

Cephalometric Characteristics of Bimaxillary Protrusion in Adolescents

Afnan J Ismael
BDS, MSc (Asst Lect)

Dept of Pedod, orthod, and Prev Dentistry
College of Dentistry, University of Mosul

الخلاصة

الاهداف: تهدف الدراسة الى تحديد قياسات الراس بالاشعة الجانبية عند المراهقين ذوي الفكوك البارزة. **المواد وطرائق العمل:** كانت عينة الدراسة مكونة من اربعة وتسعين طالبا بعمر (12-15) سنة أختيروا من المدارس المتوسطة في مدينة الموصل. اربعة واربعون طالبا كانت فكوكهم بارزة وهم من الصنف الاول من الاطباق ممن لديهم قياس الزاوية بين القواطع اقل من 110° ، وخمسون من ذوي الصنف الاول من الاطباق الطبيعي. أخذت اشعة جانبية لقياسات الرأس لكل طالب ، أستعمل في هذه الدراسة ستة عشر متغيرا، تسعة من الزوايا وسبعة خطيا . **النتائج:** اظهرت النتائج اختلافات كبيرة في اغلب القياسات الخطية وقياسات الزوايا المستعملة في هذه الدراسة وهذه الاختلافات كانت في : الارتفاع الوجهي الامامي، الارتفاع الوجهي السفلي، الارتفاع السني الامامي العلوي، الارتفاع السني الامامي السفلي، الزاوية التي تقيس موقع الفك العلوي بالنسبة للقاعدة القحفية، الزاوية التي تقيس موقع الفك السفلي بالنسبة للقاعدة القحفية، زاوية ميلان المستوى الفكي السفلي بالنسبة للقاعدة القحفية، زاوية الارتفاع العمودي للفكين ، الزاوية الفكية السفلية ، زاوية ميلان القاطع المركزي العلوي بالنسبة للقاعدة القحفية و زاوية ميلان القاطع المركزي السفلي بالنسبة للقاعدة القحفية، لان توجد فروق كبيرة في القياسات الاتية: الارتفاع الوجهي الامامي العلوي، الارتفاع الوجهي الخلفي، ارتفاع الشعبة الصاعدة من عظم الفك السفلي وزاوية ميلان المستوى الحنكي بالنسبة للقاعدة القحفية. كذلك كان قياس زاوية القواطع عند ذوي الفكوك البارزة اقل بكثير مما عند ذوي الاطباق الطبيعي. **الاستنتاجات:** اغلب قياسات الوجه الامامية كانت عالية بشكل كبير لذوي الفكوك البارزة بالقياس مع ذوي الاطباق الطبيعي اذا ما قورنت بالارتفاع الوجهي الخلفي وارتفاع الشعبة الصاعدة من عظم الفك السفلي باتجاه الاسفل وباتجاه الخلف عند ذوي الفكوك البارزة.

ABSTRACT

Aims:The purpose of this study was to identify the cephalometric features of bimaxillary protrusion in adolescents. **Materials and Methods:** Ninety four students were selected aged (12-15) years from secondary schools in Mosul City. Forty four with class I biprotrusion which were chosen to have an interincisal angle less than 110° , and 50 with class I normal occlusion. A standardized lateral cephalometric radiograph was taken for each student, sixteen variables, (9 angular and 7 linear) were used in this study. **Results:** Significant differences were seen in the majority of the linear and angular measurements used in this study, the total anterior facial height, lower anterior facial height, upper anterior dental height , lower anterior dental height, the angle defines the anteroposterior position of maxilla in relation to anterior cranial base, the angle indicates the anteroposterior position of the mandible in relation to the anterior cranial base, mandibular plane angle, palatomandibular plane angle, gonial angle, the angulation of upper central incisor to anterior cranial base and the angulation of lower central incisor to mandibular plane were significantly higher in bimaxillary protrusion than normal occlusion in both sexes and total sample. No significant differences were seen in other measurements : upper anterior facial height, posterior facial height, ramus height and the angle of palatal plane inclination in relation to anterior cranial base. Interincisal angle was significantly smaller in bimaxillary protrusion than normal occlusion. **Conclusions:** Most of the anterior facial measurements were significantly higher in bimaxillary protrusion than normal occlusion if compared to posterior facial height and ramus height due to the downward and backward rotation of the mandible in bimaxillary protrusion.

Keywords: Bimaxillary protrusion, Cephalometric norms.

Ismael AJ. Cephalometric Characteristics of Bimaxillary Protrusion in Adolescents. *Al-Rafidain Dent J.* 2012; 12(1): 135-141.

Received: 13/10/2010

Sent to Referees: 19/10/2010

Accepted for Publication: 19/12/2010

INTRODUCTION

The efficacy and timing of the treatment of malocclusion often depends upon the pubertal growth spurt. Treatment effects may be impaired or enhanced by var-

iations in the direction, timing, and duration of development in the facial area. Extensive knowledge of facial morphology and development is thus necessary for the successful treatment of dentofacial defor-

mities.⁽¹⁾

The positions of the maxillary and mandibular incisors have long been recognized as useful guides in the diagnosis and treatment of malocclusion, like wise, incisor protrusion and inclination are generally considered to influence the stability of orthodontic results and the esthetics of the lips relative to the chin and nose.⁽¹⁾

Patients with bimaxillary protrusion demonstrated increased incisor proclination and protrusion, a vertical facial pattern, increased procumbency of the lips, a decreased nasolabial angle, and thin and elongated upper and lower anterior alveoli.⁽²⁻⁴⁾

Bimaxillary protrusion is seen commonly in African-American and Asian population, but it can be seen in almost every ethnic group. Because of the negative perception of protrusive dentition and lips in most cultures, many patients with bimaxillary protrusion seek orthodontic care to decrease this procumbency.⁽⁵⁻⁸⁾

The etiology of bimaxillary protrusion is complex involving environmental factors, genetic component, soft-tissue function, volume and habit.⁽⁹⁾

Tooth size of the overall maxillary and mandibular dentition was larger in the bimaxillary protrusion than in the normal,⁽¹⁰⁾ thus the bimaxillary protrusion may exhibit a mild mandibular anterior crowding.⁽¹¹⁾

The dramatic improvement in facial profiles of bimaxillary surgery patients is primarily related to backward movement of the mandible and significant reduction in the lower lip area.⁽¹²⁾

Hashimoto *et al*,⁽¹³⁾ stated that in bimaxillary protrusion the facial profile with lip protrusion was improved remarkably, and good occlusion was achieved after the portions of the mandible were surgically removed.

In both the anteroposterior and vertical directions, skeletal anchorage achieved good control during the treatment of maxillary dentoalveolar protrusion.^(14,15)

Facial esthetics is an important con-

sideration in orthodontic treatment particularly when extractions are considered.⁽¹⁶⁾

The aim of this study was to identify the cephalometric features and the part of craniofacial structures in class I bimaxillary protrusion.

MATERIALS AND METHODS

The sample of this study was collected from secondary schools in Mosul City. Ninety four students (males and females) were selected aged (12-15) years, 50 with class I normal occlusion as control (25 males and 25 females) and 44 (17 males and 27 females) with class I biprotrusion.

The criteria of sample selection:

1. Bilateral class I molar and canine relationships with normal overbite and overjet (2-4mm) in class I normal occlusion.^(17, 18)

2. The bimaxillary protrusion group was chosen to have an interincisal angle of 110° or less (in the lateral cephalometric radiograph) with bilateral class I molar relationships.⁽³⁾

3. Full set of permanent dentition excluding third molars.⁽¹⁹⁾

4. No history of orthodontic treatment or orthognathic surgery.⁽²⁰⁾

5. Good medical history.⁽²¹⁾

6. Non of the subjects had congenital anomalies, significant facial asymmetries or congenitally missing teeth.⁽¹⁾

Cephalographs were taken with standardized tube mid sagittal distance. The head was placed in a craniostat so that the Frankfort plane was parallel with the floor. Each cephalogram was taken in centric occlusion for the subject with lips in relaxed position.^(2, 9)

The lateral cephalometric radiographs from the selected individuals were traced, and reference points and planes were then obtained. From these reference points and planes 7 linear and 9 angular measurements illustrated in Figure (1) were constructed.

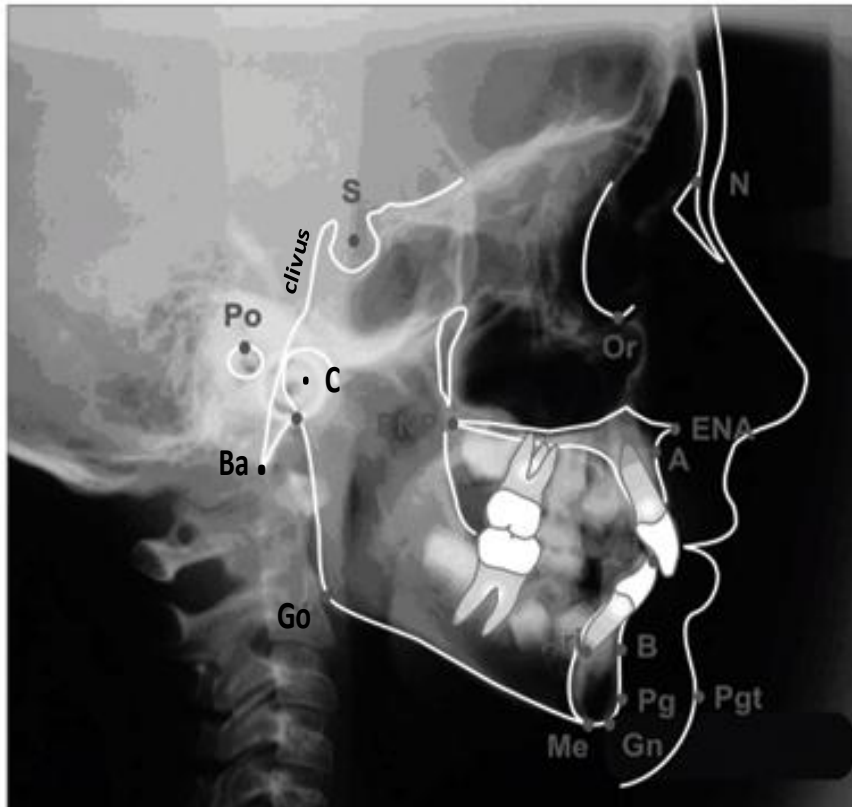


Figure (1): linear measurements :1, TAFH, 2,UAFH, 3,LAFH, 4,PFH, 5,RH, 6,UADH, 7,LADH .Angular measurements: 8,U1/L1, 9,SNA, 10,SNB, 11,SN-PP, 12,SN-MP, 13,PP-MP, 14,GO, 15,U1SN, 16,L1MP.

***The linear measurements include:**

- TAFH : Total Anterior Facial Height (N-Me).⁽¹⁾
- UAFH : Upper Anterior Facial Height (N-ANS).⁽¹⁾
- LAFH : Lower Anterior Facial Height (ANS-Me).⁽¹⁾
- PFH : Posterior Facial Height (S-Go).⁽¹⁾
- RH : Ramus Height (Ar-Go).⁽²²⁾
- UADH : Upper Anterior Dental Height, the perpendicular distance from maxillary central incisor edge (UIE) projected at a right angle to the palatal plane.⁽¹⁾
- LADH : Lower Anterior Dental Height, The perpendicular distance from mandibular central incisor edge (LIE) projected at a right angle to the mandibular plane.⁽¹⁾

***The angular measurements include:**

- U1/L1 : Interincisal angle.⁽¹⁾
- SNA : This angle defines the antero-posterior position of maxilla in relation to anterior cranial base.⁽¹⁾

-SNB : This angle indicates the anteroposterior position of the mandible in relation to the anterior cranial base.⁽¹⁾

-SN-PP : The angle of palatal plane inclination in relation to anterior cranial base.⁽²³⁾

-SN-MP : Mandibular plane angle.⁽¹⁾

-PP-Mp : Palatomandibular plane angle.⁽²⁴⁾

-GO : Gonial angle (Ar.Go.Me).⁽¹⁾

-U1SN : The angulation of upper central incisor to SN plane.⁽¹⁾

-L1MP : The angulation of lower central incisor to mandibular plane.⁽¹⁾

Analysis of data by using SPSS program was done including means, and standard deviations of the variables (linear and angular measurements) for normal and bimaxillary protrusion samples. Comparison between bimaxillary protrusion and normal occlusion (males , females and total sample) were done for all variables by using t-test at $p < 0.05$ as significant and $p < 0.01$ as highly significant.

RESULTS

The comparisons between normal bite and bimaxillary protrusion for males,

females and total sample were described in Tables (1, 2).

Table (1): Comparison of linear measurements between normal occlusion and bimaxillary protrusion for each sex and total sample.

Variables	Bite	Total sample				Males				Females			
		Mean	SD	t-value	Sig	Mean	SD	t-value	Sig	Mean	SD	t-value	Sig
TAFH	N	122.4412	6.25			122.9	7.15			121.98	5.40		
	B	6.43	7.37	3.26	HS	127.53	6.06	3.20	HS	125.56	8.18	1.85	S
UAFH	N	55.82	2.86			55.36	3.05			56.28	2.65		
	B	55.72	3.40	-0.33	NS	55.88	2.78	1.05	NS	55.44	3.84	-1.25	NS
LAFH	N	68.62	5.55			69.46	6.21			67.78	4.80		
	B	73.15	5.68	4.31	HS	73.65	5.73	3.03	HS	72.92	5.61	3.82	HS
PFH	N	81.28	6.32			82.48	7.03			80.08	5.46		
	B	83.40	5.17	1.87	NS	83.06	5.44	1.89	NS	83.56	5.28	1.86	NS
RH	N	49.31	5.69			49.94	7.11			48.68	3.85		
	B	49.65	5.18	0.24	NS	48.24	5.30	-0.36	NS	50.36	5.14	0.95	NS
UADH	N	28.53	2.82			29.04	3.1			28.02	2.60		
	B	30.02	3.63	2.58	S	29.88	3.85	1.65	NS	30.04	3.58	2.41	S
LADH	N	42.79	3.15			43.20	3.30			42.38	3.01		
	B	44.56	3.09	2.96	HS	45.0	3.41	2.28	S	44.16	2.76	1.93	S

N: Normal bite; B: Bimaxillary protrusion; S: Significant at $P \leq 0.05$; HS: Highly Significant at $P \leq 0.01$; NS: Not Significant; TAFH: Total Anterior Facial Height. UAFH: Upper Anterior Facial Height. LAFH: Lower Anterior Facial Height. PFH: Posterior Facial Height. RH: Ramus Height. UADH: Upper Anterior Dental Height. LADH: Lower Anterior Dental Height.

Table (2): Comparison of angular measurements between normal occlusion and bimaxillary protrusion for each sex and total sample.

Variables	Bite	Total sample				Males				Females			
		Mean	SD	t-value	Sig	Mean	SD	t-value	Sig	Mean	SD	t-value	Sig
U1/L1	N	124.63	6.58			122.81	5.75			126.48	6.94		
	B	109.36	7.33	-9.93	HS	109.18	6.93	-5.22	HS	108.96	7.57	-8.33	HS
SNA	N	79.42	1.90			79.91	1.88			78.93	1.83		
	B	83.75	3.66	7.21	HS	84.12	4.23	5.09	HS	83.40	3.31	5.38	HS
SNB	N	77.51	2.31			77.15	1.99			77.88	2.59		
	B	79.65	2.94	3.23	HS	80.23	3.28	3.05	HS	79.08	2.62	1.43	S
SN-PP	N	8.61	3.42			7.79	3.46			9.43	3.22		
	B	7.65	3.43	-1.45	NS	6.76	2.53	-1.32	NS	8.36	3.92	-1.02	NS
SN-MP	N	31.54	6.57			30.96	4.74			32.12	8.05		
	B	35.90	5.39	3.65	HS	36.41	4.03	3.49	HS	35.80	6.3	2.13	S
PP-MP	N	23.44	4.85			23.12	4.67			23.78	5.12		
	B	27.93	5.82	4.12	HS	29.0	6.87	3.007	HS	27.44	5.18	2.84	HS
Go	N	120.24	4.12			118.18	3.32			122.30	5.20		
	B	127.64	6.86	2.43	S	131.35	5.59	2.50	S	125.84	6.25	1.84	NS
U1SN	N	105.61	4.25			105.30	6.50			105.93	5.1		
	B	112.75	4.92	8.21	HS	112.59	5.28	4.95	HS	112.96	4.86	6.59	HS
L1MP	N	98.77	6.20			98.59	6.60			98.89	5.82		
	B	102.98	6.88	-1.79	HS	102.59	6.23	-3.67	HS	103.56	7.56	0.87	HS

N: Normal bite; B: Bimaxillary protrusion; S: Significant at $P \leq 0.05$; HS: Highly Significant at $P \leq 0.01$; NS: Not Significant; U1/L1: Interincisal angle. SNA: The anteroposterior position of maxilla in relation to anterior cranial base. SNB: The anteroposterior position of mandible in relation to anterior cranial base. SN-PP: Inclination of palatal plane in relation to anterior cranial base. SN-MP: Mandibular plane angle. PP-MP: Palatomandibular plane angle. GO: Gonial angle. U1SN: The angulation of upper central incisor to SN plane. L1MP: The angulation of lower central incisor to mandibular plane.

Significances were seen in most of the linear measurements in which the TAFH, LAFH, UADH and LADH were significantly higher in bimaxillary protrusion than normal occlusion. No significant differences were seen in UAFH, PFH and RH between the occlusions. U1/L1 angle was significantly smaller in bimaxillary protrusion than normal occlusions. Concerning other angular measurements, SNA, SNB, SN-MP, PP-MP, Go, U1SN and L1MP angles were significantly higher in bimaxillary protrusion than normal occlusion for both sexes and total sample except the Go angle in females. No significant differences were seen in SN-PP angle between the two occlusions.

DISCUSSION

In comparisons of the linear measurements between bimaxillary protrusion and normal occlusion, the TAFH and LAFH are significantly higher in bimaxillary protrusion than normal occlusion for both sexes and total sample while the UAFH was not significantly different between the two occlusions, our result agrees with the finding of Keating⁽²⁵⁾ and Bills et al.,⁽³⁾ this indicate that individuals with bimaxillary protrusion tend to have vertical growth patterns.

This result disagrees with that of Tsai⁽¹⁾, who reported that there were no significant differences in males only in females.

Between the two occlusions, our result agrees with the finding of Keating⁽²⁵⁾ and Bills et al.,⁽³⁾ this indicate that individuals with bimaxillary protrusion tend to have vertical growth patterns. This result disagrees with that of Tsai,⁽¹⁾ who reported that there were no significant differences in males only in females.

No significant difference was noticed in PFH and RH between bimaxillary and normal occlusion in both sexes and total sample similar to the findings of Keating⁽²⁵⁾ in both sexes and Tsai⁽¹⁾ for males, while in females he showed that PFH and RH in bimaxillary protrusion had greater value than the normal occlusion.

The direction of the mandibular growth of the bimaxillary protrusion showed a tendency of downward and backward when compared with normal

occlusion. Our results showed that the UADH was significantly higher in bimaxillary protrusion than normal occlusion in females and total sample with no significant difference was seen in males. LADH was significantly higher for both sexes and total sample in bimaxillary protrusion than normal occlusion. Our findings are similar to Bills et al.,⁽³⁾ and Keating,⁽²⁵⁾ this is consistent with the increase in AFH. Concerning the angular measurements, U1/L1 angle was significantly smaller in bimaxillary protrusion, while SNA and SNB angles were significantly higher in bimaxillary protrusion than normal occlusion for both sexes and total sample, this comes in agreement with Lamberton et al.,⁽⁹⁾ and Keating⁽²⁵⁾. The interincisal angle increased with age in both sexes that indicate uprighting both the upper and lower central incisors.⁽²⁶⁾ Tsai⁽¹⁾ reported that SNA angles was significantly higher in bimaxillary protrusion than normal occlusion in females with no differences in males, while SNB angle showed no significant differences for both sexes. The SNA and SNB measurements in bimaxillary protrusion were greater than those in normal occlusion because of the forward movement of points A and B with the protrusion of the front teeth. There were no significant differences in SN-PP angle in both occlusions in males, females and total sample, while SN-MP and PP-MP angles were significantly higher in bimaxillary protrusion than normal occlusion for both sexes and total sample due to the vertical growth patterns and diverging of facial planes. Our result agrees with Keating,⁽²⁵⁾ and Bills et al.,⁽³⁾ but disagrees with Tsai⁽¹⁾ who showed that SN-Mp and PP-Mp angles were not significantly different between bimaxillary protrusion and normal occlusion for both males and females. The Go angle was significantly higher in bimaxillary protrusion in males and total sample with no significant differences were seen in females. Tsai⁽¹⁾ showed that there were no significant differences in Go angle between the two occlusions for males and females. This study showed that U1SN and L1MP angles were significantly higher in bimaxillary protrusion for both sexes and total sample. This comes in agreement with the authors,^(1,3,27) which

demonstrated the incisor proclination and protrusion and facial convexity.

CONCLUSIONS

The adolescents with bimaxillary protrusion were compared with the normal occlusion adolescents. Patients with bimaxillary protrusion had significant smaller interincisal angle and greater facial convexity, increased incisors proclination, a vertical facial pattern, the direction of the mandibular growth showed a tendency of downward and backward rotation and diverging of the facial planes.

REFERENCES

1. Tsai HH. Cephalometric characteristics of bimaxillary dentoalveolar protrusion in early mixed dentition. *J Clin Pediatr Dent.* 2002 ; 26 (4): 363-370.
2. Diels RM, Kalra V, Deloach N, Powers M, Nelson SS. Changes in soft tissue profile of African- Americans following extraction treatment. *Angle Orthodontist.* 1995; 4: 285-292.
3. Bills DA, Handelman Ch S, Be Gole EA. Bimaxillary Dentoalveolar protrusion: Traits and orthodontic correction. *Angle Orthodontist.* 2005; 75 (3): 333 - 339.
4. Lino S, Sacoda S, Miyawaki S. An adult Bimaxillary protrusion Treated with Corticotomy- Facilitated Orthodontics and Titanium Miniplates. *Angle orthodontist.* 2006; 76 (6): 1074-1082.
5. Scott SH, Johnston LE. The perceived impact of extraction and nonextraction treatments on matched samples of African- American patients. *Am J Orthod Dentofacial Orthop.* 1999; 116: 352-358.
6. Farrow AK, Zarrinniak, Aziz K. Bimaxillary protrusion in black Americans- an esthetic evaluation and the treatment considerations. *Am J Orthod Dentofacial Orthop.* 1993; 104: 240-250.
7. Lew K. Profile changes following orthodontic treatment of bimaxillary protrusion in adults with the Begg appliance. *European J Orthod.* 1989; 11: 375-381.
8. Tan TJ. Profile changes following orthodontic correction of bimaxillary protrusion with a preadjusted edgewise appliance. *Int J Adult Orthod Orthog Surg.* 1996; 11: 939-251.
9. Lamberton CM, Reichart, Triratanimit P. Bimaxillary protrusion as a pathologic problem in the Thai. *Am J Orthod Dentofacial Orthop.* 1980; 77: 320-329.
10. Mc Cann J, Burden DJ. An investigation of tooth size in Northern Irish people with bimaxillary dental protrusion. *European J Orthod.* 1996; 18(1): 617-621.
11. Chung KR, Nelson G, Kim SH, Kook YA. Severe bidentoalveolar protrusion treated with orthodontic microimplant-dependent en-mass retraction. *Am J Orthod Dentofacial Orthop.* 2007; 132(1): 105-115.
12. Altug-Atac TA, Bolatoglu H, Memikoglu T. Facial soft tissue profile following bimaxillary orthognathic surgery. *Angle Orthod.* 2006; 78(1): 50-57.
13. Hashimoto T, Kuroda S, Kamioka H, Mishima K, Suqahara T, Takano-Yamamoto T. Bimaxillary Protrusion with masseter muscle hypertrophy treated with titanium screw anchorage and masseter surgical reduction. *Am J Orthod Dentofacial Orthop.* 2009; 135(4): 536-548.
14. Chung-Chen Jane You, Eddie Hsaing-Hua Lai, Jenny Zweichieng Chang, I.Chen, Yi-Jane Chen. Comparison of treatment outcomes between skeletal anchorage and extra oral anchorage in adults with maxillary dentoalveolar protrusion. *Am J Orthod Dentofacial Orthop.* 2008; 134 (5) : 615-24.
15. Upadhyag M, yadar S, Naqaraj K, patils. Treatment effects of mini-implants for enmass retraction of anterior teeth in bialveolar dental protrusion patients: a randomized controlled trial. *Am J Orthod Dentofacial Orthop.* 2009; 135 (1): 5-6.
16. Chae JM. Unusual Extraction Treatment of class I Bialveolar protrusion using Microimplant Anchorage. *Angle Orthod.* 2006 ; 77 (2) : 367-376.
17. Angle EH. Treatment of malocclusion of teeth. 7th ed. Philadelphia, S.S. white Manufacturing Co. 1907; Pp 40-52.
18. Kinaan BK. Overjet and overbite distribution and correlation. A comparative epidemiological English Iraqi study. *Br*

- J Orthod. 1986; 12: 79-86.
19. Swierenga D, Oesterle LJ, Messersmith ML. Cephalometric values for adult Mexican-Americans. *Am J Orthod Dentofacial Orthop.* 1994; 106(2): 146-55.
20. Mouakeh M. Cephalometric evaluation of craniofacial pattern of Syrian children with class III malocclusion. *Am J Orthod Dentofacial Orthop.* 2001; 119: 640-649.
21. Ursi BWJS, Trotman CA, Mc Namara JRJA, Behrent RG. Sexual dimorphism in normal craniofacial growth. *Angle Orthod.* 1993; 63 (1): 47-56.
22. Katsaros C, Berg R. Anterior Open bite malocclusion. *European J Orthod.* 1993; 15 :273-280.
23. Stuani As , Matsumoto MAN, Stuani MBS. Cephalometric evaluation of patients with anterior open bite. *Braz Dent J.* 2000; 11(1) : 35-40.
24. Pae EK, Kuhlberg A, Nanda Rs. Role of pharyngeal length in patients with a lack of overbite. *Am J Orthod Dentofacial Orthop.* 1997; 112 : 179-86.
25. Keating PJ . Bimaxillary protrusion in the Caucasian : a cephalometric study of the morphological features. *Br J Orthod.* 1985; 12: 193-201.
26. Mohammed AN. Evaluation of incisors and lips parameters between (11-15) years of age in Mosul City (Digital cephalometric study). Msc. Thesis , college of dentistry, university of Mosul. 2008.
27. Hussein E, Abumois M. Bimaxillary protrusion in the Palestinian Population. *Angle Orthod.* 2007; 77(5): 817-820.