle. In our study, the range for MKG angle for class I malocclusion was 54º and for class II malocclusion it was 61.4° and for class III malocclusion it was 45.6°. Although the other sagittal traits may also be used, anteroposterior dysplasia should not be diagnosed by a single measurement. Since they are connected, more factors ought to be utilized to test it.

CONCLUSION

High correlations were found among the ANB, Beta, Yen, Pi, W, and MKG angle measurements, thus it can be concluded that the MKG 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.

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