

# The Relation of Dentoskeletal Parameters with Mandibular Anterior Crowding in the Early Mixed Dentition

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## الخلاصة

**الاهداف:** هدف هذه الدراسة تقييم القياسات السنية والهيكلية التي من الممكن ان تكون لها علاقة بتزاحم الأسنان الأمامية في الفترة المبكرة من التسنين المختلط، ولتحديد الاختلاف في القياسات بين المرضى الذين لديهم والذين ليس لديهم تزاحم في الأسنان. **المواد وطرائق العمل:** قيمت موديلات قوالب الاسنان والصور الشعاعية الجانبية للرأس لثمانين طفل عراقي يعيشون في مركز مدينة الموصل (٤٠ ذكراً و ٤٠ أنثى) تراوحت اعمارهم من ٧-١٠ سنوات. قسمت القوالب الى مجموعتين، افراد المجموعة الاولى اسنانهم متزاحمة والاخرى غير متزاحمة. قيست ابعاد القوالب من حيث الطول والعرض والقياسات السنية والهيكلية (الاطوال والزوايا) للصور الشعاعية لتقييم علاقة هذه القياسات في تزاحم الأسنان. **النتائج:** وجدت اختلافات كبيرة بين مجموعتي تزاحم وعدم تزاحم الأسنان في عدة قياسات سنية وهيكلية خصوصاً الزوايا التي تقيس العلاقة بين الفك العلوي والسفلي مع قاعدة الجمجمة الأمامية وكذلك الزوايا التي تقيس ميلان القواطع السفلية مع مستوى الفك السفلي. درست العلاقة بين شدة التزاحم للأسنان مع بقية القياسات. بعض النتائج كانت علاقتها موجبة والبعض الاخر كانت سالبة. **الاستنتاجات:** اقترحت النتائج الحالية بالإضافة الى حجم السن وابعاد الفك العرضية، فأن القياسات السنية الهيكلية تعد عوامل مهمة لها علاقة بتزاحم الأسنان الامامية السفلية في فترة التسنين المختلط المبكر.

## ABSTRACT

**Aims:** The aims of this study were to evaluate the dental and skeletal parameters which might be associated with mandibular anterior crowding in the early mixed dentition and to determine if these parameters of patients with and without crowding differ. **Materials and Methods:** Study models and lateral cephalometric radiographs of 80 Iraqi children lived in the center of Mosul City (40 boys and 40 girls), were evaluated. The age ranged between 7-10 years. The casts were divided into two groups ; crowding and non crowding, the lengths and widths of the lower dental arches, dental and skeletal (linear and angular) cephalometric measurements were used to determine the effect of these measurements on mandibular anterior crowding. **Results:** Significant differences between crowding and non crowding groups were seen in many of dental and skeletal measurements particularly the angles measured the relation between the maxilla and mandible to the anterior cranial base, the length of the anterior and posterior cranial base and the angles measured the inclination of lower incisors to the mandibular plane. The correlation coefficients of the amount of crowding with all the measurements were studied. Some of them showed a positive correlation , while others showed a negative one. **Conclusions:** The current results suggested that besides tooth size and transverse arch dimensions, effective dentoskeletal measurements are also an important factors related to mandibular anterior crowding in the early mixed dentition.

**Key words:** Dentoskeletal parameters, Anterior crowding, Mixed dentition.

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## INTRODUCTION

The four mandibular incisors are the teeth most prone to positional irregularity.<sup>(1)</sup> Malocclusion is the result of either a skeletal or a dental discrepancy , the prevalence of dental crowding was higher in the anterior region, whereas decreased in the premolar and molar regions.<sup>(2-4)</sup> Crowding may be of a genetic origin and might not be caused by excessive tooth size or changes in environmental factors (masticatory activity).<sup>(5)</sup> Tooth size and crown proportion is only one of the several

factors that may be involved in the etiology of dental crowding<sup>(6,7)</sup>. Malocclusion is an increasingly common, multifactorial problem. The most prevalent malocclusion result from excess tooth size compared with the size of the supporting bone , this creates a tooth -size arch- size discrepancy.<sup>(8)</sup> Crowding of the incisors is of special interest for stability and relapse in orthodontic treatment.<sup>(9)</sup> Proffit *et al.*,<sup>(10)</sup> defined tooth size discrepancy as a disproportion among the size of individual teeth. Anterior crowding is an orthodontic condition

that the public considers to be a significant esthetic problem,<sup>(6,11)</sup> and the most common problems that motivate patients to seek orthodontic treatment.<sup>(11,12)</sup> Decrease maxillary and mandibular effective lengths constitute an important factor associated with dental crowding in patients with complete class II malocclusion.<sup>(12)</sup> The aims of this study were to determine the differences of dentoskeletal parameters between crowding and non crowding groups and to study the correlation of these parameters with the amount of crowding.

#### MATERIALS AND METHODS

The materials of this study consisted of maxillary and mandibular dental casts and lateral cephalometric radiographs of 80 children, 40 boys and 40 girls. The age ranged between 7-10 years. The sample was collected from College of Dentistry in Mosul University, Department of Orthodontics. These subjects were selected according to the following criteria: 1. Class I or flush terminal plane of 1st permanent molars. 2. Early mixed dentition stage (fully erupted four permanent incisors, deciduous canines, deciduous molars and permanent 1st molars). 3. No congenitally missing permanent teeth or premature loss of deciduous or permanent molars. 4. minimal loss of tooth dimension by caries or attrition 5. No previous orthodontic treatment. 6. Iraqi children lived in the center of Mosul City.

The sample was divided into 2 groups crowded (CG) and non crowded (NCG). Because 1.6 mm of mandibular anterior crowding was considered as normal at this stage which was reported to be solved by a slight increase in an inter canine width, labial positioning of the permanent incisors relative to the primary incisors and slight backward movement of the canines into the primate space,<sup>(13,14)</sup> subjects who had anterior crowding less than or equal to 1.6 mm were included in the non crowded group, and those who had anterior crowding of more than 1.6 mm were included in the crowded group. Each group composed of 40 subjects (20 males and 20 females). The following measurements were obtained from the mandibular cast which was measured with a digital caliper to the nearest 0.01mm:<sup>(15)</sup>

1.ICW: Inter canine width: Distance between the tips of the cusps of right and left deciduous canines.

2.IMW: Intermolar width: Distance between the tips of the distobuccal cusps of the right and left mandibular 1st permanent molars.

3.AL: The distance between the mesial surface of right lower 1st permanent molar to the mesial surface of the left lower 1st permanent molar measured segmentally

4.Space required = Mesiodistal dimension of the lower right and left permanent incisors.

5.Space available = distance between the mesial surface of lower deciduous canine to the mesial surface of lower 1st permanent incisor. The right and left sided. The segment lengths for the right and left sides were summed. Total incisors width was subtracted from available space to calculate the amount of crowding.

Each subject was radiographed in a standing position by positioning the subject's head in the cephalostat with the left side of the face toward the x-ray tube. The head was then adjusted so that the Frankfort horizontal plane is parallel to the floor. Each subject was instructed to close the teeth in maximum intercuspation with the lips in contact and not to move until exposure was completed, the lateral cephalometric radiographs from the selected individuals were traced manually, and reference points and planes were then recorded:

#### #The skeletal measurements:

1.SNA: Anteroposterior position of the maxilla in relation to anterior cranial base.<sup>(16)</sup>

2.SNB: Anteroposterior position of the mandible in relation to anterior cranial base.<sup>(16)</sup>

3.ANB: The difference between SNA and SNB angles.<sup>(16)</sup>

4.S: Saddle angle (N.S.Ar).<sup>(17)</sup>

5.Go: Gonial angle (Ar.Go.Me).<sup>(17)</sup>

6.PP-MP: The angle between palatal plane and mandibular plane.<sup>(17)</sup>

7.ACL: Anterior cranial base length (N-S).<sup>(17)</sup>

8.PCL: Posterior cranial base length (S-Ba).<sup>(17)</sup>

#### #The dental measurements:

1.Occ-SN: The inclination of occlusal plane to anterior cranial base.<sup>(17)</sup>

2.U1SN: The inclination of upper central incisor to SN plane.<sup>(19)</sup>

3.L1Mp: The inclination of lower central incisor to MP plane.<sup>(19)</sup>

4.II: Interincisal angle.<sup>(19)</sup>

5.U1NA: The distance between the incisal edge of upper central incisor and NA line.<sup>(16)</sup>

6.L1NB: The distance between the incisal edge of lower central incisor and NB line.<sup>(16)</sup>

Analysis of data by using SPSS software was done including descriptive statistics (means and standard deviations) of all measurements for males and females. Comparison between CG and NCG variables were done using *t*-test at  $p \leq 0.05$  and

$p \leq 0.01$  level of significant. Pearson correlations were examined for inter relationships between crowding and all the measurements, correlation is significant at 0.01 and 0.05 level of significance.

## RESULTS

Tables (1-3) described descriptive statistics (means and standard deviation) and *t*-test between CG and NCG. In males the significant differences were seen in IMW, ICW, SNA, SNB, ANB, S, GO, PP-MP, ACL, Occ-SN, U1SN, L1MP, and L1NB, while in females the significant differences were seen in MD, SNA, SNB, GO, PP-MP, ACL, PCL, Occ-SN and L1MP.

Table (1): Descriptive statistics (means and standard deviations) and *p*-value in crowding and non crowding groups for cast measurements.

Variables	occlusion	Males			Females		
		Mean	SD	<i>P</i> -value	Mean	SD	<i>P</i> -value
IMW	N	48.74	4.14	0.012*	45.94	3.35	0.442
	C	45.32	2.59		44.68	5.31	
ICW	N	26.10	1.83	0.050*	26.20	2.43	0.359
	C	23.57	2.50		25.43	2.10	
AL	N	67.13	5.58	0.779	67.40	3.59	0.263
	C	66.64	3.45		65.98	3.20	
MD	N	21.86	1.55	0.557	20.46	1.32	0.001*
	C	22.23	1.84		23.82	1.72	

\*Significance at  $p \leq 0.01$  and 0.05 level. N=Normal, C=Crowding.

Table (2): Descriptive statistics (means and standard deviations) and *p*-value in crowding and non crowding groups for skeletal measurements.

Variables	occlusion	Males			Females		
		Mean	SD	<i>p</i> -value	Mean	SD	<i>p</i> -value
SNA	N	82.93	2.43	0.016*	81.80	5.21	0.014*
	C	78.06	3.57		77.33	3.55	
SNB	N	79.26	3.19	0.005*	76.53	4.25	0.013*
	C	74.33	3.82		73.26	2.49	
ANB	N	3.66	0.81	0.021*	5.06	2.73	0.931
	C	4.73	1.48		5.13	1.64	
S	N	118.66	2.99	0.006*	121.80	4.02	0.240
	C	123.33	5.34		123.73	4.77	
GO	N	128.33	3.86	0.013*	129.93	3.05	0.026*
	C	133.86	7.05		133.86	3.49	
PP-MP	N	27.40	3.26	0.001*	28.43	3.61	0.006*
	C	32.73	3.43		31.26	0.88	
ACL	N	68.66	2.79	0.021*	69.20	1.78	0.019*
	C	65.40	2.26		66.60	3.64	
PCL	N	46.06	3.01	0.072	45.43	4.02	0.008*
	C	47.93	2.49		50.53	5.68	

\*Significance at  $p \leq 0.01$  and 0.05 level. N=Normal, C=Crowding.

Table (3): Descriptive statistics (means and standard deviations) and *p*-value in crowding and non crowding groups for dental measurements.

Variables	occlusion	Males			Females		
		Mean	SD	<i>p</i> -value	Mean	SD	<i>p</i> -value
<b>Occ-SN</b>	N	18.36	3.72	0.006*	19.53	4.17	0.011*
	C	22.73	4.25		21.53	2.89	
<b>U1SN</b>	N	101.20	8.18	0.030*	101.13	7.07	0.235
	C	96.20	6.93		98.66	3.45	
<b>L1MP</b>	N	96.33	9.62	0.022*	95.06	5.43	0.03*
	C	90.80	10.79		91.13	7.62	
<b>II</b>	N	128.13	11.86	0.441	126.20	8.99	0.70
	C	131.66	12.90		127.53	9.78	
<b>U1NA</b>	N	1.53	0.91	0.484	2.66	1.82	0.317
	C	1.26	1.13		1.76	2.89	
<b>L1NB</b>	N	4.90	2.23	0.029*	5.73	1.37	0.267
	C	2.46	0.91		5.03	1.95	

\*Significance at  $p \leq 0.01$  and 0.05 level, N=Normal, C=Crowding.

The correlation coefficients of the amount of crowding with all measurements for males and females were de-

scribed in table (4). Some of them showed a positive correlation, while others showed a negative one.

Table (4): Pearson correlations of the crowding and all the measurements for males and females.

Variables	Males Significance	Females Significance
<b>IMW</b>	-0.34*	-0.17
<b>ICW</b>	-0.38*	-0.26
<b>AL</b>	-0.18	-0.16
<b>MD</b>	0.07	0.74**
<b>SNA</b>	-0.37*	-0.39*
<b>SNB</b>	-0.45**	-0.64**
<b>ANB</b>	0.73**	0.80**
<b>S</b>	0.66**	0.88**
<b>GO</b>	0.36*	0.22
<b>PP-MP</b>	0.78**	0.75**
<b>ACL</b>	-0.46**	-0.87**
<b>PCL</b>	0.20	0.68**
<b>Occ-SN</b>	0.42**	0.84**
<b>U1SN</b>	-0.21	-0.28
<b>L1MP</b>	-0.67**	-0.60**
<b>II</b>	0.41**	0.98**
<b>U1NA</b>	-0.20	-0.19
<b>L1NB</b>	-0.53**	-0.84**

\*Correlation is significant at  $p \leq 0.05$  level, \*\*Correlation is significant at  $p \leq 0.01$  level.

In males , positive correlations were seen in ANB, S,GO, PP-MP, Occ-SN,II, and negative correlation with IMW, ICW, SNA, SNB, ACL, L1MP and L1NB. In females, positive correlations seen with MD, ANB, S, PP-MP, PCL, Occ-SN,II, , and negative correlations with SNA, SNB, ACL, L1MP and L1NB.

## DISCUSSION

Predicting permanent incisor crowding at an early stage is very important for preventive orthodontic and treatment plan. Some studies evaluated the relation between crowding and mandibular cast measurements, and very few studies also evaluated the relationships between mandibular anterior crowding and cephalometric measurements in the early mixed dentition.<sup>(2)</sup> So, our study discussed the effect of both cast and lateral cephalometric measurements on mandibular anterior crowding .A review of the literature indicated conflicting results about the factors contributing to mandibular anterior crowding.<sup>(12,20,21)</sup>

### Cast measurements

Males showed a significant differences in ICW and IMW in which CG had smaller values than NCG,while in females the significant difference seen in MD with larger value in CG.

Bernabe *et al.*<sup>(20)</sup> stated that only the IMW and AL differed between the groups, while our result showed no significant differences in AL between CG and NCG in both sexes.Prabhakar *et al.*,<sup>(21)</sup> studied the crowding on the deciduous dental casts and found a significant differences seen in IMW and AL between the groups.In our study ,although the AL of CG was smaller than that of NCG in both sexes,it is not to a significant degree. Inversely, Melo *et al.*,<sup>(22)</sup> reported that mandibular dental AL was an effective discriminator in separating normal and crowded cases.

Some authors<sup>(23)</sup> found significant differences in tooth dimensions between subjects with and without crowding . While others reported that the total width of four mandibular incisors did not differ significantly between CG and NCG.<sup>(23,24)</sup> Our results showed significant differences of MD dimensions between the groups only

in females.It may be said that tooth size is only one of the several factors that may be involved in the etiology of dental crowding.

### Cephalometric measurements

#### Skeletal measurements:

Melo *et al.*,<sup>(22)</sup> evaluated indicators of crowding in the primary dentition , which may lead to future mandibular anterior crowding in the mixed dentition stage .They found maxillary and mandibular dental arch lengths were possible indicators for crowding in the early mixed dentition. Guilherme *et al.*,<sup>(12)</sup> concluded that patient with class II malocclusion and moderate to severe mandibular crowding have significantly smaller effective apical base lengths than subjects with the same malocclusion and slight mandibular crowding. In our study SNA and SNB were significantly smaller in the CG and the ANB was greater .Thus, we can state that mandibular anterior crowding is more likely to occur in retrognathic cases, and that the bimaxillary retrusion cases are more likely to produce mandibular anterior crowding than bimaxillary protrusion cases.

Leighton and Hunter,<sup>(25)</sup> in their longitudinal study, stated that patients with severe crowding had a steeper mandibular plane , greater PP-MP, increase SN-Occ, SN-MP and FH-MP angles in both mixed and permanent dentition stages, on the other hand, Lundstrom<sup>(26)</sup>, Rainer and Angelika<sup>(27)</sup> found no correlation between these angles and crowding. Our study similar to that found by Leighton and Hunter in which a significant differences seen in Occ-SN and PP-MP angles, which mean that mandibular dentition with crowding characterized by a downward and backward growth direction.

Melo *et al.*,<sup>(22)</sup> assumed that the subjects in the normal group had long ACL and short PCL.While other studies showed that there were no relation between ACL and PCL and crowding dentition.<sup>(27,28)</sup> Our study confirmed the study of Melo *et al.*,<sup>(22)</sup> in which a significant differences were seen between CG and NCG for cranial base dimensions, in which the CG have deficient in ACL which effect on maxillary and mandibular growth and lead

to backward rotation and crowding. so it can be considered as indicators when attempting to predict dental crowding in the early mixed dentition.

#### Dental measurements:

Because orthodontics makes it possible to alter the dentoalveolar tooth position, it is very important to determine whether incisor position and inclination contribute to crowding. Leighton and Hunter<sup>(25)</sup> found that the lower incisors in the CG were less protrusive than NCG.

Bishara *et al.*<sup>(29)</sup> stated that the up-righting of the incisors could not, by itself, be a determinant of the severity of the anterior or total change in arch length discrepancy.

Our result showed that the significant differences between CG and NCG were seen in L1MP and L1NB in male and L1MP in female in which CG have small values than NCG. So, it revealed that inclination of the lower incisors was associated with mandibular anterior crowding in the mixed dentition stage, so retrusion of teeth results in available arch loss.

#### Correlations:

Conflicting results existed in the literature evaluating the correlation between crowding and dentoskeletal dimensions. Some of the studies stated that there were no correlation between lower incisor crowding and either skeletal morphology or lower incisor position.<sup>(27,28)</sup> Others concluded that significant correlations (positive or negative) were present between crowding and total incisor width, ICW, IMW, SNB, L1NB, ACL and mandibular dental measurements.<sup>(24,30)</sup> In this study a significant positive correlation was found between the crowding and ANB, S, PP-MP, Occ-SN, II and negative with SNA, SNB, ACL, L1MP and L1NB. So any of the dentoskeletal characteristics, whether alone or in combination with other factors can be associated with the development of mandibular incisor crowding.

### CONCLUSIONS

Crowding of the mandibular incisors in the early mixed dentition is not only a tooth –arch size discrepancy. Dentoskeletal parameters also can be associated with this malalignment.

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