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Evaluation of Maxillary and Mandibular Arch Forms and Dimensions in Saudi Adults with Normal Occlusion in Makkah Province

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ABSTRACT

Context: The dental arch is one of the most important references for orthodontic planning and treatment. The principal goal of orthodontic treatment is to maintain the stability and aesthetics of the arch. Thus, it is crucial to identify and preserve the patient's arch form during orthodontic therapy otherwise the probability of relapse will increase.

Aims: To determine the average dental arch form and size for adult's Saudi population in Makkah region.

Methods and Material: This is a cross-sectional study done in Makkah city. Dental casts of 126 Orthodontically untreated individuals with normal occlusion were selected from multiple centers. For each model, the intermolar width, intercanine width, molar depth and canine depth measured using a digital caliper. Each dental arch study models were classified into tapered, ovoid, or square form. The data were analyzed using SPSS version 23.

Results: The most common form was ovoid (46.7%) followed by square (29.3%) and tapered (24.0%). There was no statistically significant difference between male and female regarding the intercanine width &depth as well as intermolar depth. Male had larger arch size than female the difference is statistically significant at intermolar distance.

Conclusions: The most frequently seen arch form in Saudi population at Makkah province was the ovoid arch form followed by the square arch form, the least frequent type shown was tapered. Male showed larger arch size than female, that was a statistically significant at the intermolar distance among the selected population. No significant difference regarding the arch form was noticed between gender.

Key words: Dental arch, Digital caliper, Dental casts, Saudi population, Arch form, Arch size

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INTRODUCTION

The dental arch is an essential element in orthodontic planning and treatment; therefore, the correct identification of dental arch form and size are of great importance to orthodontist and considered necessary to achieve a stable, functional and aesthetic result of orthodontic treatment; otherwise, the probability of relapse will increase [1-3].

Many years ago, great attention was given to the arch form, the Bonwell-Hawley pattern identified by Chuck et al. was one of the traditional ideal arch forms that was used to construct archwires [4].

Throughout the literature, different methods were used to determine arch form and dimension, some of these methods are simple such as measurement of arch dimension using caliper and subjective determination of arch form [5,6]. Nowadays, with huge development in technology and computer programs much software were used for digitization and accurate 3D construction of dental casts to achieve precise measurement of arch dimensions and accurate determination of arch form [7,8].

Many studies were done to determine the arch form and size. Lavelle et al. measured the dental arches in four major ethnic groups: Caucasoid, Mongoloid, Negroid, and Australoid. They concluded that there were some basic differences in dental arch size and shape between the different populations [9]. Cassidy et al. believed that the arch size and form influenced by the environmental factors more than the genetic factors [10]. Omar et al. conducted a study to determine arch form and dimension among Saudi population. The sample was 149 dental models included class I, II and III Angle's dental classification. Digital caliper was used for measurement. The result relived that the most prevalent arch form was narrow tapered, followed by narrow ovoid. Females had smaller dental arch measurement than males [11].

The aim of this study is to determine the average dental arch form and size among adult's Saudi population.

MATERIALS AND METHODS

126 adults (18-30 years old) selected through convenient sampling method from several centers across Makkah province in the western region of Saudi Arabia between Nov 2017 and Oct 2018. This study was done in full accordance with the ethical principles.

The inclusion criteria were: Orthodontically untreated individuals, Class I canine and molar relationship, Well-aligned teeth or teeth with minimal crowding, Symmetric arch, Normal vertical growth pattern; determined by clinical examination of the profile, normal overjet one to two mm and overbite two to three mm. Those who have dental Class II, III canine and molar relationship, Missing teeth, supernumerary teeth or anterior proximal restorations, Posterior cross-bite and crowding or rotated teeth excluded from the study.

First, the consent form was signed by the participant; the serial number used as coding for each one to protect patient confidentiality. Each participant was asked to set in upright position, looking forward on the dental chair and examined clinically to ensure that each participant fulfils all the inclusion criteria. Upper and lower alginate impression using properly fit dentulous metallic trays were taken for each. The impressions were transferred to the laboratory for pouring with dental stone to obtain dental arch models within maximum half an hour; to avoid dimensional changes of the material. Each study model was signed by the coding number and either F or M letter (F=female, M=male). The arch form was determined for each subject depending on the mandibular arch. 3M unitek arch forms template (Figure 1) was used as a guide to determine the arch form for each subject [12].

A digital caliper (Neiko)* used to measure the following parameters: i) Inter-molar distance: the distance measured from facial axis point of the first molar to the contralateral. (Figure 2A) ii) Inter-canine distance: the distance measured from facial axis point of the canine to the contralateral. (Figure 2B) iii) Inter-molar depth: from the arch midline to the line drawn between the right and left first molars. (Figure 3A) iv) Inter-canine depth: from the arch midline to the line drawn between the right and left canines (Figure 3B).

Data were analysed using IBM SPSS version 23 (IBM Corporation, New York, USA). Descriptive statistics was done to define the variables by obtaining the frequency, mean and standard deviation as the data was normally distributed (Table 1). Chi-square test used to find if there is a statistically significant difference between arch form and sex at P value 0.05. While T-test was used to detect the relation between arch size and sex, the level of significance was set at 0.05.

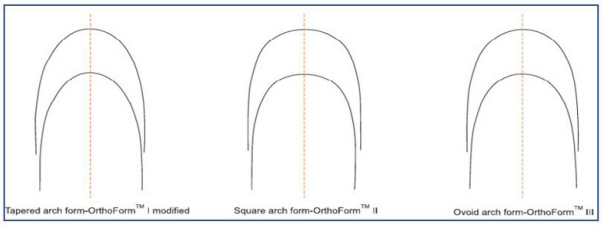

Figure 1: Arch form templates (Orthoform TM, 3M, Unitek, CA, USA) used To determine the arch form of each study model.

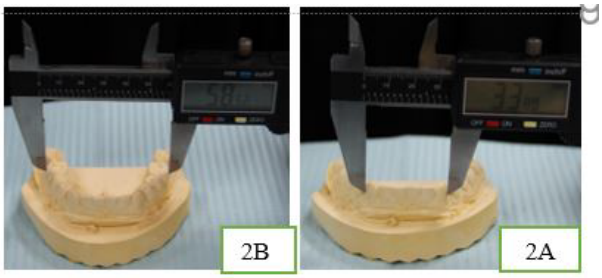

Figure 2 A: The inter-canine width was measured from the facial axis point of canines using digital caliper. B: Also, the intermolar width were measured from the facial axis points of 1st molars using digital caliper.

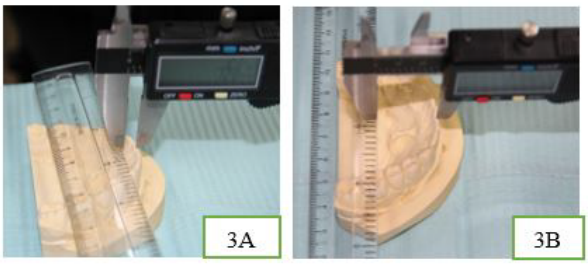

Figure 3 A-A ruler was placed on the cast representing the inter-canine width and the digital caliper measured the distance from the arch midline to the inter-canine width line. B-The same method was applied to determine the intermolar width for each cast.

Table 1: Shows the mean and standard deviation of the sample's measurements (inter-canine and inter-molar width and depth).

	N	Minimum	Maximum	Mean	Std. Deviation
Lower inter-canine width	126	22.82	39.34	29.6983	2.82638
Lower inter-canine depth	126	2.17	12.4	5.7171	1.52713
Lower inter-molar width	126	39.78	59.84	49.4461	3.57607
Lower inter-molar depth	126	18.58	46.73	24.0898	2.94651
Upper inter-canine width	126	27.2	54.12	36.8246	3.20021
Upper inter-canine depth	126	5.97	13.52	8.8606	1.53653
Upper inter-molar width	126	15.46	62.45	52.6103	6.62984
Upper inter-molar depth	126	21.66	32.91	27.6787	1.90964
Valid N (Listwise)	126				

Table 2: Shows the prevalence of each arch form.

		Arch form			Total
		Ovoid	Tapered	Square	
Gender	Female	35	19	22	76
	Male	26	9	15	50
Total		61	28	37	126

RESULTS

A total of 126 subjects were included in the study among them 60% were female and 40% were male. (Table 2) shows the frequency distribution of the three arch forms among whole sample. The most common form was ovoid (46.7%) followed by square (29.3%) and tapered (24.0%).

The mean intercanine distance in the upper arch was 36.82±3.2 mm and intermolar distance was 52.61±6.6 m; whereas in the lower arch the results were 29.70±2.8 mm, 49.4±3.6 mm respectively. There was no statistically significant difference between male and female regarding the arch form (P>0.05). Male had larger arch size than female, the difference was statistically significant at the intermolar distance (Tables 3-4).

DISCUSSION

Identification of dental arch form and size before orthodontic treatment is an important element in the selection of the archwire; to achieve a stable, functional, and esthetic results otherwise, the probability of relapse will increase. Such studies regarding the average dental arch form and size in a specific population is substantial because it helps companies to construct archwires that mostly fit the arch form and size of that population [5,8]. Very few studies were conducted in Saudi Arabia about the dental arch form and dimension.

This study was conducted to calculate the average

Table 3: Shows the results of T-test, there was no statistically significant difference between male and female regarding the size of the dental arches.

	Levenes Test for Equality of variances		T-test for equality of means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. Error difference	95% confidence interval of the difference	
								Lower	Upper
Equal variance assumed	1.331	0.251	-1.481	124	0.141	-0.75876	0.51222	-1.7726	0.25507
Equal variance not assumed			-1.53	115.727	0.129	-0.75876	0.49584	-1.74086	0.22333
Equal variance assumed	2.42	0.122	-0.547	124	0.585	-0.15262	0.27886	-0.70457	0.39933
Equal variance not assumed			-0.586	123.14	0.559	-0.15262	0.26058	-0.66841	0.36317
Equal variance assumed	1.634	0.204	-4.092	124	0	-2.51119	0.61367	-3.72583	-1.29656
Equal variance not assumed			-4.274	118.695	0	-2.51119	0.58754	-3.67461	-1.34778
Equal variance assumed	0.004	0.95	-2.61	124	0.01	-1.36869	0.52449	-2.4068	-0.33058
Equal variance not assumed			-2.404	76.957	0.019	-1.36869	0.56936	-2.50244	-0.23494
Equal variance assumed	4.035	0.047	-3.229	124	0.002	-1.81473	0.56193	-2.92694	-0.70252
Equal variance not assumed			-2.907	70.467	0.005	-1.81473	0.62419	-3.05948	-0.56997
Equal variance assumed	2.498	0.117	-1.081	124	0.282	-3.0214	0.2796	-0.85556	0.25127
Equal variance not assumed			-1.04	91.181	0.301	0.30214	0.29058	-0.87933	0.27505
Equal variance assumed	0.017	0.895	-1.696	124	0.092	-2.03238	1.19829	-4.40413	0.33936
Equal variance not assumed			-1.655	96.05	0.101	-2.03238	1.22839	-4.47071	0.40594
Equal variance assumed	0.018	0.894	-1.117	124	0.266	-0.38805	0.34739	-1.07563	0.29953
Equal variance not assumed			-1.131	109.234	0.261	-0.38805	0.3432	-1.06824	0.29214

Table 4: Shows the result of chi-square test.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.897a	2	0.639
Likehood ratio	0.913	2	0.634
Linear by linear association	0.097	1	0.756
N of valid cases	126		

dental arch form and size for adult population in the western region of Saudi Arabia. The sample of our study was selected from multiple private and governmental centers in Makkah city to be representative for patients seeking dental treatment in this city.

The arch form has many classifications, in this study we used the first and most common classification which was developed by Chuck et al. who classified the arch form into three categories tapered, ovoid, and square arch forms [4]. Eventually many clinicians and investigators used this classification over the years as well as the manufacturers construct archwires based on it [5]. Different methods were used to describe dental arch form including simple subjective classification of arch form, objective analysis of arch width measurement and the application of polynomial to describe arch form [13]. Angle stated that the difference in arch forms can be attributed to many factors including race, type, and temperament. Many studies were done to describe the dental arch form across different populations. The most common arch form in Turkey [3], Iran [5] and Malaysia [12] was the tapered arch form. While the Vietnamese population had the square arch form as the most distributed arch form followed by ovoid and lastly tapered arch form, unlike the Korean [14] population who showed evenly distributed arch forms.

In our study, we found that the most common arch form among Makkah population is the ovoid arch form followed by square and lastly tapered arch form which is similar to the results found by Paranhos et al. on Caucasian individuals. Compared to the study done by Omar et al. among Saudi population in Jeddah city, the most prevalent arch form was the narrow-tapered form, followed by the narrow ovoid form. The results differences can be attributed to the different sampling, where in our study we included patients with normal occlusion seeking regular dental treatment while study conducted in Jeddah in 2017 included patients with different type of malocclusion seeking orthodontic treatment.

Previous studies show that the dental arch width changes rapidly with age. For that reason, the selected age group in our study was 18-30 years old, since the arch size reaches the maximum growth with minimal changes at the adolescence period [15].

Prasad et al. found that male arch widths were significantly larger than those of females ($P<0.05$) in untreated adult South Indian population, they compared their results with studies done on other population and concluded that the dental arch width varies according to many factors including gender and race [16]. Raberin et al. found that the size was related to the sex, which was smaller in female as compared to male, whereas the arch form was not related to the sex [17]. Later many studies conform Raberin et al. finding as the results of these studies showed that male arch widths were significantly larger than females' arch widths [16-21]. In our study the arch size of male showed larger dimension than female and the significance was noticed at intermolar distance. The mean intercanine distance in the upper arch was 36.82 ± 3.2 mm and intermolar distance was 52.61 ± 6.6 m, whereas in the lower arch the results were 29.70 ± 2.8 mm, 49.4 ± 3.6 mm respectively. Compared to study conducted by Omar et al. males generally had significantly larger dental arch measurements than females. The mean intercanine distances in the upper and lower arches were nearly the same. The intermolar distance of upper and lower arches in our study were larger by 10.36 mm and 16.89 mm, respectively.

CONCLUSION

The most frequently seen arch form in Saudi population at Makkah province was the ovoid arch form followed by the square arch form, the least frequent type shown was tapered. Male showed larger arch size than female, that was a

statistically significant at the intermolar distance among the selected population. No significant difference regarding the arch form was noticed between gender.

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