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Correlation of overjet, ANB and wits appraisal for assessment of sagittal skeletal relationship

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Abstract

Introduction: The purpose of this study was to determine the sagittal skeletal relationship through overjet and its reliability in determining skeletal relationship by correlating it with ANB angle and Wits appraisal in Angle's class I, class II division I and class III malocclusion groups in a tertiary care hospital sample.

Material and Methods: On clinical examination overjet was measured with the teeth in centric occlusion. Lateral cephalograph was taken to measure the ANB angle and Wits appraisal.

Results: The correlational analysis of overjet with ANB angle in the three malocclusion classes showed, that there was a weak correlation of overjet with ANB angle in class III group with "r" value of 0.444 whereas P value showed statistical significance (P-value < 0.05). The correlation of ANB angle in the other two malocclusion classes was weak as well as statistically insignificant i.e in class I (r = 0.106, P-value > 0.05) and in class II division I (r = -0.187, P-value > 0.05). The correlation between overjet and Wits appraisal in class III was strong and statistically significant with the "r" value of 0.605 and P-value < 0.05. The results of correlational analysis showed that there was a weak correlation between overjet and Wits appraisal in class I and class II division I (r = 0.317 and 0.398 respectively), whereas class I correlation was statistically insignificant (P-value > 0.05) and class II division I was significant (P-value < 0.05).

Conclusions: This study concluded that overjet is a good predictor for sagittal skeletal relationship only in class III malocclusion.

Keywords: ANB angle; Wits appraisal; Anteroposterior jaw relationship; Overjet.

Introduction

Diagnosis of an orthodontic case requires history of the patient, clinical examination and certain diagnostic tools. Clinical examination focuses on establishment of the type and severity of malocclusion and can determine whether the problem has a skeletal or dental origin. It also helps to determine what diagnostic records might be needed.[1] The diagnostic tools include dental casts, radiographs and photographs.[2]

Overjet is an important linear parameter that can be measured clinically and is one of the parameters used to assess the sagittal relationship of upper and lower dental arches. The cause of change in overjet could be skeletal, dental, or a combination of both.[3]

For accurate measurement of sagittal skeletal relationship, cephalometric analyses such as Steiner and Wits appraisal can be used.[3] ANB measurement in the Steiner's analysis is used for the assessment of sagittal skeletal relationship. It indicates the magnitude of the skeletal jaw discrepancy and in a normal well proportionate face, ranges from 1 to 5 degrees.[4] However ANB angle has certain limitations. A false value can be recorded with altered anteroposterior and vertical position of nasion, increased or decreased vertical height of the face,[5] tipping of SN plane and variation in ANB angle between patient's centric occlusion and centric relation.[6]

Wits analysis was conceived to overcome the limitations of ANB.[1] Wits also has certain limitations e.g. misinterpretation of Wits value can be encountered due to variability in the occlusal plane.[7]

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Correlation between overjet and various cephalometric measurements has been determined in different classes of malocclusion.[3] Zupancic et al studied the correlation between overjet, ANB and Wits appraisal. It was found in the study that, significantly positive correlation exists between overjet and ANB with 'r' value of 0.690, and for overjet and Wits appraisal 'r' value being 0.750. The conclusion of the study was that overjet is a statistically significant predictor of sagittal skeletal relationship in class II division I malocclusion, however the results for other types of malocclusions were not very promising.[3] In another study correlation was studied between different parameters for assessing the sagittal jaw relationship. It was found that correlations existed between A-B plane and ANB angle with 'r' value 0.794, for ANB and Wits appraisal 'r' value being 0.29 and for Wits appraisal and beta angle 'r' value being 0.377. The study concluded that statistically positive correlation existed between different parameters.[5]

The rationale of this study was to determine the sagittal skeletal relationship through a non-invasive parameter of Overjet rather than establishing the same through x-rays in a Pakistani population and to find out whether the study previously performed is applicable in our population or not.

Material and Methods

Subjects were 91 Orthodontic patients, out of which 22 were males and 69 were females. The investigations were based on a cross sectional sample and the age range was 12 to 34 years. A patient was only included if he or she could be patients having complete permanent dentition up to first permanent molar, patients having Angle's class I, class II division I and class III malocclusion, no supernumerary tooth. The exclusion criteria were patients having previous orthodontic treatment and patients having any asymmetry of jaws.

Patient's history was taken and clinical examination was done to confirm the inclusion criteria. Patients were divided into three groups according to Angle's classification into class I, class II division I and class III molar relationship. On clinical examination, overjet was measured when the teeth were in occlusion with the help of a ruler in millimeters, by placing the ruler over the labial surface of lower central incisor so that ruler was perpendicular to the labial surface. Distance from the labial surface of lower central incisor to the incisal edge of the most prominent upper central incisor was recorded. Lateral cephalograph was taken with the patient's Frankfurt horizontal plane parallel to floor, mandible in centric occlusion and lips at rest. Each radiographic film was traced on 8 x 10 inch standard translucent acetate tracing paper, over a standard illuminated view box with a lead pencil. On cephalograph, the ANB angle was measured by drawing two lines from nasion to point A called as NA line and other line from nasion to point B called as NB line. Angle formed between these two lines was taken as ANB angle.

For Wits appraisal, bisected occlusal plane was drawn and then perpendicular was dropped over that plane from point A and point B that were called as AO and BO point respectively. Linear measurement between AO and BO point was measured with the help of a ruler in millimeters.

Results

The age range of patients included in the study was from 12 to 34 years with mean age of 15.83 ± 4.177 years. The overall sample consisted of three groups on the basis of malocclusion. There were 29 (31.87%) class I malocclusion patients, 40 (43.96%) class II division I malocclusion patients and 22 (24.18%) class III malocclusion patients.

The mean age of class I patients was 16.22 ± 4.801 years (12 to 34 years), class II division I patients was 15.42 ± 3.234 (12 to 24) years and

class III patients mean age was 16.05 ± 4.904 (12 to 32) years.

There were 22 (24.18%) males and 69 (75.82%) females in overall sample. Out of these there were 7 (7.69%) males in class I malocclusion, 8 (8.79%) males in class II division I malocclusion and 7 (7.69%) males in class III malocclusion and 22 (24.18%) females in class I malocclusion, 32 (35%) females in class II division I malocclusion and 15 (16.48%) females were in class III malocclusion groups as shown in fig I.

The overall distribution of overjet showed that the minimum value of overjet was -5 mm and maximum 13 mm with mean of 4.35 ± 4.045 mm. The mean overjet measurement in class I group was 3.76 ± 2.488 mm with range of 1 to 5 mm, in class II division I group was 7.35 ± 2.953 mm with range of 4 to 13 mm and in class III group was -0.34 ± 2.238 mm with range of -5 to 2 mm (Table I).

The overall mean ANB angle was 3.66 ± 3.611 degrees with minimum value of -9 to a maximum value of 9 degrees. The mean ANB angle in class I was 4.14 ± 2.761 with the range of 0.5 to 7 degrees, in class II division I was 5.48 ± 1.877 with range of 2.5 to 9 degrees and in class III was -0.27 ± 4.047 with range of -9 to 4 degrees (Table II).

The measurement of Wits appraisal also had a vast distribution with a minimum measurement of -14 mm to a maximum value of 11 mm with a mean value of 2.571 ± 4.8377 mm. The widest distribution of Wits appraisal was seen in class III group with mean value of -2.977 ± 4.7696 mm and range of -14 to 2 mm followed by class I with mean value of 2.466 ± 3.3272 mm and range of -3.0 to 7 mm. The mean Wits appraisal value in class II division I was 5.7 ± 2.5288 mm with the range of 2 to 11 mm (Table III).

The correlational analysis of overjet with ANB angle in three malocclusion classes showed that there was a weak correlation of overjet with ANB angle in class III group with "r" value of 0.444 however, P value showed statistical significance (P-value < 0.05) (Table IV). The correlation of ANB angle in other two malocclusion classes was weak as well as statistically insignificant i.e in class I (r = 0.106, P-value > 0.05) and in class II division I (r = -0.187, P-value > 0.05) (Table V & VI).

The correlation between overjet and Wits appraisal in class III was strong and statistically significant with "r" value of 0.605 and P-value < 0.05 (Table VII). The results of correlational analysis showed that there was a weak correlation between overjet and Wits appraisal in class I and class II division I (r = 0.317 and 0.398 respectively), whereas class I correlation was statistically insignificant (P-value > 0.05) (Table VIII)and class II division I correlation was statistically significant (P-value < 0.05) (Table IX).

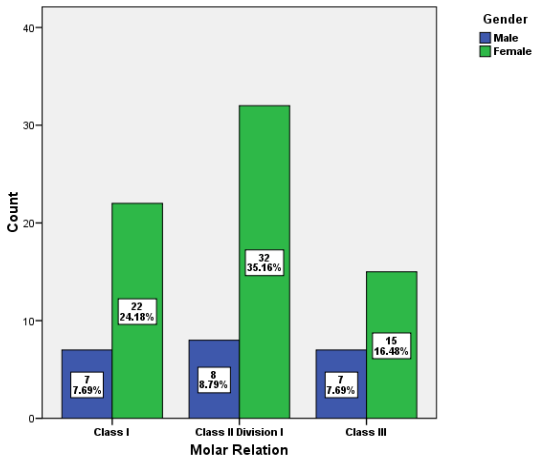

Figure 1: Gender distribution with respect to malocclusion group

Table I: Distribution of overjet (mm) with respect to malocclusion group

Malocclusion group	N	Minimum	Maximum	Mean	Std. Deviation
Class I	29	1	5	3.76	2.488
Class II Division I	40	4	13	7.35	2.953
Class III	22	-5	2	-0.34	2.238

Table II: Distribution of ANB angle (degrees) with respect to malocclusion groups

Malocclusion group	N	Minimum	Maximum	Mean	Std. Deviation
Class I	29	0.5	7	4.14	2.761
Class II Division I	40	2.5	9	5.48	1.877
Class III	22	-9	4	-.27	4.047

Table III: Distribution of wits appraisal with respect malocclusion groups

Malocclusion group	N	Minimum	Maximum	Mean	Std. Deviation
Class I	29	-3.0	7.0	2.466	3.3272
Class II Division I	40	2.0	11.0	5.700	2.5288
Class III	22	-14.0	2.0	-2.977	4.7696

Table IV: Correlation of overjet with ANB angle in class III

	Correlations	ANB angle
Overjet	Pearson Correlation	0.444(**)
	Sig. (2-tailed)	0.038
	N	22

** Correlation is significant at the 0.05 level (2-tailed).

Table V: Correlation of overjet with ANB angle in class I

	Correlation	ANB angle
Overjet	Pearson Correlation	0.106*
	Sig. (2-tailed)	0.583
	N	29

* The Correlation is Insignificant at 5% level of significance

Table VI: Correlation of overjet with ANB angle in class II division I

	Correlations	ANB angle
Overjet	Pearson Correlation	-0.187*
	Sig. (2-tailed)	0.248
	N	40

* The Correlation is insignificant at 5% level of significance

Table VII: Correlation of overjet with Wits appraisal in class III

	Correlation	Wits Appraisal
Overjet	Pearson Correlation	0.605(**)
	Sig. (2-tailed)	0.003
	N	22

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

Table VIII: Correlation of overjet with Wits appraisal in class I

	Correlation	Wits Appraisal
Overjet	Pearson Correlation	0.317*
	Sig. (2-tailed)	0.094
	N	29

* The Correlation is Insignificant at 5% level of significance

Table IX: Correlation of overjet with Wits appraisal in class II division I

	Correlation	Wits Appraisal
Overjet	Pearson Correlation	0.398(**)
	Sig. (2-tailed)	0.011
	N	40

** Correlation is significant at the 0.05 level (2-tailed).

Discussion

Among the criteria required for diagnosis and treatment planning, the sagittal relationship between maxilla and mandible is critical. 8 Correction of sagittal dysplasia is very important in achieving balanced profile after orthodontic treatment. Many parameters used to evaluate the inter-maxillary relationship have been described. [9,10,11,12,13]

The aim of this study was to determine whether any correlation exists between overjet value, as measured clinically, and cephalometric parameters, which evaluate the craniofacial complex in the sagittal plane. Therefore, within individual classes of malocclusion according to Angle's classification, the average values of these parameters were calculated and their correlations tested. The extent to which overjet can determine skeletal relationships in the sagittal plane was assessed.

A number of factors influence measurement of ANB angle including sagittal and vertical parameters: facial prognathism, age, and the growth rotation of the jaws in relation to the cranial reference planes.

The amount of rotation is greatly related to the facial pattern of the individual. The mean values are higher for dolicofacial pattern in comparison with mesofacial and brachyfacial facial types, but facial type does not have an influence on the correlation between parameters.[8]

In this study there were 22 (24.18%) males and 69 (75.82%) females. There were more female subjects present as the sample was not collected on the basis of gender.

For overjet and ANB, a positive correlation was expected, because they both directly and indirectly reflect the jaw relationships in the sagittal plane. But alteration can occur, which is probably due to the fact that overjet is influenced by inclinations of the upper and the lower incisors and ANB also depends on the anteroposterior position of nasion, inclination of the SN line, maxillary inclination, and the vertical position of nasion. These are normal variations and should be considered when ANB is interpreted. In fact, any different horizontal or vertical position of point N and the location of points A and B in the vertical plane will influence the size of ANB and not the actual sagittal relationship of the jaws. The inclination of the occlusal plane also affects ANB, although the sagittal relationship remains constant.

Likewise, for overjet and Wits appraisal, both parameters also evaluate jaw relationships in the sagittal plane. In contrast to ANB, the line of reference for Wits appraisal is the occlusal plane, which is a dental parameter. Therefore, it is not surprising that the correlation coefficient was higher when compared with the value for overjet and ANB.

The correlational analysis of overjet with ANB angle in three malocclusion classes showed that there was a weak correlation of overjet with ANB angle in class III group with "r" value of 0.444 whereas P value showed statistical significance (P-value < 0.05). The correlation of ANB angle in the other two malocclusion classes was weak as well as statistically insignificant i.e in class I, r value was 0.106, P-value was > 0.05 and in class II division I, r value was -0.187 and P-value was > 0.05.

The correlation between overjet and Wits appraisal in class III was strong and statistically significant with r value of 0.605 and P-value of < 0.05. The results of correlational analysis showed that there was a weak correlation between overjet and Wits appraisal in class I and class II division I (r = 0.317 and 0.398 respectively), whereas class I correlation was statistically insignificant (P-value > 0.05) and class II division I correlation was statistically significant (P-value < 0.05).

This result was comparable with the results of Zupancic et al [3] who showed that a statistically significant and strong correlation ($P < 0.01$,) was found between the values of overjet and ANB ($r = 0.690$), overjet and Wits appraisal ($r = 0.750$), and overjet and

convexity at point A (r = 0.608) when assessing the whole sample.

Thayer [14] found a lower correlation between overjet and Wits appraisal (r = 0.574 using the functional occlusal plane and r = 0.647 when using a bisected occlusal plane). Either occlusal plane can be used in the calculation of Wits appraisal. A bisected occlusal plane had higher reproducibility than the functional occlusal plane, but an error of 5 degrees may change the Wits appraisal by 3 – 6 mm, depending on the vertical dimensions of the face. This might be the reason for the difference between correlation factors.

In this case, knowing the overjet value, prediction of the values of ANB and Wits appraisal within a certain range can be made. However, overjet may only account for part of the variability

of these parameters. Overjet is certainly not the only factor which should be taken into account when evaluating skeletal relationships in the sagittal plane.

One study showed that, there was a tendency for inconsistency between ANB and Wits assessments in the high occlusal plane angle group and a tendency for consistency in the low occlusal plane angle group. [7]

Some studies showed that in the ANB assessment, the most important influence was anterior facial height. Geometric effects cause the occlusal plane angle to modulate the ANB and Wits assessments. It was suggested that, in the high occlusal plane angle group, ANB might have overestimated AP positioning of the jaws, or Wits might have underestimated AP positioning of the jaws and in the low occlusal plane angle group ANB assessment was confirmed by the Wits assessment for the long anterior cranial base subgroup and the large cranial base angle subgroup.

When the means of overjet, ANB and Wits in three Angle's classes were compared with the findings by Zupancic et al [3] our values are slightly higher as compared to their values of 3.8 ± 2.0, 2.6 ± 2.7 and − 2.8 ± 3.3 for overjet, ANB and Wits respectively in class I, 6.0 ± 2.8, 4.8 ± 1.8 and 1.2 ± 3.3 for overjet, ANB and Wits respectively in class II div I and 0.0 ± 2.9, − 1.4 ± 2.5 and − 10.3 ± 3.1 for overjet, ANB and Wits respectively in class III.

Conclusions

In this study it was determined that:

1. There is a weak correlation between overjet and ANB angle in all three malocclusion groups but it is statistically significant only in class III malocclusion.
2. The correlation between overjet and Wits appraisal in class III is strong and statistically significant.
3. There is weak correlation between overjet and wits appraisal in class I and class II division I but it is statistically significant only in class II division I malocclusion.

This study concluded that overjet is a good predictor for sagittal skeletal relationship only in class III malocclusion. Still, there is a relatively wide interval variability, which cannot be explained by overjet alone. Probably, there are other important factors which were not included in this study and further research is warranted.

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