Original Research

Study of Correlation between Different Angular and Linear Measurements to Assess Sagittal Skeletal Discrepancy – A Cephalometric Study

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Abstract

Background: This study aims to find correlation between angular and linear cephalometric measurements used to assess sagittal skeletal discrepancy. **Methods:** Sixty subjects, aged 15–25 years, were studied and their cephalograms were traced, and ANB angle, Wits appraisal, and Beta angle, YEN angle and W angle, and dentoskeletal overjet were measured to detect correlation among them and Pearson correlation coefficient was used to calculate correlation coefficients between various parameters. **Results:** Beta angle showed negative linear correlation −0.5, −0.673, and −0.352 in conjunction with ANB angle and Wits appraisal and dentoskeletal overjet, respectively. The W angle had a negative significant relation −0.492 with ANB angle and a positive significant relation 0.475, 0.527 with Beta angle and YEN angles, respectively. Dentoskeletal overjet had a positive correlation 0.328 and 0.494 with ANB angle and Wits, respectively, and negative correlation −0.558, −0.588, and −0.352 with YEN angle, Beta angle, and W angle, respectively. **Conclusion:** A negative linear correlation was found for Beta angle with ANB angle, Wits appraisal, and dentoskeletal overjet. In the same way, the W angle had a negative significant relation with ANB angle but, a significant positive relation with Beta angle and YEN angles.

Keywords: Beta angle, Cephalometric study, Dentoskeletal overjet, Wits appraisal, YEN angle

Introduction

An imperative measure, in orthodontic diagnosis and treatment planning, is the evaluation of sagittal apical base relationship. Cephalometric analysis gives information of angular and linear relations for skeletal anteroposterior discrepancies from many decades. Riedel *et al*. in 1972 proposed the use of angle ANB and is a commonly used parameter to determine sagittal discrepancy. ANB angle was varies with growth and it will also affected by the position of nasion. Nasion is also not a static point because it alters with growth.[1-3] Similarly, growth rotation of mandible as well as rotation due to orthodontic treatment can also alter the ANB angle.[4]

In 1975, Wits appraisal proposed by Jacobson for sagittal discrepancy. He used a functional occlusal plane on which point A and point B denote the sagittal position of maxilla and mandible. This parameter, introduced to overcome the drawbacks of angle ANB, had a few shortcomings. First, the main problem associated with the Wits appraisal was easy identification of accurate functional occlusal plane and reproducibility of this plane. In many conditions such as mixed dentition cases, missing teeth or multiple impacted teeth and Class II cases with severe curve of Spee are associated with difficulty in identification of accurate occlusal plane. Severe skeletal deformity such as skeletal open bite, occlusal canting, and skeletal facial asymmetry also contributes difficulties in easy identification and reproducibility of occlusal plane.[5-7]

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Second, main problem associated with Wits appraisal was change in functional occlusal plane either by development[8,9] or therapeutic reason. Development of dentition with age and orthodontic treatment[10,11] may also alter the fictional occlusal plane which affects the Wits appraisal. Hence, Wits appraisal may be of limited value in orthodontic treatment planning.

Baik and Ververidou[12] proposed Beta angle to determine the true apical base relationship. Beta angle formed by the point A in maxilla, point B in mandible, and condylion so Beta angle does not depend on any reference point of the cranium. Point A is influenced by the remodeling of alveolar bone in maxillary incisor region which generally affected by orthodontic tooth movement.[13,14] The reproducibility of condylion position in lateral cephalograms is quite limited.[15,16]

The YEN angle was introduced by Neela *et al*.[17] in 2009 to measure sagittal discrepancy. The angle was formed by Sella point in cranium, M point in maxilla, and G point in mandible. This angle can mask true basal dysplasia due to growth rotation of jaw and the changes due to orthodontic treatment. To control these existing issues, most recently introduced W angle in 2011 by Bhad *et al*.[18] to assess sagittal jaw discrepancy and another measurement named dentoskeletal overjet been proposed by AL-Hammadi *et al*.[19] in 2011.

This study was performed to find correlation between angular and linear cephalometric measurements used to assess sagittal skeletal discrepancy.

Materials and Methods

The study was conducted on 60 subjects within an age range of 15–25 who reported to department of orthodontics. Exclusion criteria considered for this study for the subjects were congenitally missing tooth, supernumerary teeth, any history of previous orthodontic treatment, and any syndromic disorder. Non-probability convenience sampling technique was used for taking sample.

The lateral cephalograms exposed with jaws in centric relation, lips relaxed, and the head in the natural head position. Same machine and same exposure parameters were used to record all the cephalograms. These cephalograms were traced, and measurement of all linear and angular parameters, that is, dentoskeletal over jet, Wits appraisal, ANB angle, Beta angle, YEN angle, and W-angle, were calculated to observe correlation between them [Figure 1].

A SPSS software was used to collect, tabulate, and statistically analyze the data. After calculation of mean value, standard deviation, minimum value, and maximum value for all linear and angular parameters, the data were summarized. Pearson correlation coefficient was performed to evaluate the correlation coefficients between various linear and angular parameters that are dentoskeletal overjet, Wits appraisal, ANB angle, W angle, Beta angle, and YEN angle.

Results

Table 1 and Figure 2 show descriptive statistics data including mean, standard deviation, and maximum and minimum values for all samples (n=60).

Table 2 and Figure 3 show the correlation between ANB angle, YEN angle, Beta angle, dentoskeletal overjet, and Wits appraisal. Pearson's correlation coefficient was used to study the correlation between various angles.

Discussion

Lateral cephalograms are the one of the most integral tools in orthodontic diagnosis and treatment planning. In lateral cephalograms, there are various linear as well as angular parameters which have been proposed to assess sagittal discrepancy and jaw position. All these linear and angular parameters which were used to assess sagittal discrepancy are

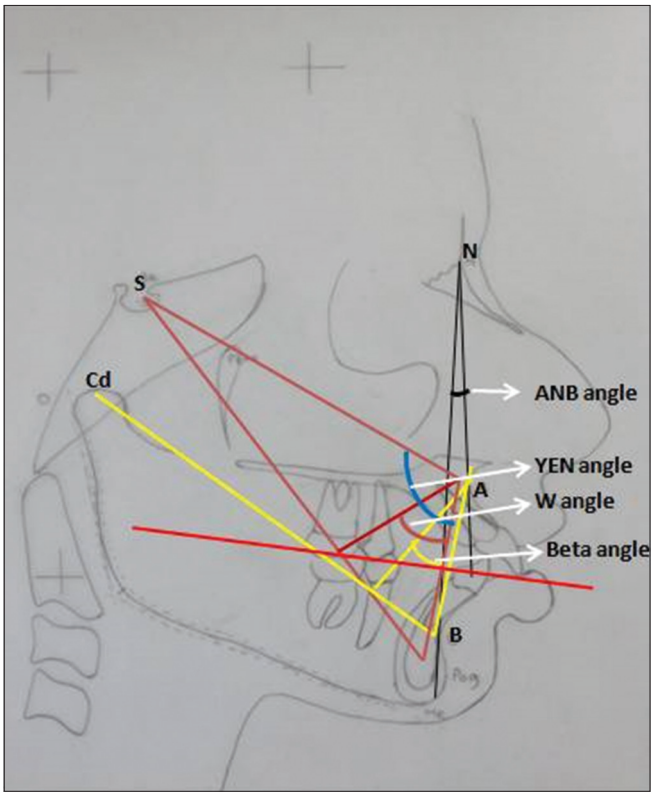

Figure1. Example of various parameters of Cephalometric analysis.

Table 1: Statistics including mean, standard deviation, and minimum and maximum values

Variables	Minimum	Maximum	Mean	Std. deviation
ANB	−2	8	4	2.56
Wits	−8	10	1.95	5.67
Beta	24	43	30.40	23.76
YEN	110	135	112.95	4.51
W angle	36	60	52.54	7.20
Dentoskeletal overjet	−8	6	0.931	3.40

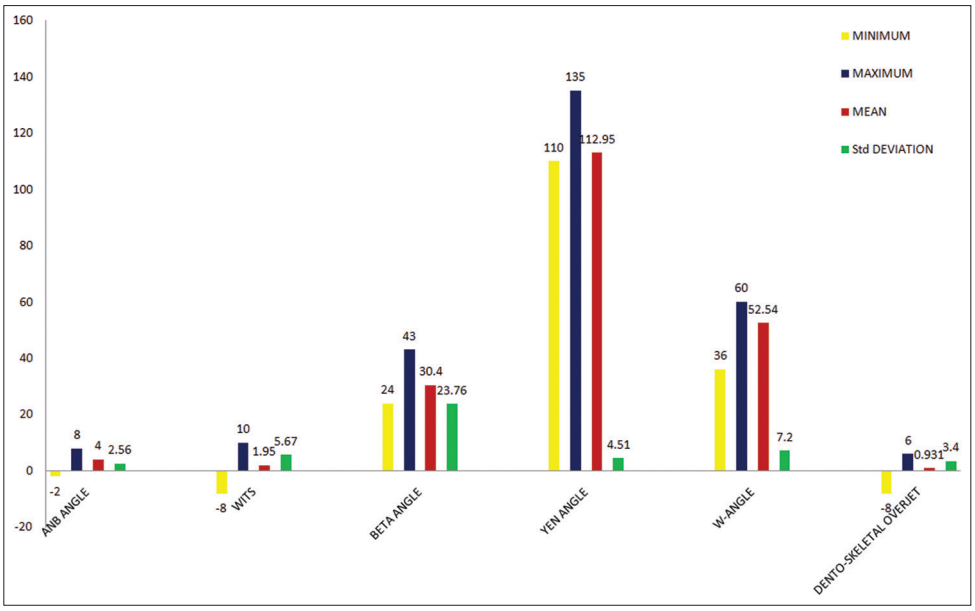

Figure 2. Statistics including mean, standard deviation, minimum and maximum values.

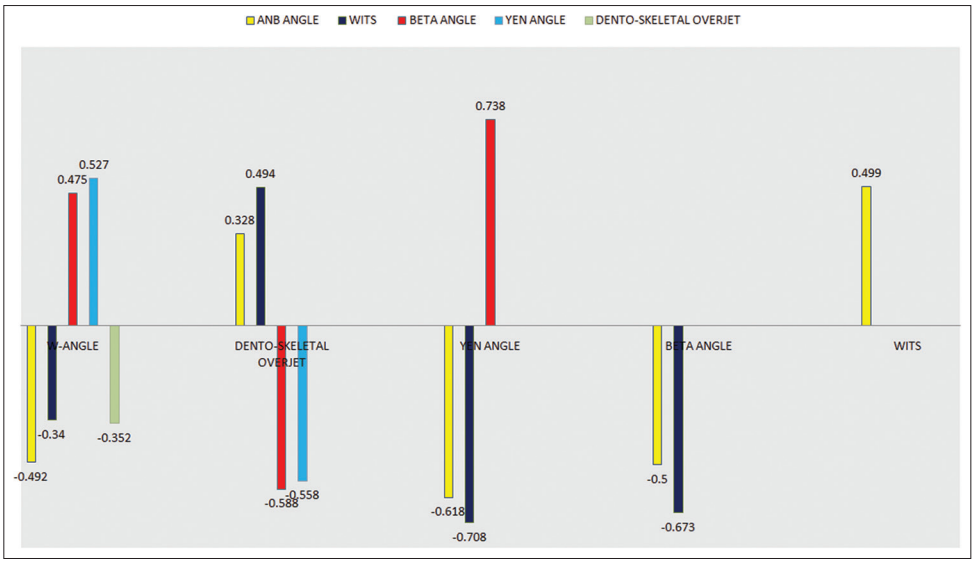

Figure 3. Correlation between ANB, YEN angle, BETA angle, Dentoskeletal overjet and Wits appraisal

Table 2: Correlation between ANB, YEN angle, Beta angle, dentoskeletal overjet, and Wits appraisal

Variables	W angle	Dentoskeletal overjet	YEN	Beta	Wits
ANB	−0.492*	0.328	−0.618**	−0.500*	0.499*
Wits	−0.340	0.494*	−0.708**	−0.673**	
Beta	0.475*	−0.588	0.738**		
YEN	0.527*	−0.558**			
Dentoskeletal overjet	−0.352				

**Correlation is significant at the 0.01 level. *Correlation is significant at the 0.05 level

not able to measure sagittal jaw relationship accurately. If the reference lines inclination alters it affects the linear parameters and similarly alteration in facial height, jaw inclination and prognathism of jaw also affect angular parameters.[12] The literature enlightens that there are number of ways to assess jaw discrepancy between maxilla and mandible, but none can be universally used with total accuracy. Therefore, the present study was made to find correlation among the different cephalometric measurements which are used to indicate sagittal (anteroposterior) jaw relationship.

To avoid the use of functional plane, an alternative angle, Beta angle was proposed as it is not affected by rotations of jaw. To calculate Beta angle, point A and point B are used. However, these points are remodeled by orthodontic treatment and growth. In addition to this, various studies have revealed that, on mouth-closed lateral head films, the reproducibility of the position of

condylion is limited. Hence, center of condyle should be taken, in place of condylion, but at the same time, center of condyle approximation is not easy.[15,16] By calculation of Beta angle, negative linear correlation with ANB angle revealed and Wits appraisal indicating that Beta angle decreases with an increase in value of ANB angle and Wits appraisal[17] and showed a significant positive correlation with W angle and YEN angle.

Recently, Neela *et al*.[17] established YEN angle to measure sagittal dysplasia. However, true basal dysplasia is masked, as rotation of jaw occurs because of growth or orthodontic treatment and YEN angle is measured between line SM and MG. YEN angle revealed significant negative correlation with ANB angle, Wits appraisal, and dentoskeletal overjet and showed positive correlation Beta and W angle. The W angle was introduced to overcome the downside of the previously known parameters.[18] The W angle had a negative notable relation with ANB angle and WITS appraisal and dentoskeletal overjet whereas it had a remarkable positive relation with Beta and YEN angles. Dentoskeletal overjet had a positive correlation with ANB angle and Wits appraisal, and negative correlation with Beta angle, YEN angle, and W angle.

Conclusion

- The Beta angle had a negative correlation with ANB angle, Wits appraisal, and dentoskeletal overjet
- The W angle had negatively correlated with ANB angle significantly
- The W angle had positively correlated with Beta angle and YEN angles significantly
- The correlation between dentoskeletal overjet and ANB angle was positive, and similarly, correlation between dentoskeletal overjet and Wits appraisal was also positive. Dentoskeletal overjet had negatively correlated with Beta angle, YEN angle, and W angle.

Ethics Committee Approval

Ethical approval was not obtained because no patient material was used in this *in vitro* study.

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