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Cranial base influence on the nasomaxillary complex in Class II division 1 malocclusion (Three dimensional cephalometric study)

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ABSTRACT

Aim: To evaluate the effect of the cranial base on the nasomaxillary complex in class II division 1 malocclusion. **Materials and Methods**: The study was carried out on a sample of 104 Iraqi subjects in Mosul City aged 18–24 years 53 females and 51 males having class II division 1 malocclusion. Lateral and posteroanterior radiographs were taken for each subject and twenty three measurements were used (Nine angular and fourteen linear). **Results** of the analysis were the median (NSBa), lateral cranial base (NSCo) and saddle angle (NSAr) showed a significant effect on the inclination of the Frankfort plane from the anterior and posterior cranial base in same direction, For the saddle angle significantly affect the inclination of the Frankfort plane but in the opposite direction while on anteroposterior position of alveolar process of the premaxilla (SNPr) in the same direction. The anterior part (SN), second lateral posterior part (SCo) and depth of cranial base (NBa) significantly affect the maxillary length (ApMax–PNS), upper anterior (N–ANS) and posterior facial height (S–PNS). For the median posterior part (SBa) and first lateral posterior part (SAr) no significant effect on (upper anterior facial height). The anterior cranial base width (GL–GL) showed a significant affect [facial (Zy–Zy), maxillary (J–J) and upper intermolar width (U6–U6)]. While posterior cranial base width (Mas–Mas) was significantly affect [facial (Zy–Zy), maxillary (J–J) and nasal width (Nc–Nc)].**Conclusion**: The median, lateral cranial base and saddle angles showed correlation with the inclination of the Frankfort plane from the anterior and posterior cranial base. The observed impact of the cranial base widths on the nasomaxillary complex widths were for anterior cranial base width there was a significant effect on bizygomatic, bimaxillary and intermolar width

Key Words: Influence, Cranial base, Class II division 1 malocclusion

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INTRODUCTION

The relationship between the cranial base configuration and maxillofacial structures is of an interest to many authors. Bjork[1] used cephalometric radiographs, to demonstrate the existence of this relationship.

As the maxilla articulates with different limbs of the cranial base, therefore, it is possible that variations in growth and orientation of the cranial base region could lead to variations in position, structure and shape of the maxilla and it is associated structures.

Many studies performed to establish the percentage of malocclusion in different countries. The prevalence of class II malocclusion represents relatively high percentage among the malocclusion subjects; also the prevalence is different among different ethnic groups. Kinaan[2] stated that 21% of the persons who attended the orthodontic departments in Baghdad were of CL II D1 malocclusion.

Although the anterior cranial base is measured as (S–N) length, there is some disagreement whether the Basion, articular or condylion could be used to determine the posterior cranial base:

Bjork[1] advocated the use of articular, because it is easier to identify, while Varjanne and koski[3] have discouraged the use of the articulare, because of it is remoteness from the mid cranial base, and advocated the use of basion because of it is anatomical significance, despite potential difficulties in identifycations, Kerr and Adams[4], Anderson and Popovich[5] advocated the use of condylion to determine the posterior limit of cranial base, because it is an integral part of the polygon that includes the face, permitting study the angle and distance within a closed system.

Some researchers[6] have published the use of Basion and articular; they found that the growth patterns of both to be very similar. Although the NSAr angle does not accurately represent the form of the cranial base. While other researchers demonstrateed high level of correlation between NSBa and NSAr[1,7]; and between NSBa, NSAr and NSCo.[8,9]

Other[10] reported that subjects with an open cranial base angle showed a tendency to have an angle class II molar relationship. The cranial base angle is suggested as a fundamental determination of the jaw relation, but in some subjects this may be compensated by differential jaw growth manifested by a change in angle ANB (difference between SNA and SNB angle)as stated by Kerr and Hirst.[11]

Some Investigators[12] stated that the median cranial base angle (BaSN) closed and the legs SN and SBa shortened systematically from CLII over CLI, then to CLIII. But, opposite to this idea Menezes[13], Guyer *et al.*,[14], Wilhelim *et al.*,[15] and Dhopatkar *et al.*,[16] all showed that no correlation exists between cranial base angles and the classes of malocclusion.

The aim of this study is to evaluate the effect of the cranial base on the nasomaxillary complex in class II division 1 malocclusion.

MATERIALS AND METHODS

The sample of this study was collected randomly from seven Colleges in Mosul University A total of 2867 Iraqi students were clinically examined, 132 students were selected the-ir ages ranged betwe-en (18–25) years and (51) males and (53) females having CLII D1 malocclusion were selected.

The criteria used to select the class II division 1 malocclusion subjects were bilateral class II molar relations, non competent lips, over jet approximately more than 5mm, full set of permanent dentitions, no history of trauma to the teeth or jaws and no history of orthodontic treatment.

The lateral and posteroanterior cephalometric radiographs were taken in the x–ray department in the Collage of Dentistry in Mosul University, using Cranex 3+ceph; model SL–4/PT–11 C/C (Finland made). The machine was set at 75 Kvp, 10 mA powers and the time used was 1 second for the lateral view and 1.2 second for the posteroanterior view. Two pac-kets of (8x10 inch) fine grain with double emulsion AGFA X–ray films–Gevaret N.V., with a kit of developing and fixing solution made in Belgium were also used with expired date at: June/2006.

Under standardized condition that is to say, the patient stand in an uprighted posture with the Frankfort horizontal plane kept parallel to the floor with the two ear rods positioned laterally, two x–ray films were taken for each selected subject of these x–ray, one for lateral view and another for frontal view. The subject was in centric occlusion during exposure. Then the radiographs were traced and the measurements obtained include cranial base angles (NSBa, NSAr and NSCo) Lavelle[10], (SNA & SNPr) Menezes [13], inclination of the Frankfort and occlusal planes from the anterior and posterior cranial base (SNFH & SNOcc) Ishii *et al.*,[26] (SBaFH & SBaOcc) Andria *et al.*,[27], laeral cranial base dimensions (SN, SBa, SAr, SCo and NBa) Dibbets [12], upper anterior and poterior facial height (UAFH and UPFH) Roh-ein and Phan[19], in addition to the anterior and poterior cranial base width (GL–GL & Mas–Mas) and some of the nasomaxillary complex withs (J–J, Zy–Zy, Nc–Nc and U6–U6) Dib-[12], Dhopatkar *et al*.[16]

RESULTS AND DISCUSSION

Tables (1, 2 and 3) showed that the NSCo angle only was significantly correlation to SNPr, There is effect on SNA but statistically not significant. This variation in the result of correlation of NSCo angle from NSBa and NSAr may be the result of tracing errors. In addition, it may be explained by the conclusi-on of Bhatia and Leighton[6]; they found that the growth patterns of Basion and articular to be very similar, so may vary from NSCo angle.

The non significant correlation of the cranial base angles (NSBa and NSAr) with the SNA and SNPr, whether increasing or decreasing, here in the present work it is probably due to relative stability of SN, and it could be the result of future remodeling process represented by resorption at point A and prosthion or even bone apposition at point nasion. The result close to the approach of Klock *et al*.,[18], Rothstein and Phan[19] But this comes in disagreeement with Kasai *et al*.,[20], Ngan *et al*.[21]

Table (1) Duncan's Multiple Range test for The correlation of NSBa angle with The Nasomaxillary complex angles of Total Class II Sample.

NSBa angle	**Mean ± SE (°)**					**Significant**
	< 120	**121–125**	**126–130**	**131–135**	**> 135**	
SNA	82.08±0.68 a	82.2±0.37 a	82.61±0.38 a	83.14±0.72 a	82.3±0.6 a	Not Significant
SNPr	83.83±0.59 a	83.95±0.31	84.4±0.4 a	85.21±0.71 a	84.55±0.6 a	Not Significant
SNFH	3.67±0.69 a	5.65±0.48 ab	5.42±0.4 a	5.7±0.94 bc	8.6±0.98 c	Significant ***
SNOcc	12.58±1.24 ab	11.12±0.84 a	13.39± 0.77 ab	13.9±1.22 ab	15.15±1.54 b	Not Significant
SBaFH	63.33±1.16 d	60.48±1.92 cd	58.35±0.6 bc	55.64±1.1 b	49.0±1.63 a	Significant ***
SBaOcc	68.0±1.68 b	66.32±0.86 b	67.39±0.9 b	60.11±3.8 a	59.8±1.52 a	Significant **

*: Significant at p<0.05; **: Significant at p<0.01; ***: Significant at p<0.001; SE: Standard error; SNA: Anteroposterior position of maxilla; SNPr: Anteroposterior position of alveolar part of premaxilla; SNFH: Anterior cranial base to Frank fort plane angle; SNOcc: : Anterior cranial base to occlusal plane angle; SBaFH: Posterior cranial base to Frank fort plane angle; SBaOcc: Posterior cranial base to occlusal plane angle.

Table (2): Duncan's Multiple Range test for The correlation of NSAr angle with the Nasomaxillary complex angles of total Class II Sample.

NSAr Angle	**Mean ± SE (°)**				**Significant**
	≤ 120	**121–125**	**126–130**	**131–135**	
SNA	83.1±0.45 a	82.41±0.34 a	82.64±0.45 a	82.66±0.61 a	Not Significant
SNPr	84.0±0.31 a	84.51±0.36 a	84.68±0.47 a	83.21±0.75 a	Not Significant
SNFH	5.33±0.48 a	4.65±0.34 a	7.94±0.67 b	7.86±0.36 b	Significant ***
SNOcc	12.32±0.88 a	12.8±0.69 a	13.64±1.05 a	11.29±1.57 a	Not Significant
SBaFH	61.55±1.09 c	56.74±0.84 ab	58.44±0.94 bc	53.57±2.22 a	Significant ***
SBaOcc	67.88±1.07 a	65.51±0.81 a	62.58±2.36 a	63.57±0.92 a	Not Significant

*: Significant at p<0.05; **: Significant at p<0.01; ***: Significant at p<0.001; SE: Standard error; SNA: Anteroposterior position of maxilla; SNPr: Anteroposterior position of alveolar part of premaxilla; SNFH: Anterior cranial base to Frank fort plane angle; SNOcc: : Anterior cranial base to occlusal plane angle; SBaFH: Posterior cranial base to Frank fort plane angle; SBaOcc: Posterior cranial base to occlusal plane angle.

Table (3): Duncan's Multiple Range test for The correlation of NSCo angle with The Nasomaxillary complex Angles of total Class II Sample.

NSCo Angle	**Mean ± SE (°)**				**Significant**
	≤ 120	**121–125**	**126–130**	**131–135**	
SNA	81.5±0.87 a	82.52±0.29 ab	82.97±0.36 ab	84.6±1.38 b	Not Significant
SNPr	84.0±0.42 a	84.01±0.27 a	84.49±0.4 a	87.0±0.84 b	Significant**
SNFH	4.38±0.86 a	5.4±0.34 ab	6.23±0.55 ab	7.5±1.58 b	Significant*
SNOcc	14.0±2.05 a	12.32±0.59 a	12.77±0.87 a	15.5±1.95 a	Not Significant
SBaFH	60.0±1.21 a	58.48±0.85 a	57.82±0.94 a	57.6±3.11 a	Not Significant
SBaOcc	65.0±1.95 a	65.89±0.72 a	64.32±1.87 a	66.4±3.43 a	Not Significant

*: Significant at $p<0.05$; **: Significant at $p<0.01$; ***: Significant at $p<0.001$; SE: Standard error; SNA: Anteroposterior position of maxilla; SNPr: Anteroposterior position of alveolar part of premaxilla; SNFH: Anterior cranial base to Frank fort plane angle; SNOcc: : Anterior cranial base to occlusal plane angle; SBaFH: Posterior cranial base to Frank fort plane angle; SBaOcc: Posterior cranial base to occlusal plane angle.

In regard to the correlation of the cr-anial base angles (NSBa, NSAr and NSCo). In general, the detected effect on (correlation with) these angles were in the same direction for SNFH and SNOcc, in the opposite direct-ion for SBaFH and SBaOcc. As illustrated in the tables (1, 2 and 3). The difference in the results of the NSAr and NSCo in their effect from the NSBa could be due to:

- The Ar point is a lateral point, not mid po-int as the Basion point which is the best in-dicator for the posterior limit of the cranial base Varjanne and Koski.[3] In addition, the Ar point is formed by the intersection of the temporal bone and the posterior bor-der of the mandibular condyle. This may lead to a confusion in the precise localizat-ion of intersection point (Technical and tr-acing errors).
- The Co point is also easily susceptible to tracing errors because Co point overlapped by the temporal bone and it is a lateral poi-nt not mid–line point.

As illustrated in the Table (4), a highly positive significant correlation of (SN, SCo and NBa) with the (ApMax–PNS, N–ANS and S–PNS) were detected. This ind-icates that the structures and dimensions of the nasomaxillary complex are related to the anterior and posterior cranial base. Th-us, increasing the dimensions of the crani-al base could lead to an increase in the na-somaxillary complex dimensions. Enl-ow[22] stated that the growth of the maxilla is under the effect of the crani-al base.

The results come in accordance with Kerr and Adams[4], that the cranial base di-mensions significantly affect the (ApMax–PNS). Kasai *et al*.,[20] showed that (SN) si-gnificantly affect (N–ANS and S–PNS), Dibbets[12] also concluded that the (SN, SBa and NBa) significantly affect the (ApMax–PNS). But this comes in contra-st with Rothstein and Phan[19] showed that the cranial base dimensions (SN, SBa, SAr and NBa) does not significantly aff-ect (S–PNS, N–ANS and ApMax–PNS).

The cranial base width measurements were significantly related in a positive ma-nner with nasomaxillary complex measu-rement as shown in Table (5). A highly si-gnificant positive influence of (Gl–Gl) on (Zy–Zy, J–J and U6–U6), and a highly sig-nificant positive relation of (Mas–Mas) with the (Zy–Zy, J–J and Nc–Nc) were ex-isted. These indicate that any changes in the dimension, configuration and position of the cranial base in both anterior and po-sterior parts could be reflected in the maxi-lla and adjacent structures. This could be supported by the conclusion approached by Lozanoff *et al*.,[23] and Dhopatkar *et al*.,[16] Lozanoff *et al*.,[23] reported that the growth of the sphenoid bone in the area near and around the sella tursica, which is one of the most important growth areas of the anterior cranial base located anteriorly to the sphenoccipital synchondrosis which is the main growth area of the posterior cr-anial base Sejrsen *et al*.,[24] could affect the maxillofacial dimensions. Dhopatkar *et al*.,[16] stated that the cranial ba-se forms the floor of the cranial vault. It is es-sentially. A mid line structure comprising parts of the nasal, ethmoid, sphenoid and occipital bones which could directly or indirectly influence the maxillofacial dimension. The results come in accordance with Enlow[22], Lozanoff *et al*.,[23] Kasai *et al*.,[20] Dibbets[12], Dhopatkar *et al*.,[16] and Hayashi.[25]

Table (4): Duncan's Multiple Range test for the correlation of the cranial base dimensions with the nasomaxillary complex dimensions.

SN (mm)	**Mean ± SE (mm)**		
	APMax–PNS	**N–ANS**	**S–PNS**
≤ 68	52.5 ± 2.45 a	53.17 ± 1.66 ab	42.5 ± 0.50 a
69–72	53.95 ± 0.97 a	52.37 ± 0.85 a	44.61 ± 0.90 a
73–76	59.13 ± 0.83 b	54.53 ± 0.53 ab	48.24 ± 0.63 b
77–80	63.30 ± 0.95 c	55.83 ± 0.85 b	49.04 ± 1.07 b
Significant	Significant *******	Significant *****	Significant *******
SBa (mm)	**APMax–PNS**	**N–ANS**	**S–PNS**
<46	52.7±1.3 a	53.0±0.79 a	42.0±0.8 a
46–50	57.41±0.82 b	54.82±0.5 a	46.47±0.55 b
51–55	60.84±1.01 b	53.85±0.93 a	50.27±1.01 c
56–60	65.36±1.41 c	54.36±1.09 a	49.909±1.01 c
Significant	Significant *******	Not Significant	Significant *******
SCo (mm)	**APMax–PNS**	**N–ANS**	**S–PNS**
≤ 20	51.92±1.177 a	53.625±0.99 ab	43.25±1.129 a
21–25	57.088±0.81 b	53.58±0.59 ab	45.87±0.59 a
26–30	60.7±0.92 bc	55.52±0.53 b	49.19±0.73 b
>30	63.6±2.03 c	52.5±2.11 a	49.6±1.8 b
Significant	Significant *******	Significant *****	Significant *******
NBa (mm)	**APMax–PNS**	**N–ANS**	**S–PNS**
≤ 105	53.25±2.49 a	52.25±1.93 a	42.25±0.48 a
106–110	53.48±0.77 a	52.89±0.57 a	44.52±0.71 ab
111–115	56.619±0.97 a	54.93±0.81 ab	47.48±0.88 bc
116–120	62.187±0.94 b	53.91±0.74 a	48.81±0.95 c
>120	64.69±1.07 b	57.37±1.012 b	50.56±0.88 c
Significant	Significant *******	Significant ******	Significant *******
Sar (mm)	**APMax–PNS**	**N–ANS**	**S–PNS**
≤ 30	52.19±1.13 a	53.45±0.87 a	45.55±1.27 a
31–35	56.27±1.27 ab	52.91±1.18 a	46.55±1.09 ab
36–40	57.94±1.05 bc	53.64±0.68 a	46.1±0.86 ab
41–45	61.67±0.99 c	55.7±0.74 a	48.92±0.83 ab
>45	60.92±2.05 c	55.0±1.1 a	49.62±1.34 b
Significant	Significant ***	Not Significant	Significant *

*: Significant at p<0.05; **: Significant at p<0.01; ***: Significant at p<0.001; SE: Standard error; SN: Anterior cranial base; APMax–PNS: Maxillary length; SBa: Median posterior cranial base length; SCo:Second lateral posterior cranial base length; NBa:Depth of cranial base; Sar: First lateral posterior cranial base length.

Table (5) Duncan's Multiple Range test for The correlation of The (Gl–Gl and Mas Mas) with the transverse dimension of The Nasomaxillary Complex of total Class II Sample.

Gl–Gl (mm)	**Mean ± SE (mm)**			
	Zy–Zy	**J–J**	**U6–U6**	**Nc–Nc**
<97	131.33±1.15 a	64.42±0.61 a	53.167±3.89 a	34.17±1.276 a
97–100	133.32±1.26 ab	66.62±1.22 ab	61.41±1.32 b	35.29±0.91 a
101–104	137.16±1.07 bc	68.7±0.64 b	59.97±0.77 b	35.38±0.54 a
105–108	140.73±1.01 c	69.13±0.745 b	62.08±1.05 b	36.31±0.52 a
>108	145.43±1.76 d	75.29±1.26 c	61.71±0.73 b	36.57±0.84 a
Significant	Significant ***	Significant ***	Significant **	Not Significant
Mas–Mas (mm)	**Zy–Zy**	**J–J**	**U6–U6**	**Nc–Nc**
<113	131.3±1.126 a	65.1±0.84 a	60.6±1.67 a	34.4±0.86 ab
113–116	132.24±1.06 a	67.105±0.91 a	60.32±1.67 a	33.84±0.77 a
117–120	137.21±1.31 b	67.16±0.91 a	59.79±1.57 a	35.26±0.76 abc
121–124	140.08±0.85 bc	72.04±1.23 b	63.33±1.01 a	37.0±0.85 c
125–128	141.58±1.24 cd	71.42±1.0 b	60.46±0.92 a	36.54±0.53 bc
>128	144.56±1.7 d	70.75±1.33 b	60.06±0.96 a	37.0±0.79 c
Significant	Significant ***	Significant ***	Not Significant	Significant **

*: Significant at p<0.05; **: Significant at p<0.01; ***: Significant at p<0.001; SE: Stadard errorGl–Gl: Width of anterior cranial base; Zy–Zy: Facial width; J–J: Maxillary base width; U6–U6: Maxillary inter molar width; Nc–Nc: Nasal width; Mas–Mas: Width of posterior cranial base.

CONCLUSION

The median, lateral cranial base and saddle angles showed correlation with the inclination of the Frankfort plane from the anterior and posterior cranial base in same direction, also the saddle angle significantly correlated the inclination of the Frankfort plane but in the opposite direction while with anteroposterior position of alveolar process of the premaxilla in the same direction.

The detected correlation of the cranial base dimensions with the nasomaxillary complex dimensions in lateral view were the anterior part, posterior part and total cranial base showed effect on (UAFH, UPFH and ApMax–PNS). While the posterior part represented by (SBa and SAr) showed no significant correlation but with (UAFH).

The observed impact of the cranial base widths on the nasomaxillary complex widths were for anterior cranial base width there was a significant effect on bizygomatic, bimaxillary and intermolar width. While the posterior cranial base width showed a significant effect on the bizygomatic, bimaxillary and nasal width.

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