International Arab Journal of Dentistry

Volume 6 | Issue 3 Article 3

10-15-2015

The relationship between overjet and skeletal parameters in untreated class II subjects

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THE RELATIONSHIP BETWEEN OVERJET AND SKELETAL PARAMETERS IN UNTREATED CLASS II SUBJECTS

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Abstract

The aim of the present study was to evaluate the association between skeletal and dentoalveolar parameters and overjet in untreated Class II subjects.

The lateral cephalograms of 75 untreated Class II Caucasian individuals (37 males and 38 females), between 18 and 25 years of age, were studied. The participants were divided into three groups based on the overjet value. The mean values of 14 variables measured on lateral cephalograms were calculated. Differences between the three groups were tested using one-way analysis of variance (ANOVA).

A statistically significant positive correlation was found between the values of overjet and ANB. Subjects with normal overjet showed horizontal facial pattern and posterior inclination of the maxilla, whereas increased overjet subjects exhibited a neutral facial pattern. In contrast, subjects with extreme overjet had a vertical facial pattern and anterior inclination of the maxilla; upper incisors were proclined and lower incisors were inclined.

Keywords: Class II malocclusion – overjet - craniofacial morphology.

IAJD 2015;6(3):108-112.

LA RELATION ENTRE LE SURPLOMB ET LES PARAMÈTRES SQUELETTIQUES CHEZ DES SUJETS DE CLASSE II NON TRAITÉS

Résumé

Le but de la présente étude était d'évaluer l'association entre les paramètres squelettiques et dento-alvéolaires, et le surplomb chez les sujets de classe II non traités.

Les céphalogrammes de 75 individus caucasiens (37 hommes et 38 femmes), entre 18 et 25 ans d'age, avec une malocclusion de classe II non traitée, ont été étudiés. Les participants ont été divisés en trois groupes en fonction de la valeur de surplomb. Les valeurs moyennes des grandeurs de mesure sur 14 téléradiographies latérales ont été calculées. Les différences entre les trois groupes ont été testées avec analyse de la variance à un facteur (ANOVA).

Une corrélation positive statistiquement significative a été observée entre les valeurs de surplomb et ANB. Les sujets avec surplomb normal ont montré un type facial horizontal et une inclinaison postérieure du maxillaire, alors que les sujets qui avaient un surplomb excessif présentaient un type facial neutre. En revanche, les sujets ayant un surplomb excessif présentaient un type facial vertical et une inclinaison antérieure du maxillaire; les incisives supérieures étaient inclinées vestibulairement et les incisives inférieures étaient inclinées.

Mots-clés: malocclusion – surplomb - morphologie cranio-faciale.

IAJD 2015;6(3):108-112.

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Introduction

Class II malocclusion is the most common skeletal discrepancy and the most difficult case in terms of diagnosis and method of treatment which mainly depends on the craniofacial growth pattern [1]. Although the craniofacial morphology of Class II malocclusion has been studied in a number of cephalometric investigations, only few studies take the overjet into account [2, 3].

Overjet, defined as the horizontal overlap of the most prominent incisor, indicates the largest horizontal distance between the upper and lower incisor [4]. There are several factors that contribute to increased overjet. Dental factors include proclined upper incisors, retroclined lower incisors or both. It may result from an abnormal jaw relationship or other reasons such as race, genetics, breathing, or bad habits [5]. Increased overjet affects “facial attractiveness” and causes “low self-esteem” [6]. In adolescents beyond the growth spurt, when deciding on surgical or orthodontic intervention, besides the facial profile, overjet is an important guideline. Generally, when the overjet is greater than 10 mm, surgery is a more successful treatment option [7].

Overjet is one of the parameters used to assess the sagittal relationship of the upper and lower dental arch and is considered as a good predictor of the sagittal relationship in subjects with a Class II division 1 malocclusion [8]. Therefore, a better understanding of the differences in craniofacial morphology associated with different overjet magnitude may be useful in the treatment planning of Class II cases.

The objectives of the present study were to determine the relationship between overjet and other measurements in sagittal and vertical levels in untreated Class II patients and to evaluate the association between overjet and incisor inclination.

Point	Original term	Definition
N	Nasion	The suture between the frontal and nasal bones
S	Sella	Located by inspection of the profile image of the fossa
A	Subspinale	The deepest point on the concavity formed by the anterior maxillary contour of the alveolar process
ANS	Anterior nasal spine	Most anterior point of the nasal floor; tip of premaxilla on midsagittal plane
PNS	Posterior nasal spine	Most posterior point on the contour of the bony palate
Is	Incision superius	Mid-point of the incisal edge of the most prominent upper central incisor
Pg	Pogonion	The most anterior point of the mandible in the midline
GN	Gnathion	The most anterior-inferior point of the chin
Me	Menton	The most inferior point on the inferior border of the chin
B	Supramentale	The deepest midline point on the mandible, between infradentale and pogonion
Go	Gonion	A posterior-interior point on the ramus. Cephalometric Go is at the intersection of the mandibular plane and the ramus plane
Point1	Incisolabial line angle	The junction between the labial surface and incisal edge of the most prominent lower central incisor [11]
Point2	Incisopalatal line angle	The junction between the palatal surface and incisal edge of the most prominent upper central incisor [11]
Ii	Incision inferius	The incisal point of the most prominent medial mandibular incisor

Table 1 : Cephalometric points [10].

Materials and methods

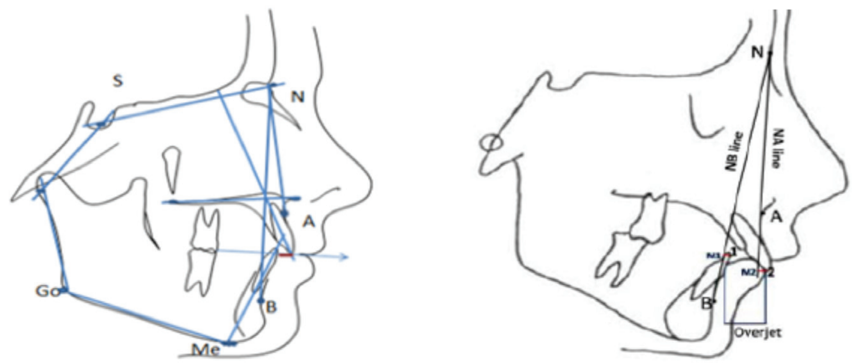
Cephalograms of 75 subjects aged between 18 and 28 years, including 38 females and 37 males, were selected. All of them had integral permanent dentition, unaffected by maxillofacial syndromes or evident trauma, and lack a history of orthodontic or surgical treatment. A lateral cephalogram was taken for each subject under rigidly standardized conditions with the mandible in centric occlusion. Based on their overjet value, the subjects were divided into three groups [9]:

Group I: 21 patients with normal overjet (less than or equal to 3 mm).

Group II: 28 patients with increased overjet (more than 3 mm but less than or equal to 6 mm).

Group III: 25 patients with extreme overjet (more than 6 mm).

All lateral cephalometric radiographs were traced and measured using a special medical software (Ax. Ceph, Audax, Ljubljana, Slovenia). Statistical analyses were conducted using the statistical program (SPSS version 18).



Figs. 1 and 2: Cephalometric points measurements used in the study.

	Group I (N= 21)	Group II (N= 28)	Group III (N= 26)	p-value			
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**I & II & III**	**I & II**	**I & III**	**II & III**
ANB	6.09 ± 1.2672	7.246 ± 1.5784	7.615 ± 1.8388	0.005**	*	**	-
Overjet	2.905 ± 0.643	5.257 ± 0.5521	8.004 ± 1.1918	0.000**	**	**	**
SN-Go-Me	36.390 ± 3.7222	33.525 ± 6.3560	36.492 ± 4.7189	0.067	*	-	*
SN-SPP	10.771 ± 3.1097	9.475 ± 2.9624	9.427 ± 2.7644	0.224	-	-	-
SPP-Go-Me	25.095 ± 6.4352	23.979 ± 5.8454	26.325 ± 6.1562	0.311	-	-	-
Bjork	395.000 ± 3.2711	393.071 ± 4.682	397.346 ± 3.887	0.094	-	-	*

Table 2: Mean and standard deviation of the cephalometric variables measured in the study.

	Group I (N= 21)	Group II (N= 28)	Group III (N= 26)	p-value			
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**I & II & III**	**I & II**	**I & III**	**II & III**
U1SN	105.3 ± 4.8683	105.6 ± 5.1395	108.842 ± 7.166	0.066	-	*	*
L1GOME	99.338 ± 4.7252	99.786 ± 6.5046	98.058 ± 4.8783	0.500	-	-	*
U1L1	119.357 ± 9.2394	120.496 ± 7.939	115.892 ± 9.1473	0.145	-	-	*
NAU1	27.105 ± 6.2000	25.093 ± 7.3783	26.638 ± 7.4676	0.574	-	-	-
NA_ U1	2.390 ± 1.8335	3.125 ± 1.5148	4.015 ± 1.9026	**0.008	-	**	-
NBL1	30.419 ± 4.7248	28.043 ± 5.8529	29.292 ± 5.6200	0.324	-	-	-
NB_L1	4.724 ± 1.9814	5.273 ± 2.6089	5.492 ± 2.0133	0.497	-	-	-

Table 3: Mean and standard deviation of the dentoalveolar parameters measured in the study.

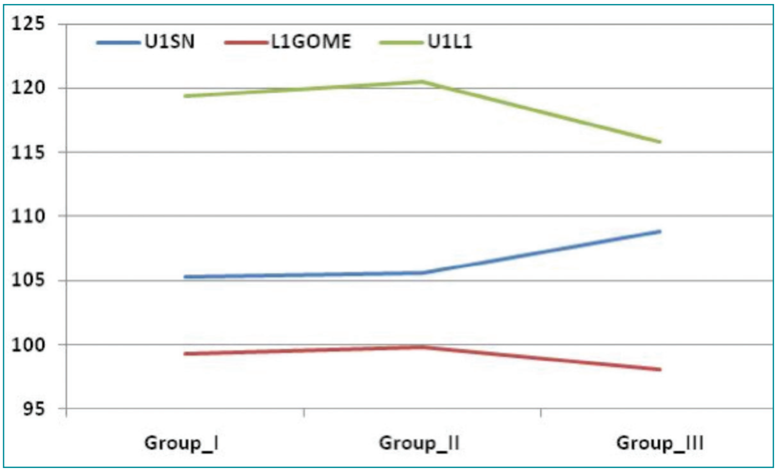


Fig. 3: The relationship between overjet and dentoalveolar parametres in the three groups.

The following cephalometric measurements were used in the study (Figs. 1 and 2):

1- ANB: The angle between lines NA and NB.
2- SN-GoMe: The angle between the anterior cranial base and the mandibular plane (Go-Me).
3- SN-SPP: The angle between the anterior cranial base (S-N) and the maxillary plane (SPP).
4- SPP-GoMe (B) Basal plane angle: The angle between maxillary plane (SPP) and mandibular plane.
5- Summ Bjork: Sum of sella, articular, and gonial angles according to Bjork (1972).
6- Overjet: The distance between point 1 and point 2 in a tangent way to both [11].
7- U1-SN: Axis angle of upper incisor, angle between long axis of upper incisor and anterior cranial base.
8- L1- Go-Me: Axis angle of lower incisor, angle between long axis of the lower incisor and mandibular plane.
9- U1-L1: The interincisal angle, angle between long axes of upper and lower incisors.
10- U1 –NA: The angle between upper incisor and NA.
11- L1–NB: The angle between lower incisor and NB.
12- U1NA: The distance between is and NA line.
13- L1NB: The distance between ii and NB line.

Method error

All measurements were made by the same person to minimize error, good reliability for all the parameters was found. To determine the method error, 20 radiographs were retraced by the same examiner after 3 to 4 weeks. The method error was calculated using Dahlberg's formula: Error of method = $\sqrt{\Sigma d2 /2n}$, where d is the difference between two measurements and n refers to the number of double determinations [12]. The error of the method varied between 0.12 and 0.47 degrees for angular measurements and between 0.11 and 0.38 mm for linear measurement.

Results

Differences between overjet groups

The mean and standard deviation of each measurement for the three groups and statistical differences between groups for total population are shown in tables 2 and 3. Significant differences were found in skeletal and dentoalveolar measurements between the three groups.

The relationship between overjet and dentoalveolar parametres in the three groups is highlighted in figure 3.

Discussion

Regarding the anterior-posterior relationship of the maxilla with the mandible, the ANB angle was significantly larger in groups 2 and 3 than in group 1, which indicates an association between ANB and the overjet. According to Zupancic et al [8], overjet was found to be a highly significant predictor of sagittal skeletal relationship in class II division I patients.

The mean SN-GoMe angle was significantly increased in the normal overjet group and in the 3rd group, indicating a hypodivergent pattern in these groups. This is in agreement with the study of Saltaje [2] who found that the extreme overjet demonstrates a hyperdivergent pattern.

The palatal plane angle (SN-SPP) was similar in the three groups, indicating an upward inclination of the maxilla with extreme overjet. Several previous studies reported a normal position of the maxilla in Class II malocclusion [13 - 15], while some others pointed out that maxillary protrusion is a dominant feature of Class II malocclusion [16]. The divergent findings may be due to ethnic differences or variant methods used in identifying the maxillary position. The (SPP-GoMe) angle was similar in the groups 1, 2 ad 3, and no significant differences were reported.

In contrast, the extreme overjet group showed an increase in (Bjork sum) angle in comparison to groups 1 and 2, demonstrating a hyperdivergent pattern. A literature review reveals an increase in the Bjork sum and (SN-Go-Me) angle [14], which indicates a hyperdivergent pattern [15].

Previous studies reported a hyperdivergent pattern in patients with Class II division 1 [14]. On the other hand, Siriwat and Jarabak [16] found that a neutral growth pattern was dominant in Class II division I malocclusion. The divergent findings may be due to ethnic differences or the various methods used in identifying the mandibular position.

The association between extreme overjet and a vertical facial pattern may be the result of an abnormal muscle function such as altered tongue posture caused by mouth breathing and tongue thrust swallowing.

Dentoalveolar parameters

The upper incisors exhibited a normal inclination and position in group 1, while they were proclined in groups 2 and 3. Increase of incisor protrusion may be associated with an increase in overjet.

L1GOME angle demonstrated a decrease in extreme overjet group which came in accord with Al-Khateeb [16] who found a lingual inclination of lower incisors in Class II/1 subjects. This was probably due to the fact that overjet is influenced by the inclination of the upper and lower incisors.

The interincisal angle (U1L1) was significantly increased in the normal overjet group and in increased overjet group, and decreased in the extreme overjet group because of extreme proclination of upper incisors clearly shown by its subjects. Saltaje [2] reviews a decreased interincisal angle in Class II/1 malocclusion in extreme overjet.

Also, there was a significant increase in the distance of incisal edge to NA plane in relation to the Overjet in groups 1 and 3, which was in correspondence with the findings stating that incisor proclination increase in Class II/1.

Conclusion

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

-Positive correlation was expected between overjet and ANB. The Overjet reflects the jaw relationships in the sagittal plane.

-An association was found between the overjet value and the tendency toward a hyperdivergent pattern. As the overjet increased, (SN-GoMe, Sum Björk) tended to increase.

-Maxillary incisors tend to procline in relation to the overjet. In severe cases, the lower incisors tend to lean lingually.

Evaluation of the dentoalveolar and skeletal parameters in different overjet groups may be useful in the analysis of the malocclusion, and prediction of treatment success.

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