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Dental Arch Perimeter and Dimensions in Kurdish Sample Aged 14-25 Years with Class I and Class II Malocclusion

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Abstract
The objectives of this study were to determine and compare the arch perimeter, arch width and vertical arch length in class I normal occlusion and class II malocclusion (division 1 and division 2) in a Kurdish sample of young adults aged 14–25 years. These measurements were taken on 100 study models (50 cases of class I normal occlusion and 50 cases of class II malocclusions). The results showed that (1) Upper and lower arch perimeters of class I normal occlusion were significantly shorter than class II division 1 [at p value= 0.000 , 0.016] subsequently ,whereas, no significant difference were found comparing with class II division 2 group[p value= 0.59 , 0.61] subsequently (2) No differences were found in upper intercanine width in the two different groups of class II malocclusion [p=0.136] and with class I normal occlusion at p> 0.05, (3) upper intermolar width in Class II division 2 were significantly smaller than that in class I normal occlusion [p= 0.000] (4) Lastly, the vertical maxillary arch length in Class II division 1 was significantly larger than Class II division 2 at p<0.05 .

Introduction

The size and shape of the maxillary and mandibular arches have considerable implications in orthodontic diagnosis and treatment planning, affecting the space available, dental esthetics, and stability of the dentition [(1).] Each dental arch describes a graceful curve and the teeth in these arches are so arranged as to be in harmony with their fellows in the same arch as well as with those in the opposite [(2 , 3)].

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This harmony in size and relation of the dental arches are important in maintaining normal occlusion of teeth besides the influence of the orofacial musculature labially, buccally and lingually [(4).] The knowledge of the standards dimensions for the dental arch in human population are very useful to clinicians in different field of dentistry in orthodontics, prosthodontics, and oral surgery and they are of great interest to anthropologists instudying the dental arch growth and development in relation to different environmental, genetic and physical factors for different population [(5-7).] Investigators have studied the growth of arch widths in persons with normal

occlusion, arch widths in adults with normal occlusion, and compared these values with those of different malocclusion samples [8, 9]. Dental arch dimensions change systematically during the period of intensive growth and development and less so in adulthood [10]. Dental arch perimeter and dimensions are also of prime importance in diagnosis and treatment planning in orthodontics and also for development of any preventive plan for malocclusion. Thus, the main purpose of this study was to analyze the dental arch dimensions and perimeter measurements for class I and class II malocclusion in Kurdish sample in Sulaimani.

Recently different studies concerning this subject was conducted for example; A study by Susan and Elham shows that class II division 1 showed the narrowest maxillary arch compared with other types of malocclusion [11] , on the other hand Huth etal reveal that both class II division 1 and division 2 groups had similar mandibular intermolar width and both smaller than normal occlusion [12], another study by Ling and Wong in southern Chinese relate arch dimension to arch forms [13].

Materials and Method

The sample of the study was collected from secondary schools and students of Sulaimani University aged 14–25 years old in random sampling method representing various socioeconomic groups. The total sample that have been examined were 1003 (540 males and 463 females) in which each one was seated on an ordinary chair with the back in upright direction and his/her head being positioned so that the Frankfort horizontal plane is parallel to the floor. Two fingers method was used to know the type of skeletal relationship, under natural light with interchangeable plane mouth mirrors. Then 100 subjects :

49 male (25 class I normal occlusion, 14 class II division 1 , 10 class II division 2) and 51 female (25 class I normal occlusion, 12 class II division 1 and 14 class II division 2) have been selected according to the criteria of the sample selection who presented with class I normal occlusion (50 cases) and class II malocclusion (26 cases for class II division 1 and 24 cases for class II division 2) with complete eruption of permanent maxillary and mandibular incisors, canines, and premolars, as well as first permanent molars, and also presented with no proximal caries or fillings, no morphological anomalies, no missing teeth, proximal or occlusal abrasion, or bruxism. A pointed Digital Caliper (0.02 mm accuracy) was used for the following measurements (figure 1 and 2):

1. Inter-canine width (C-C): The linear distance from the cusp tip of one canine to the cusp tip of the other **[14,15,16]**

2. Inter-first molar width (M-M): The liner distance from the mesiobuccal cusp tip of one first permanent molar to mesiobuccal cusp tip of the other **[17,18,19]** .

3. Anterior arch length (I-CC): The vertical distance from the incisal point perpendicular to the inter-canine distance at the cusp tips **[20,21,22]** .

4. Molar-vertical distance (I-MM): The vertical distance from the incisal point perpendicular to a line joining the mesiobuccal cusp tips of the first permanent molars **[15, 18, 23]** .

5. Incisal -canine distance (I-C, Left and right): The linear distance from the incisal point to the canine cusp tip **[9, 16, 17]** .

6. Canine-molar distance (C-M, Left and right):
The linear distance from the canine cusp tip to the mesiobuccal cusp tip of the first permanent molar **[18]** .

7. Incisal-molar distance (I-M, Left and right): The linear distance from the incisal point to the mesiobuccal cusp tip of the first permanent molar **[23]** .

8. Dental arch perimeter (AP): It is the distance from the mesiobuccal cusp of the first permanent molar around the dental arch to the same point in the opposite side.
It was measured from adding four segmental measurements with each others, which included two incisal segments and two buccal segments **[24]** .

Pilot Study

The study casts of participants from the first school were used in the pilot study .Ten randomly selected study casts were measured and analyzed on two different occasions at an interval of at least 1 month. Paired t-tests were performed to compare intraobserver measurements. The two-tailed P value was greater than 0.05, thus, there were non significant differences.

Statistical Analysis

The collected data was analyzed by using statistical package for social sciences (spss version 12) program for obtaining the descriptive and inferential statistics.

Results

All the variables of the upper and lower dental arch perimeter, dimensions for the total sample (class I, class II division 1 and class II division 2) were subjected to the descriptive analysis including means, standard deviation and variance (tables 1-6) .As a comparison between class II division 1 and class II division 2 (Table 1), all the upper arch measurements were significant (evaluated by t-test at $p < 0.001$) except:
segmental arch measurement C-M and arch width (C-C , M-M) whereas in lower arch measurements (Table 2), all the measurements are not significant except: left I-C, right I-C and I-MM. Table 3 and 4 shows the comparison between the results of class II division 1 malocclusion with class I normal occlusion. The findings reveal that there were no significant differences ($p>0.05$) concerning upper and lower arch width M-M and C-C while the other upper arch measurement were highly significant, on the other hand the lower left and right I-C were highly significant. Table 5 and 6 shows that there were significant differences when a comparison of class I normal occlusion data with class II division 2 malocclusion were made regarding the upper right C-M and upper I-C other else the other measurement were no significant.

Discussion

Knowledge of arch width and length which is associated with malocclusion is helpful in determining orthodontic treatment goals and likely post-treatment sequence for the malocclusion. There is no previous study in the north of Iraq concerning this subject since various ethnic and racial groups are subjected to different environmental factors exhibiting different genetic and developmental features so they show variation in size and length of dental arches. This young group of Kurdish population was chosen for measurement to minimize the alteration of dental arch dimensions because of attrition, restoration, or caries. Efforts were made to ensure randomization and adequate sample size to ensure validity and adequate clinical significance of the prediction equations. Comparisons of data on dental arch dimensions from different studies are hampered by the fact that it is not easy to tabulate all data on different landmarks. Moreover, different authors chose different sample groups for measurement. It has also been shown that individual dental arch dimensions changes with age [(24).] Various landmarks have been described and discussed by different investigators, but universal agreement on how dental arch width should be determined has not been reached. Most studies used the dimension of the arch across the permanent canines, premolars, and first molars, at the cusp tips, central fosse, or contact points, or the greatest distance between buccal surfaces [(13).] The most popular landmarks have been selected to be used in this study to enhance the comparison with other different studies on different ethnic groups. This study uses definitions for dental widths that allow different studies to be compared. In addition to population study data on dental arch perimeters, this study provides a database by which various related studies involving arch widths can be compared. Poosti and Jalali [(25)] related tooth size and arch dimension using the definitions of lingual and buccal intercanine widths. This

can be related to our data by applying the results from the lingual areas and buccal cusps as landmarks. Isik et al [26] and Huth et al [12] compared the arch widths between Class II division I and division 2 malocclusions. They used the buccal cusps as landmarks for intercanine and intermolar widths.

These can be compared with our data, in which the buccal cusps are used as landmarks. In comparison of arch perimeter between class II division 1 and class II division 2 there were significant differences concerning upper arch, whereas all the measurements were shorter in class I when compared with class II cases especially with class II division 1 since there were significant differences, this is very important in treatment plan of class II malocclusion whether to extract teeth or not. Since any treatment beyond the normal limit of arch perimeter will not be stable, an increase in lower intercanine width and arch length achieved by orthodontic treatment always relapsed. This relapse associated with post-retention irregularities and crowding [27] . No differences were found in upper intercanine width in the two different groups of class II malocclusion as well as with class I normal occlusion; this is in agreement with a study by Uysal et al [28] and Martina etal [29] ,while disagree with Herren and Jordi [30] , also sayin and turkkahraman [9] reported a larger intercanine width in class II division 1 than class I occlusion and class II division

2. Based on previous studies on relapse, it is generally agreed that post orthodontic occlusal stability is enhanced through maintenance of the original inter-canine width. Again no significant differences found comparing upper and lower intermolar widths (M-M) in all groups , this come in accordance with Frhlich [31] , Nojima etal [32] , Kook [33] and Susan and Elham [11]. while disagree with other studies [34,35] in which the M-M width is class II division 1 is significantly smaller than class II division 2 and class I normal occlusion. Lastly comparing arch length (I-CC ,I-MM) of all groups there were no significant differences except that of upper and lower arch length in class II division 1 is significantly larger than that of class II division 2 and normal occlusion this is in accordance to the finding of Susan and Elham in Jordan population [11] , this may be attributed to proclination of anterior teeth . Whereas, comparing with class 1 only upper anterior arch length of class I normal occlusion is significantly smaller than class II division 1 as well as the lower I-MM . As a suggestion to further studies, it is of interest to relate dental arch width to the prevalence of respiratory disease. Epidemiologic surveys have shown that the prevalence of asthma in Iraq is relatively higher than in other nearby countries like Turkey, Lebanon, Jordan. Moreover, and was much higher than France, Italy, Sweden and Spain [36]. Accordingly, further study is needed to investigate the association between the prevalence of respiratory disease and arch widths in our population.

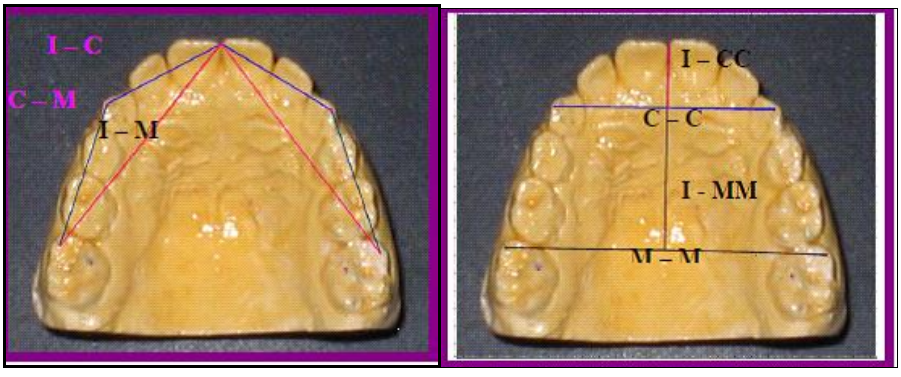

Fig.(1):- Dental arch measurements of maxillary study model

Fig. (2):- digital caliper

Table (1):- Comparison between class II division 1 and class II division 2 malocclusion (Upper arch)

Class II division 1 Upper	N	Mean	S D	Variance	Class II division 2 Upper	N	Mean	S D	Variance	P-value
Perimeter	26	84.74	4.96	24.605	Perimeter	24	80.07	5.62	31.58	0.002
Left I-M	26	39.94	2.32	5.38	Left I-M	24	36.52	3.72	13.84	0.000*
Left C-M	26	22.68	1.315	1.73	Left C-M	24	21.85	1.93	3.759	0.08
Left I-C	26	19.97	1.246	1.55	Left I-C	24	18.54	1.86	3.465	0.002**
M-M	26	47.69	10.41	108.52	M-M	24	47.89	4.28	18.37	0.76
C-C	26	34.35	2.58	6.68	C-C	24	33.15	3.008	9.052	0.136
I-MM	26	30.56	3.11	9.69	I-MM	24	25.73	3.25	10.56	0.000 *
I-CC	26	9.80	1.908	3.64	I-CC	24	6.22	2.61	6.821	0.000 *
Right I-M	26	39.29	2.93	8.63	Right I-M	24	35.79	3.71	13.83	0.000 *
Right C-M	26	22.25	1.94	3.79	Right C-M	24	21.85	1.46	2.157	0.41
Right I-C	26	19.82	1.507	2.27	Right I-C	24	17.78	1.735	3.012	0.000 *

All the measurement in mm. * p<.0001 highly significant. **P<0.05 significant.

Table (2):- Comparison between class II division 1 and class II division 2 malocclusion (Lower arch)

Class II division 1 Lower	N	Mean	S D	Variance	Class II division 2 Lower	N	Mean	S D	Variance	P-value
Perimeter	26	72.99	4.27	18.23	Perimeter	24	70.73	4.80	23.11	0.09
Left I-M	26	33.12	2.55	6.54	Left I-M	24	32.15	3.04	9.25	0.22
Left C-M	26	21.54	1.18	1.41	Left C-M	24	21.44	1.69	2.87	0.8
Left I-C	26	15.19	1.25	1.58	Left I-C	24	14.34	1.62	2.63	0.04 **
M-M	26	43.79	4.65	21.68	M-M	24	43.92	4.41	19.47	0.91
C-C	26	29.24	5.66	32.10	C-C	24	26.88	3.27	10.73	0.08
I-MM	26	25.70	2.36	5.61	I-MM	24	23.71	2.93	8.59	0.01 **
I-CC	26	5.66	1.16	1.34	I-CC	24	4.89	1.95	3.82	0.09
Right I-M	26	32.94	3.27	10.69	Right I-M	24	32.19	2.60	6.80	0.37
Right C-M	26	21.24	2.54	6.49	Right C-M	24	20.78	1.64	2.69	0.45
Right I-C	26	15.01	1.05	1.11	Right I-C	24	14.15	1.52	2.31	0.02 **

All the measurement in mm. **P<0.05 significant

Table (3):- Comparison between class I normal occlusion with class II division 1 malocclusion (upper arch)

Class I Upper	N	Mean	SD	Variance	Class II division I Upper	N	Mean	S D	Variance	P-value
Perimeter	50	79.46	4.12	17.02	Perimeter	26	84.74	4.96	24.60	0.000*
Left I-M	50	37.35	1.861	3.46	Left I-M	26	39.94	2.32	5.38	0.000*
Left C-M	50	21.15	1.334	1.78	Left C-M	26	22.68	1.31	1.73	0.000*
Left I-C	50	18.79	1.035	1.07	Left I-C	26	19.97	1.24	1.55	0.000*
M-M	50	52.12	2.471	6.11	M-M	26	47.69	10.41	108.52	0.15
C-C	50	33.94	1.612	2.61	C-C	26	34.35	2.58	6.68	0.39
I-MM	50	26.00	3.944	15.55	I-MM	26	30.56	3.11	9.69	0.000*
I-CC	50	7.97	1.005	1.01	I-CC	26	9.80	1.90	3.64	0.04**
Right I-M	50	37.10	2.148	4.61	Right I-M	26	39.29	2.93	8.63	0.000*
Right C-M	50	20.87	1.271	1.61	Right C-M	26	22.25	1.94	3.79	0.000*
Right I-C	50	18.66	1.164	1.35	Right I-C	26	19.82	1.50	2.27	0.000*

All the measurement in mm. * p<0.001 highly significant. * *P<0.05 significant

Table (4):- Comparison between class I normal occlusion with class II division1 malocclusion (lower arch)

Class I Lower	N	Mean	SD	Variance	Class II division 1 Lower	N	Mean	S D	Variance	P-value
Perimeter	50	70.10	5.15	26.52	Perimeter	26	72.99	4.27	18.23	0.016**
Left I-M	50	32.24	2.68	7.19	Left I-M	26	33.12	2.55	6.54	0.171
Left C-M	50	21.05	1.67	2.79	Left C-M	26	21.54	1.18	1.41	0.187
Left I-C	50	14.02	1.185	1.40	Left I-C	26	15.19	1.25	1.58	0.000*
M-M	50	44.67	2.31	5.36	M-M	26	43.79	4.65	21.68	0.348
C-C	50	25.98	1.82	3.31	C-C	26	29.24	5.66	32.10	0.102
I-MM	50	23.41	1.931	3.73	I-MM	26	25.70	2.36	5.61	0.000*
I-CC	50	5.16	0.98	0.97	I-CC	26	5.66	1.16	1.34	0.05**
Right I-M	50	32.64	2.27	5.18	Right I-M	26	32.94	3.27	10.69	0.641
Right C-M	50	20.96	1.682	2.83	Right C-M	26	21.24	2.54	6.49	0.262
Right I-C	50	13.95	1.106	1.22	Right I-C	26	15.01	1.05	1.114	0.000*

All the measurement in mm. * p<0.001 highly significant. **P<0.05 significant

Table (5):- Comparison between class I normal occlusion with class II division 2 malocclusion (upper arch)

Class I Upper	N	Mean	SD	Variance	Class II division 2 Upper	N	Mean	S D	Variance	P-value
Perimeter	50	79.46	4.12	17.02	Perimeter	24	80.07	5.62	31.58	0.59
Left I-M	50	37.35	1.861	3.46	Left I-M	24	36.52	3.72	13.84	0.318
Left C-M	50	21.15	1.334	1.78	Left C-M	24	21.85	1.93	3.759	0.07
Left I-C	50	18.79	1.035	1.07	Left I-C	24	18.54	1.86	3.46	0.439
M-M	50	52.12	2.471	6.11	M-M	24	47.89	4.28	18.37	0.000*
C-C	50	33.94	1.612	2.61	C-C	24	33.15	3.008	9.05	0.28
I-MM	50	26.00	3.944	15.55	I-MM	24	25.73	3.25	10.56	0.771
I-CC	50	7.97	1.005	1.01	I-CC	24	6.22	2.61	6.821	0.081
Right I-M	50	37.10	2.148	4.61	Right I-M	24	35.79	3.71	13.83	0.059
Right C-M	50	20.87	1.271	1.61	Right C-M	24	21.85	1.46	2.15	0.004**
Right I-C	50	18.66	1.164	1.35	Right I-C	24	17.78	1.735	3.01	0.012**

All the measurement in mm. * p<0.001 highly significant. **P<0.05 significant

Table (6):- Comparison between class I normal occlusion with class II division 2 malocclusion (lower arch)

Class I Lower	N	Mean	SD	Variance	Class II division 2 Lower	N	Mean	S D	Variance	P-value
Perimeter	50	70.10	5.15	26.52	Perimeter	24	70.73	4.80	23.11	0.61
Left I-M	50	32.24	2.68	7.19	Left I-M	24	32.15	3.04	9.25	0.897
Left C-M	50	21.05	1.67	2.79	Left C-M	24	21.44	1.69	2.87	0.352
Left I-C	50	14.02	1.185	1.40	Left I-C	24	14.34	1.62	2.63	0.338
M-M	50	44.67	2.31	5.36	M-M	24	43.92	4.41	19.47	0.383
C-C	50	25.98	1.82	3.31	C-C	24	26.88	3.27	10.73	0.271
I-MM	50	23.41	1.931	3.73	I-MM	24	23.71	2.93	8.59	0.61
I-CC	50	5.16	0.98	0.97	I-CC	24	4.89	1.95	3.82	0.431
Right I-M	50	32.64	2.27	5.18	Right I-M	24	32.19	2.60	6.80	0.45
Right C-M	50	20.96	1.682	2.83	Right C-M	24	20.78	1.64	2.69	0.66
Right I-C	50	13.95	1.106	1.22	Right I-C	24	14.15	1.52	2.31	0.52

All the measurement in mm

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