Mesio-distal crown dimension of permanent dentition in normal, crowding, and spacing of young adult sample aged 18-25 years

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ABSTRACT

Background: This study aimed to assess the effect of tooth width in malocclusion in relation to normal, crowding, and spacing dentition.

Materials and methods: The sample included dental casts of some dental students and orthodontic patients; their age was (18-25) years and having three groups normal, crowding, and spacing dentition groups. The sample was equally divided to three groups normal, crowding, and spacing dentition groups, each group contained 50 maxillary and 50 mandibular casts that were further subdivided by gender; all the stone casts were measured by highly sensitive digital vernier.

Results and Conclusions: Non-significant side difference was found in both dental arches in the three studied groups. Males had higher mesiodistal crown dimension than females in all three groups, with significant gender difference in crowding and normal dentition groups. The mesiodistal distance of the segment measurements (Total Anterior material; Total Posterior material and Total teeth material) were larger in crowded dentition then followed by normal and spaced dentition groups respectively in both gender. Total Anterior material in both arches had direct significant correlation with crowding malocclusion, while maxillary Total Anterior material had indirect significant correlation with spacing malocclusion.

Keywords: Mesiodistal crown dimension, segment measurements, normal dentition, crowding dentition, spacing dentition. (J Bagh Coll Dentistry 2014; 26(4):180-186).

الخلاصة

الهدف من الدراسة: هو تقييم تأثير عرض الأسنان فيما يتعلق بالاسنان المزدحمة ،الطبيعية، والمتباعدة، والذي تم عن طريق فحص مرضى تقويم الأسنان الذين حضروا قسم تقويم الأسنان في كلية طب الأسنان، و طلاب كلية طب الأسنان / جامعة بغداد,و كانت اعمارهم (18-25) سنة.

اداة البحث: تم تقسيم العينة بالتساوي إلى ثلاث مجاميع المزدحمة، الطبيعية، ومجموعة الأسنان المتباعدة، كل مجموعة تحتوي على 50 قالب سني للفك العلوي و50 للفك السفلي, و كذلك تم تقسيمها حسب الجنس ؛ وقد تم قياس كل القوالب السنية باستخدام المقياس السني الرقمي وهو حساس للغاية.

الاستنتاج: تم العثور على فرق غير ذا دلالة إحصائية بين الجانب الأيمن والأيسر على حد سواء لأقواس الأسنان في المجموعات الثلاث التي شملتها الدراسة. الذكور عموما كانوا يمتلكون اكبر بعد في التاج الإنسي الوحشي للأسنان من الإناث في جميع الفئات الثلاث، مع فارق كبير بين الجنسين في مجموعة الاسنان الطبيعية والمزدحمة.البعد الإنسي الوحشي للقياسات المجزأة للقوس السني (إجمالي مواد الاسنان الأمامية؛ إجمالي مواد الاسنان الخلفية وإجمالي مواد الأسنان) كانت أكبر بشكل موحد في مجموعة الاسنان المزدحمة ثم تليها مجموعة الأسنان الطبيعية والمتباعدة على التوالي في كلا الجنسين. كان إجمالي مواد الاسنان الأمامية في كل من الأقواس السنية لها ارتباط كبير و مباشر مع مقدار التناقض في حجم الأسنان في مجموعة الاسنان المزدحمة، في حين الفك العلوي كان إجمالي مواد الاسنان الأمامية لها ارتباط كبيروغيرمباشر مع مقدار التناقض في حجم الأسنان في مجموعة الاسنان المتباعدة فقط.

INTRODUCTION

Nance [1] described dental crowding as the difference between the spacing needed in the dental arch and the space available in that arch. Also, the dental arches of a considerable number of individuals show spaces between some, or even all of the teeth, such dental arches are known as spaceddentition [2,3]. Thus, crowding or spacing can be described as an expression of an altered tooth/tissue ratio of as a dentoalveolar disproportion.

Tooth size in relation to the mandibular and maxillary arches determines whether the dentition is spaced or crowded, and discrepancies in the sizes of teeth in different arches determine buccal inter-digitation, overjet, overbite, and center line discrepancies [4,5]. Correspondingly, genetic factors may influence variation in space anomalies among different ethnic groups.The factors that associatedwith variability in space anomalies prevalence are gender [6], heredity and environment [7] and location, i.e. maxillary or mandibular arch [8].

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Crowding and spacing are considered as the most common manifestations of malocclusion and can occur as a result of either a shortage of the space required for tooth alignment or an excess of available space. Hence, tooth size and arch perimeter should generally correspond in cases of acceptable arch alignment [9].

This study aimed to compare the mesio-distal crown dimension of the teeth for both arches in both sides and for both gender in normal, crowded and spaced permanent dentition groups and to find out the correlation between mesio-distal crown dimension of the teeth with crowding and spacing malocclusion.

MATERIALS AND METHODS

Sample

The sample included dental casts ofstudents of college of dentistry/Baghdad Universityand orthodontic patients who attended orthodontic department in college of dentistry/Baghdad University.The sample was equally divided to three groups normal, crowding, and spacing dentition groups

Selection Criteria

All subjects were Iraqi Arab in origin with an age (18-25) years, all of their permanent teeth must present except wisdom teeth.

Exclusion Criteria

The following subjects were excluded:

1. Bimaxillary protrusion malocclusion;
2. History of orthodontic treatment or interproximal stripping performed prior to impression taken;
3. Coronal carious lesion, restoration, crowns and/or onlays that affect mesio-distal dimensions of the teeth.
4. Clinical sign of attrition; broken tooth;
5. Pathological periodontal problems according to the gingival index and calculus deposition;
6. Congenital dental defects such as deformed or supernumerary teeth;
7. Bad habits; congenital deformity (cleft lip and palate).

The sample was divided into:

- 1st group (Normal arches): This group included 50 cases (24 males and 26 females) with a space discrepancy (crowding or spacing) of less than 2 mm [12], bilateral CL I molars relationship [17], and bilateral CL I canines relationship [18], normal overjet and overbite (2-4 mm) [19]. No evident rotation of teeth.
- 2nd group (Crowded arches): This group included 50 cases (26 males and 24 females), with a space deficiency of 2 mm or more [12].
- 3rd group (Spaced arches): This group included 50 cases (22 males and 28 females), with a space excess of 2 mm or more [12].

Method

Clinical examination

Each examined subject seated on the dental chair in an upright position, then clinically examined (extra-orally and intra-orally) to check his/her fulfillment of the required sample selection criteria, and if the examined subject was chosen to be included in the sample, his/her name, age and gender were recorded in a specific case sheet.

Dental Cast Production

Alginate hydrocolloid impression material was mixed with water according to manufacture instruction, after that, upper and lower impressions were taken for every subject of the samples from each group, and then the impression was poured immediately with dental rock die stone. Before the final setting of the dental stone, the cast base was prepared. The base was labeled for name and number recording to be ready for the measuring procedure.

Cast Measurements

After completion of the cast production, the following measurements were done:

A. Space Required

Mesiodistal crown dimension in millimeters of all maxillary and mandibular teeth except 1st, 2nd, and 3rd permanent molar was measured. The anatomic mesial and distal contact points of each tooth were marked by a fine marker on the dental cast and then the greatest MDCD was measured by sharp ends of digital vernier. The largest mesiodistal widths of the teeth are obtained by measuringthe distance between the anatomically correct contactpoints of each tooth mesial to the first molars**.** Thedigital vernier was usually positioned buccal tothe teeth and parallel to the occlusal plane (the instrument held at right angle to the long axis of the crown). The measuring device may need tobe positioned occlusal to a rotated tooth [20, 21]. Each pair of study casts required 20 measurements which were all recorded on the subject's case sheets.

B. Space Available

Arch length measurement was obtained by digital vernier. The tips of measuring instrument are placed in the alveolar ridge from the points where the teeth are expected to contact one another in ideal alignment. Only the arch length mesial to first permanent molar was measured. The measurement was done by dividing the arch into six segments (right and left)[21]:

1. The anterior segments extend from a point between the central incisors to the point mesial to the canines.
2. The arch length around the canine.
3. The posterior parts of arch were measured from distal of canine to the mesial of the first permanent molar.

Grouping of the Casts

The grouping of the castswill be done on the basis of space analysis (tooth size-arch lengthdiscrepancy) into [12]**:**

1. The normal arches: those with a space discrepancy of less than 2 mm and other normal occlusion features.
2. The crowded arches: those with a spacediscrepancy (space deficiency) of ≥ (-2 mm).
3. The spaced arches: thosewith a space discrepancy (space excess) of ≥ (+2 mm).

Space discrepancy should be coinciding for both arches in each group.

The measuring data

The measuring data from the selected casts were computed into two waysfor the purpose of statistical analysis:

I. Segment measurements as:
   a) Total Anterior Material (TAM): Cumulative MDCD of the four incisors in each arch.
   b) Total Posterior Material (TPM): Cumulative MDCD of the both canines and the four premolars in each side for each arch.
   c) Total Teeth Material (TTM): Cumulative MDCD of TAM and TPM Materials in each arch.

II. Individual teeth measurements: MDCD of each tooth separately in each arch for all groups.

Statistical Analysis

All the data of the sample were subjected to computerized statistical analysis using SPSS computer program (version 19). The statistical analysis includes:

1- Descriptive statistics: including means, Standard deviation (SD), Statistical tables and figures.

2- Inferential Statistics: including Paired t-test: for intra-examiner and inter-examiner calibration and for side comparison, Independent sample t-test: for the gender difference, ANOVA test: for the comparison among the three groups, LSD test: for pair comparisons when ANOVA test was significant and Person's correlation coefficient: for establish correlation of space discrepancy with mean values of segment measurements in each group.

In the statistical evaluation, the following levels of significance are used:

NS: Non-Significant, $P > 0.05$
S: Significant, $0.05 \geq P > 0.01$
HS: Highly Significant $P \leq 0.01$

RESULTS AND DISCUSSION

Side difference

The measured mean values of MDCD of individual teeth, in both arches showed no significant difference (p-value > 0.05)between right and left side by using paired t- test in all three groups of the sample, therefore, the mean of both sides of each individual tooth can be taken in the present study, and the degree of freedom was (d.f) = 49.

However, the cause of this side similarity was attributed to a fact that, same factors on the same individual that affects the tooth size like genetic, nutrition, hormonal disturbances will affect its antimer [27]. This is similar to previous findings [24,25] who found that, there were no differences between the right and left sides, in the permanent dentition**.**

Gender difference

I. Segment measurements: By using independent t-test, there was no significant difference (P > 0.05) between males and females regarding M-D distances of all segment measurements (TAM, TPM, TTM) of spacing dentition group in both arches and the degree of freedom was (d.f) = 48.

However, regarding normal dentition group, the degree of freedom was (d.f) =48; while maxillary TAM (p-value = 0.03; t-test =2.242), mandibular TPM (p-value = 0.002; t-test =3.199) and TTM (p-value = 0.004; t-test =3.015) had significant difference between males and females**.**

Regarding crowding dentition group the degree of freedom was (d.f) =48; while maxillary TPM (p-value =0.037; t-test =2.151) and TTM (p-value =0.046; t-test =2.052)had significant difference between males and females.

II. MDCD of Individual teeth: There were varying degree of significance and non-significance in all three measured groups of the sample between males and females in both arches by using independent t-test as shown in table (1).

Comparison among the MDCD of the Segment measurements

The mean values of segment measurements in both arches and in both gender were higher in crowding dentition group then followed by normal and spacing dentition group respectively, with high significant difference (p-value = 0.000) as indicated by ANOVA test among the three group as shown in table (2); while LSD test as shown in the table (3).

The present finding partially agreed with previous findings [22,23] who found crowded arches had significantly larger teeth than those with no crowding. Furthermore, these findings partially agreed with previous studies [22, 14] who found the TTM in both arches and mandibular TAM was significantly smaller in spaced dentition when compared with normal dentition. Also, the present results were in agreement with previous findings [22,23] who found crowded group had significantly larger segment measurements than spaced group**.**

The large MDCD of crowding dentition when compared with normal dentition group was attributed to environmental factors as the dietary consistency, the ''toughness'' of the diet and how much it exercises the muscles and stimulates the jaw growth [13,27].

Table 1: Descriptive statistics and genders difference of the MDCD of the individual teeth (mm)

	Arch	Teeth	Descriptive Statistics				Genders difference (d.f.=98)	
			Males		Females			
			Mean	S.D.	Mean	S.D.	t-test	p-value
Normal	Maxillary	I1	8.78	0.52	8.47	0.48	3.05	0.003 (HS)
		I2	6.88	0.59	6.62	0.5	2.36	0.02 (S)
		C	7.89	0.52	7.7	0.51	1.81	0.073 (NS)
		P1	6.9	0.4	6.92	0.33	-0.28	0.784(NS)
		P2	6.66	0.41	6.6	0.4	0.73	0.466 (NS)
	Mandibular	I1	5.48	0.37	5.37	0.27	1.67	0.099 (NS)
		I2	6.03	0.43	5.79	0.36	3.08	0.003 (HS)
		C	7	0.49	6.58	0.41	4.64	0.000 (HS)
		P1	7.14	0.4	6.89	0.39	3.17	0.002 (HS)
		P2	7.18	0.5	6.88	0.4	3.37	0.001 (HS)
Crowding	Maxillary	I1	9.3	0.53	8.99	0.57	2.8	0.006 (HS)
		I2	7.24	0.81	7.15	0.43	0.65	0.517 (NS)
		C	8.21	0.54	7.95	0.42	2.68	0.009 (HS)
		P1	7.38	0.44	7.21	0.47	1.88	0.063 (NS)
		P2	7.02	0.46	6.79	0.46	2.44	0.016 (S)
	Mandibular	I1	5.82	0.32	5.71	0.3	1.69	0.094 (NS)
		I2	6.44	0.38	6.32	0.39	1.46	0.147 (NS)
		C	7.32	0.41	6.89	0.38	5.43	0.000(HS)
		P1	7.43	0.43	7.5	0.46	-0.78	0.436 (NS)
		P2	7.68	0.57	7.66	0.51	0.24	0.814 (NS)
Spacing	Maxillary	I1	8.44	0.47	8.27	0.51	1.75	0.084 (NS)
		I2	6.49	0.51	6.54	0.51	-0.42	0.678 (NS)
		C	7.76	0.37	7.46	0.49	3.31	0.001 (HS)
		P1	6.78	0.48	6.85	0.43	-0.82	0.414 (NS)
		P2	6.53	0.51	6.63	0.43	-1.07	0.289 (NS)
	Mandibular	I1	5.27	0.33	5.31	0.32	-0.69	0.494 (NS)
		I2	5.72	0.35	5.83	0.53	-1.15	0.252 (NS)
		C	6.82	0.38	6.57	0.47	2.89	0.005 (HS)
		P1	6.86	0.41	6.83	0.4	0.37	0.715 (NS)
		P2	6.94	0.48	7.02	0.46	-0.86	0.39 (NS)

Table 2: Comparison among segment measurements (mm)

Genders	Arch	Measurements	Descriptive Statistics						Comparison	
			Crowding		Normal		Spacing		d.f. =71	
			Mean	S.D.	Mean	S.D.	Mean	S.D.	F-test	p-value
Males	Maxillary	TAM	33.08	1.98	31.31	1.94	29.88	1.7	17.476	0.000 (HS)
		TPM	45.22	2.19	42.9	1.95	42.13	2.17	14.276	0.000 (HS)
		TTM	78.3	3.71	74.21	3.52	72	3.66	18.79	0.000 (HS)
	Mandibular	TAM	24.5	1.24	23.03	1.39	21.98	1.16	24.021	0.000 (HS)
		TPM	44.86	2.11	42.64	2.47	41.24	2.05	16.389	0.000 (HS)
		TTM	69.36	2.99	65.68	3.57	63.22	2.99	22.652	0.000 (HS)
Females	Maxillary	TAM	32.29	1.76	30.19	1.6	29.62	1.71	17.555	0.000 (HS)
		TPM	43.91	2.11	42.45	1.95	41.89	2.21	6.302	0.003 (HS)
		TTM	76.2	3.5	72.63	3.21	71.5	3.66	12.667	0.000 (HS)
	Mandibular	TAM	24.07	1.08	22.33	1.14	22.28	1.32	18.223	0.000 (HS)
		TPM	44.09	2.26	40.7	1.79	40.83	2.03	22.258	0.000 (HS)
		TTM	68.16	2.98	63.04	2.57	63.12	3.05	25.84	0.000 (HS)

Table 3: LSD test for segment measurements (mm).

Gender	Arch	Measurements	Groups		Mean Difference	p-value
Males	Maxillary	TAM	Crowding	Normal	1.77	0.001 (HS)
				Spacing	3.2	0.000 (HS)
			Normal	Spacing	1.43	0.012 (S)
		TPM	Crowding	Normal	2.32	0.000 (HS)
				Spacing	3.09	0.000 (HS)
			Normal	Spacing	0.77	0.218 (NS)
		TTM	Crowding	Normal	4.09	0.000 (HS)
				Spacing	6.3	0.000 (HS)
			Normal	Spacing	2.21	0.043 (S)
	Mandibular	TAM	Crowding	Normal	1.47	0.000 (HS)
				Spacing	2.52	0.000 (HS)
			Normal	Spacing	1.05	0.006 (HS)
		TPM	Crowding	Normal	2.22	0.001 (HS)
				Spacing	3.62	0.000 (HS)
			Normal	Spacing	1.41	0.035 (S)
		TTM	Crowding	Normal	3.69	0.000 (HS)
				Spacing	6.15	0.000 (HS)
			Normal	Spacing	2.46	0.011 (S)
Females	Maxillary	TAM	Crowding	Normal	2.11	0.000 (HS)
				Spacing	2.68	0.000 (HS)
			Normal	Spacing	0.57	0.220 (NS)
		TPM	Crowding	Normal	1.46	0.016 (S)
				Spacing	2.02	0.001 (HS)
			Normal	Spacing	0.56	0.330 (NS)
		TTM	Crowding	Normal	3.57	0.000 (HS)
				Spacing	4.7	0.000 (HS)
			Normal	Spacing	1.13	0.236 (NS)
	Mandibular	TAM	Crowding	Normal	1.74	0.000 (HS)
				Spacing	1.78	0.000 (HS)
			Normal	Spacing	0.05	0.882 (NS)
		TPM	Crowding	Normal	3.38	0.000 (HS)
				Spacing	3.26	0.000 (HS)
			Normal	Spacing	-0.13	0.815 (NS)
		TTM	Crowding	Normal	5.12	0.000 (HS)
				Spacing	5.04	0.000 (HS)
			Normal	Spacing	-0.08	0.918 (NS)

Correlation between the space discrepancy and Segment measurements

By using Person's correlation test, TAM in both arches had direct significant correlation in crowding dentition group, this is came to be in agreement with the previous findings [15,16], while, maxillary TAM had indirect significant correlation in spacing dentition group,the present finding may be attributed to genetic factors or racial variation of present sample, table (4).

Correlation between the maxillary and mandibular segment measurements

By using Person's correlation test, there were highly significant direct correlations between each variable with its opposite variable in the opposing arch in all three groups of the sample; as shown in table (5). Regarding to normal dentition group, the present finding agreed with the previous findings [11,24] who found that, correlation coefficient for the incisors group and the canines and premolars group between maxillary and mandibular arch were moderate to high correlation between the variables. Regarding to crowding and spacing dentitions ,the present findings agreed with the previous findings [10] who found that, because of the pervasive, positive inter-correlations among crown sizes, people with large dimensions of one tooth are predisposed to have large dimensions of other teeth and vice versa.

The conclusions that can be drawn from this study are:

1. No significant side difference for MDCD of the individual teeth in the dental arches of normal, crowding and spacing dentition groups.
2. The segment measurements (TAM, TPM and TTM):

A. Mostly higher in males than in females in both arches and in all three groups.
B. Significantly larger in crowded dentition group compared with normal dentition group in both genders.
C. Significantly smaller in spaced dentition in comparison to normal dentition group in males and no significant in females.
D. Significantly larger in crowded dentition group in comparison to spaced dentition group in both genders.

3. Total Anterior Material in both arches had direct significant correlation with crowding malocclusion, while TAM in the maxillary arch had indirect significant correlation with spacing malocclusion.

Table 4: Correlation between the space discrepancy and segment measurements (mm)

Groups	Arch	Teeth		Mandibular		
				TAM	TPM	TTM
Normal	Maxillary	TAM	r	0.742	0.771	0.829
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
		TPM	r	0.59	0.778	0.775
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
		TTM	r	0.734	0.856	0.885
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
Crowding	Maxillary	TAM	r	0.582	0.398	0.516
			p-value	0.000 (HS)	0.004 (HS)	0.000 (HS)
		TPM	r	0.582	0.82	0.824
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
		TTM	r	0.645	0.694	0.756
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
Spacing	Maxillary	TAM	r	0.736	0.657	0.751
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
		TPM	r	0.718	0.837	0.865
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)
		TTM	r	0.774	0.808	0.869
			p-value	0.000 (HS)	0.000 (HS)	0.000 (HS)

Table 5: Correlation between the maxillary and mandibular segment measurements (mm)

Arch	Teeth		Crowding	Spacing
Maxillary	TAM	r	0.287	-0.297
		p-value	0.043 (S)	0.036 (S)
	TPM	r	0.174	-0.124
		p-value	0.226(NS)	0.390 (NS)
	TTM	r	0.251	-0.213
		p-value	0.079(NS)	0.138 (NS)
Mandibular	TAM	r	0.325	-0.168
		p-value	0.021 (S)	0.242 (NS)
	TPM	r	0.19	-0.19
		p-value	0.187(NS)	0.186 (NS)
	TTM	r	0.265	-0.199
		p-value	0.063(NS)	0.167 (NS)

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