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Prediction of craniofacial relationship in sagittal and vertical plane using occlusal features

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Abstract

Introduction: Orthodontic diagnosis often requires complex means and Orthodontists are always in search of simpler means for the said purpose. The purpose of this study was to determine whether occlusal features, over-jet and over-bite can be predictors of sagittal malocclusion and facial vertical pattern.

Material and Methods: The study was carried out on 102 orthodontic patients (28 males and 74 females), with age ranging from 12 - 34 years. Over-jet and over-bite were measured on obtained study casts of patients. Lateral cephalogram was traced to measure ANB angle and Witts value in sagittal plane and SN-MP angle in the vertical plane and a correlation was established.

Results: Correlation between over-jet, ANB and Witts was moderate (r = 0.495 and 0.475 respectively). Statistically insignificant correlation was found among over-jet and SN-MP (p=0.145). Over-bite increased as SN-MP decreased and as over-bite decreased, SN-MP increased, over-bite indicated 36.2% negative association with SN-MP which was statistically significant.

Conclusions: Although over-jet could be used for predicting the sagittal jaw relationship, it is not the predictor of vertical facial pattern. Over-bite is a good predictor of vertical facial pattern.

Keywords: Over-jet; sagittal jaw relation; over-bite; vertical facial pattern

Introduction

Occlusion varies from ideal to severe forms of deranged occlusal relationships. The concept that definitive relationship exist among occlusion and craniofacial morphology is well known to orthodontists.[1] The anteroposterior discrepancy is usually of utmost concern to patient and parents and hence has maximum attention in orthodontics.

Over-jet is one of the important tools to measure sagittal discrepancy.[2] It is defined as the horizontal distance between upper and lower incisors measured from the most prominent incisor.[3] There are several factors that contribute to increased over-jet. Dental factors include proclined upper incisors and retroclined lower incisors or a combination of both. Soft tissue factors include hypotonic upper lip and lower lip trap. Skeletal factors includes abnormal jaw relationship.[4] As many factors affect over-jet, therefore it should be combined with cephalometric analysis for accurate determination of sagittal skeletal relationship.

Various cephalometric variables such as ANB, Witts appraisal, beta angle,Yen angle, McNamara analysis values have been used to access the sagittal pattern of patient.[5-9]

The reliability of ANB value relative to jaw position is influenced by two factors other than anteroposterior jaw position. Change in anteroposterior position and vertical position of Nasion will change ANB angle.[10] The validity of criticism on this value has led to use of different indicators for evaluation of anteroposterior jaw discrepancy.

The assessment of anteroposterior relationship with Witts appraisal depends mainly on accurate definition of occlusal plane and its inclination.[6]

Patients with malocclusion can be presented with problems in the vertical plane of space

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along with sagittal plane. In vertical dimensions, jaw relationship may have normodivergent, hyperdivergent and hypodivergent facial patterns demonstrating normal, long and short face respectively.[11]

A number of studies have evaluated the relationship of over-jet with sagittal and vertical facial morphology. However the comparison of relationship of over-bite with vertical facial pattern has not been done so far. The objective of present study was to determine the relationship between occlusal features and craniofacial skeletal structures in sagittal and vertical plane.

Material and Methods

The current study was conducted using six months data from pre-treatment orthodontic records of patients who visited the Orthodontic Department, University College of Dentistry, The University of Lahore. Informed consent was taken from each patient. 102 orthodontic patients were selected out of which 28 were males and 74 were females, with age range from 12 to 34 years. All of them had permanent dentition unaffected by maxillofacial syndromes, trauma and lack of history of orthodontic and surgical treatment. Over-jet was measured on study cast of each patient as the distance from labial surface of mandibular central incisor to labial surface of most prominent maxillary central incisor with digital vernier calliper, accurate to 0.01 and held parallel to occlusal plane.

Based on the over-jet value, subjects were divided into three groups:

Group I: Included 35 patients with normal over-jet (over-jet less than or equal to 3 mm)

Group II: Included 27 patients with increased over-jet (over-jet more than 3mm but less than or equal to 6mm)

Group III: Included 40 patients with extreme over-jet (over-jet more than 6mm)

Over-bite was measured in percentages on study casts by evaluating amount of vertical overlap of lower incisors by upper incisor.

A lateral cephalometric radiograph was taken for each subject under standardised condition with mandible in centric occlusion. All lateral cephalometric radiographs were traced by one investigator using 0.3 mm diameter lead pencil. For sagittal skeletal relationship, ANB angle and Witts appraisal were determined and analysed on lateral cephalometric radiograph. Cephalometric analysis of vertical facial morphology included SN - Go-Me (SN-MP) angle.

Data was analysed using SPSS version 23.0 and Spearman rank coefficient of correlation between ANB, Witts, SN-MP, over-bite and Over-jet was ascertained with significance test for correlation values. The association of SN-MP levels with over-jet was assessed using Pearson chi square test. P-values less than 0.05 were considered significant. Bar chart s were used to show the trends of relationship among studied parameters.

Results

The current study included 102 patients out of which 28 (27.5%) were males and 74 (72.5%) were females (Table I). The age range was from 8 to 36 years. The most common age group was 8 to 15 years followed by 16 to 20 years (Table II). The overall sample consisted of 3 groups on the basis of over-jet. There were 35 patients (34.3%) in group I, 27 patients (26.47%) in group II and 40 patients (39.21%) in group III.

The correlation between over-jet and ANB was moderate (r=0.495). Similarly, correlation between Over-jet and Witts values was also moderate (r=0.473). It meant that in about 16% of the sample over-jet was used as a predictor of sagittal relationship. Both these correlations were statistically significant (Table III).

The mean ANB angle for group I was 3 +/- 40, for group II was 5 +/- 20 and for group III it was 6 +/- 20.

The mean Witts value for group I was 0.50 +/- 6.142 mm, for group II, 3.16 +/- 3.5 mm and for group III it was 4.22+/- 4.25mm. This shows that as over-jet increased, the ANB angle and Witts values also increased (Table IV). The ANB angle and Witts values were statistically different in three groups of over-jet (Table V).

Table VI gives the results for association of SN-MP levels with over-jet. It was observed that 48.6% subjects with normal over-jet were hypodivergent, 40.7% increased over-jet subjects were hyperdivergent and 35% extreme over-jet subjects were normodivergent. SN-MP angle (p = 0.145) however, gives the evidence that there was no significant association between SN-MP and Over-jet levels.

The over-bite gives 36.2% negative association with SN-MP, and it was statistically significant with p-value less than 0.01 (Table VII). Its means that as over-bite increases, SN-MP decreases and as over-bite decreases SN-MP increases.

Table I: Age distribution of the sample

Age group (years)	Frequency	Percentage (%)	Cumulative percentage (%)
8-15	36	35.3	35.3
16-20	38	37.3	72.5
21-25	20	19.6	92.2
26-30	7	6.9	99.0
36-50	1	1.0	100.0
Total	102	100.0	

Table II: Vertical patterns of patients

Vertical pattern	Frequency	Percentage (%)	Cumulative Percentage (%)
low Angle	52	51.0	51.0
Normal angle	25	24.5	75.5
High angle	25	24.5	100.0
Total	102	100.0	

Table III: Correlation between sagittal cephalometric parameters and over-jet

		OJ(mm)	ANB (degrees)	Witts (mm)
OJ	Pearson Correlation	1	**.495**	**.473**
	Sig. (2-tailed)		.000	.000
	N	102	102	102
ANB	Pearson Correlation	.495	1	.715
	Sig. (2-tailed)	.000		.000
	N	102	102	102
Witts	Pearson Correlation	.473	**.715**	1
	Sig. (2-tailed)	.000	.000	
	N	102	102	102

Table IV: Mean and standard deviation in different groups of Over-jet

Over-jet groups		ANB(degrees)		Witts (mm)	
		Mean	SD	Mean	SD
	Group I	3	4	.500	6.142
	Group II	5	2	3.167	3.514
	Group III	6	2	4.225	4.256

*Group I (less than 3); Group II(3-6 mm); Group III (6 or more)

Table V: Comparison of ANB and Witts angles by severity of over-jet

		Sum of Squares	df	Mean Square	F	Sig.*
<ANB	Between Groups	192.723	2	96.362	11.428	.000
	Within Groups	834.796	99	8.432		
	Total	1027.520	101			
Witts	Between Groups	268.192	2	134.096	5.747	.004
	Within Groups	2309.975	99	23.333		
	Total	2578.167	101			

* ANOVA test

Table VI: Association of over-jet and SN-MP angles using Pearson Chi Square test

SN-MP Levels		Over-jet		
		Normal over-jet less than 3	Increased over-jet from 3 - 6	Extreme over-jet more than 6
Normodivergent	**n**	13	5	14
	%	37.1	18.5	35.0
Hypodivergent	**n**	17	11	14
	%	48.6	40.7	35.0
Hyperdivergent	**n**	5	11	12
	%	14.3	40.7	30.0
p=0.145 obtained using Pearson Chi square test				

Table VII: Correlation between SN-MP and Over-bite

		SN-MP	Over-bite
SN-MP	Pearson Correlation	1	-.349**
	Sig. (2-tailed)		.001
	N	102	95
Over-bite	Pearson Correlation	-.349**	1
	Sig. (2-tailed)	.001	
	N	95	95
**. Correlation is significant at the 0.01 level (2-tailed).			

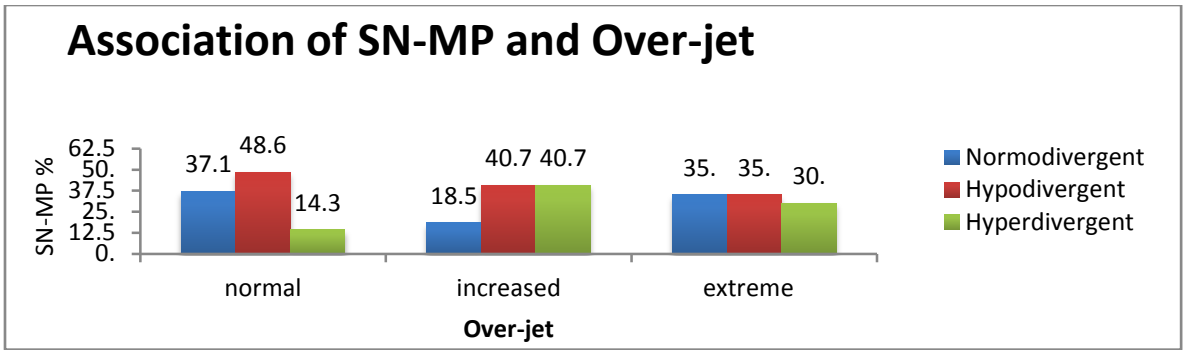

Figure 1: Proportions of SN-MP levels and over-jet group

Discussion

The craniofacial relationship both in sagittal and vertical plane is critical for correct diagnosis and treatment planning. Several cephalometric analyses are available to analyse craniofacial relationship.[6,13,14] In cephalometrics both angular and linear measurements have been proposed to analyse sagittal jaw base relationship.[15]

The aim of this study was to determine whether occlusal features can be used to determine craniofacial relationship in sagittal and vertical plane.

Over-jet is one of the parameters that is used to investigate the sagittal relationship of maxillary and mandibular dentition. The cause of increased positive or negative over-jet could be skeletal, dental or combination of both.[15] Profit et al[16] indicated that when over-jet > 10 mm, orthognathic surgery is the better treatment modality. Several studies have been done showing relationship of over-jet with sagittal relationship. According to Zupancic et al,[2] over-jet is a good predictor for class II div I malocclusion only. According to Abdul Jabbar[17] there was a weak correlation between over-jet and ANB angle in all three malocclusion groups, though statistically significant only in class III malocclusion. This could be due top the fact that over-jet is influenced by inclination of upper and lower incisors and ANB also depends on certain parameters e.g anteroposterior position of nasion, bi-maxillary prognathism , rotation of jaws and vertical distance between N and ptoints A and B. Hasan et al[4] also found positive correlation between over-jet and sagittal jaw relations and the tendency towards vertical pattern. Contrary to these findings, few studies[1,18] found weak correlation between over-jet and sagittal jaw relations.

In the present study, over-jet relationship with ANB and Witts values was moderate.

According to Kumari et al[19] over-jet is not a predictor of vertical facial morphology while according to Sajlaji et al,[20] over-jet was a moderate predictor of vertical facial pattern. The current study also showed insignificant association between over-jet and SN-MP (p value = 0.145).

The correlation of over-bite with vertical facial morphology is significant. As over-bite increased there was tendency for hypodivergent pattern whereas, as over-bite decreased, tendency for hyper-divergency increased.

Conclusions

Within limitations of the present study, we can conclude that:

1. There was a moderate correlation (r = 0.495) between over-jet and ANB angle.
2. The relationship between over-jet and Witts appraisal is also moderate(r=0.473).
3. Over-jet is a statistically insignificant predictor of vertical pattern
4. Over-bite is a statistically significant inverse predictor of craniofacial vertical pattern.

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