Analysis of Correlation between Mesiodistal width of the Maxillary and Mandibular Anterior and Posterior Teeth for Both Genders in Iraqi Population

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Abstract: *Choosing suitable artificial teeth for partially edentulous patients and arranging these teeth in a way to look natural is difficult. An important factor in dentures construction is the mesiodistal width of anterior teeth, because a denture would not appearance natural if artificial teeth are of incorrect size. While for a successful orthodontic treatment, mesiodeistal width of teeth is important for space analysis and for establishing proper occlusion. The aim of this study is to determine the correlation between the average mesiodistal width of anterior and posterior teeth in male and female Iraqi population. 40 Iraqi subjects with normal occlusion participated in this study. Mesiodistal measurement of all teeth was carried out on stone cast. Obtained data was analyzed using SPSS 15 computer software. Mean and standard deviation were calculated for each variable. Comparisons between male and female samples were made for each variable using t-test. The average mesiodistal width of maxillary central incisor for male and female samples was (8.84 ± 0.46 and 8.58 ± 0.45, respectively).Mesiodistal width for mandibular central incisor for male and female samples was (5.46 ± 0.41 and 5.44 ± 0.24, respectively). These results are well within normal value for other ethnic groups. The ratio between maxillary and mandibular anterior and posterior teeth was also calculated. Mesiodistal width of anterior teeth and posterior teeth can be used as a guideline forchoosing correct artificial teeth for partially edentulous patients and it is important for a good outcome in an orthodontic treatment.*

Keywords: Mesiodistal width, anterior ratio, posterior ratio, Iraqi population

1. Introduction

Missing teeth lead to unaesthetic and socially unacceptable malocclusion; this is the main reason that patients seek dental treatment. The absence of teeth can affect social life of patientsand reduce masticatory function [1].

Discrepancy of the tooth dimension should be considered in treatment planning. It should also include compensating esthetic procedures such as composite bonding, prosthetic reconstruction, stripping, and crown restoration. A lack of information about tooth size could also compromise the final results in extraction cases and leads to a clinically significant maxillo-mandibular tooth size discrepancy [2].

Tooth size is particularly important for partially edentulous patients since a number of anterior and posterior teeth may stillremain in one or both jaws. It is very important to choose the correct size of artificial teeth considering the size of the remaining teeth besides the ratio of posterior to anterior teeth. Proportionality in size between Maxillary and mandibular teeth is necessary; otherwise, occlusal relationships could not be possible [3].

Tooth size ratio represents a good diagnostic tool that can be used for scientific prediction of the outcome of any treatment and may alsolessen the need for further diagnostic setups in complex cases. The most widely studied crown dimension in the literatures is the mesiodistal diameter [4].

Tooth size is generally believed to be polygenic in nature [5].

Environmental factors, include neonatal factors, also have a key role in determining the dimensions of permanent tooth crown [6], [7]. Studies on various populations have found that different ethnic backgrounds have differences in tooth size and malocclusions [8].

Mesiodistal diameter is useful to anthropologists to draw the evolution of tooth size. Tooth size provides a perception of relation between populations and their environment[9]. A proper relationship of the mesiodistal width of the maxillary dentition to the mesiodistal width of the mandibular dentition will favor an optimal post treatment occlusion [2].

In past, tooth sizes measurement was proceed by Black in 1902 [10] and Neff in 1949 [11]. These studies were followed by the classic work of Bolton[12] who quantified the maxillary-to-mandibular tooth size relationship and provided the accepted normative data.

Nowadays, most of dentists from all ambits are concerned with the mesiodistal dimension of anterior teeth, though the implications may be different [13]. The objective of this study is to determine the correlation between the average mesiodistal width of anterior and posterior teeth for male and female Iraqi population.

2. Materials and Method

2.1 Sample

The sample included 40 casts of upper and lower jaws of

Iraqi Arab subjects aged 18-28 years with normal occlusion. The sample was 50% male and 50% female dental students of College of Dentistry, University of Baghdad.

2.2 Sample criteria

1) All the subjects were Iraqi Arab in origin.
2) All the subjects with class I normal occlusion.
3) Having complete permanent dentition regardless the third molars.
4) The age ranged between 18-28 years.
5) No attrition, no abrasion in all teeth
6) Healthy gingival tissue with no gingivitis or periodontitis or any gum recession.
7) Mild (1-2mm) or no crowding or spacing in all dental classes.
8) No rotation and normal canine inclination.
9) Intact tooth structure, no fracture, caries, trauma or heavy restoration.
10) No history of significant medical disease or trauma.
11) No previous orthodontic, prosthetic or surgical treatment was recorded.

2.3 Dental cast production and measurement

Impressions were taken for every subject with irreversible hydrocolloid impression material (Alginmax, Major, Italy), then poured with a prepared amount of dental stone (Elite Model thixotropic, Zhermack,Italy). After setting of the dental stone, a base was made for every cast with Plaster of Paris (Al-Ahliyah, Iraq) using rubber base former mold. After final setting of the gypsum, the cast was removed from the mold and made ready for the measuring procedure.

Mesiodistal width was measured directly on the casts for all the teeth from the right to the left second molars of both jaws for both genders using an electronic digital caliper (Mitutoyo, Tokyo, Japan) with precision 0.01 mm(Figure 1). Proper knowledge of normal dental anatomy is essential to perform these measurements. The measurement was done in the site of largest correct anatomical contact point as the following [14], [15]:

• Maxillary arch
1) The mesial contact of the incisors is usually more incisal than that the distal contact.
2) Maxillary canines and premolars are similar to mandibular canines and premolars.
3) Maxillary molars are similar to mandibular molars.

• Mandibular arch
1) The incisors are widest just below their incisal edges.
2) The canine contact area about one-quarter down the crown mesially and nearly half the way distally.
3) Premolars usually have their normal contacts at the tip of the interdental papillae (just cervical to the junction of occlusal and middle thirds).
4) The center of the contact areas of molar teeth also drop cervically.

The measuring device was needed to be positioned occlusal to a rotated tooth (hold the beaks of the measuring device parallel to the long axis of the crown) [16], [17].

2.4 Statistical analysis

All data of the sample were subjected to computerized statistical analysis using SPSS computer program (version 15). The mean and standard deviation values were calculated for each variable. Differences between the genders were compared for each variable using Independent sample t-test and Paired t-test were used for side comparison.

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 $P \leq 0.01$

Figure 1: Mesiodistal width measurement on the cast

3. Results

(Table 1) lists the descriptive statistics for the average mesiodistal width of upper and lower posterior teeth in right and left side (URpost, ULpost, LRpost, LLpost) and anterior sextants of dental arches (Uant, Lant) and upper and lower central incisor in right and left (URCI, ULCI, LRCI, LLCI) for both genders. Also (table 1) lists the Independent sample t-test to differentiate between genders which showed a significant difference between male and female in Uant, ULCI, Lant, LRpost and LLpost. With mean values larger in male than in female except for LLCI.

Although in most cases, teeth in the left sextant were larger than the right sextant, as shown in (table 2) there was no significant difference between the mesiodistal width of upper posterior teeth in the right and left sextants in both genders ($P = 0.94$ and $P = 0.80$, respectively). Moreover, there was no significant difference between mesiodistal width of lower posterior teeth in the right and left sextant in both genders ($P = 0.05$ and $P = 0.77$, respectively). Therefore, the ratios were calculated using the values obtained for the right upper and lower sextant. Also no significant difference showed between mesiodistal width of upper and lower central incisors in the right and left in both male and female samples so in the study the right side was used.

The mean ratio of mesiodistal width of upper to lower anterior sextant was calculated for male and female samples (1.29 ± 0.04 and 1.28 ± 0.05, respectively) as shown in (table 3).

(Table 3) showed mean values for the upper central incisor mesiodistal width were calculated for male and female samples (8.84 ± 0.46 and 8.58 ± 0.45, respectively). Moreover, the mean values of mesiodistal width for lower central incisor were calculated for male and female samples (5.46 ± 0.41 and 5.44 ± 0.24, respectively). In addition, the mean ratio of mesiodistal width of upper to lower central incisor was calculated for male and female samples (1.62 ± 0.1 and 1.58 ± 0.08, respectively).

Table 1: Descriptive statistics and Independent t-test

Jaw	variables	Gender M=20 F=20	Mean	SD	Mean Difference	t-test	p value
				Descriptive statistics		Independent t-test, df=38	
Upper	Uant	Male	47.80	1.82	1.84	2.90	0.01 S
		Female	45.96	2.18			
	URCI	Male	8.84	0.46	0.26	1.82	0.08 NS
		Female	8.58	0.45			
	ULCI	Male	8.86	0.48	0.33	2.31	0.03 S
		Female	8.53	0.42			
	URpost	Male	23.95	0.94	0.36	1.11	0.27 NS
		Female	23.59	1.09			
	ULpost	Male	23.96	0.93	0.42	1.44	0.16 NS
		Female	23.55	0.89			
Lower	Lant	Male	37.04	2.04	1.15	2.13	0.04 S
		Female	35.89	1.31			
	LRCI	Male	5.46	0.41	0.02	0.21	0.83 NS
		Female	5.44	0.24			
	LLCI	Male	5.45	0.43	-0.04	-0.33	0.74 NS
		Female	5.49	0.21			
	LRpost	Male	25.63	1.19	1.11	2.95	0.01 S
		Female	24.51	1.20			
	LLpost	Male	25.93	1.07	1.36	3.84	0.00 HS
		Female	24.57	1.17			

NS: Non-Significant, P > 0.05 , S: Significant, 0.05 ≥ P > 0.01, HS: Highly Significant P ≤ 0.01

The mean ratio of mesiodistal width for the upper anterior sextant to the upper central incisor was calculated for male and female samples (5.41 ± 0.19 and 5.36 ± 0.18, respectively). The mean ratio of mesiodistal width of upper posterior to the upper central incisor was calculated for male and female samples (2.18 ± 0.15 and 2.76 ± 0.16, respectively). The mean ratio of mesiodistal width for the lower anterior sextant to the upper central incisor was calculated for female and male samples (4.19 ± 0.19 and 4.19 ± 0.14, respectively). The mean ratio of mesiodistal width of lower posterior to the upper central incisor was calculated for female and male samples (2.9 ± 0.16 and 2.86 ± 0.11, respectively).

4. Discussion

It is the dentist responsibility to evaluate and assess the selection of artificial teeth in accordance with the esthetic and functional needs of individual patient [18].

Choosing incorrect artificial teeth size is one of the most common errors in prosthodontic treatment of patients with missing teeth, which leads to undesired esthetic appearance.

Mesiodistal width of teeth is more important than the length of the crown when choosing teeth size [19].

Table 2: Differences between right and left teeth

Differences between right and left posterior teeth		P value	
Male	URpost – Ulpost	0.94	
	LRpost – Llpost	0.05	
Female	URpost – Ulpost	0.8	
	LRpost – Llpost	0.77	
Differences between right and left CI teeth		P value	no sig. difference
Male	URCI-ULCI	0.80	
	LRCI-LLCI	0.88	
Female	URCI-ULCI	0.33	
	LRCI-LLCI	0.24	

Table 3: Mean mesiodistal width ratio

	Variable	Male (no. =20)		Female (no. =20)	
		Mean	Std. Deviation	Mean	Std. Deviation
		Descriptive Statistics			
	UCI	8.84	0.46	8.58	0.45
	LCI	5.46	0.41	5.44	0.24
	UANT	47.8	1.82	45.96	2.18
	LANT	37.04	2.04	35.89	1.31
	URpost	23.95	0.94	23.59	1.09
	LRpost	25.63	1.19	24.51	1.2
ratio	UANT/URPOST	2.00	0.09	1.95	0.08
	LANT/LRPOST	1.45	0.07	1.47	0.07
	UANT/LANT	1.29	0.04	1.28	0.05
	UCI/LCI	1.62	0.1	1.58	0.08
	UANT/UCI	5.41	0.19	5.36	0.18
	URpost/UCI	2.18	0.15	2.76	0.16
	LANT/UCI	4.19	0.19	4.19	0.14
	LRpost/UCI	2.9	0.16	2.86	0.11

It is a well-known fact that space analysis, which is considered as a keystone in perfect treatment planning of each orthodontic case, depends mostly on measuring the space available and the space required which is based on measuring mesiodistal width of teeth [20].

It was emphasized the significance of tooth width measurement and its application in diagnosis and treatment planning in many studies. Some of the most common types of malocclusion are primarily due to discrepancy between the size of the dental arches and the size of teeth. This discrepancy can appear clinically as crowding of the teeth, if a combination of large teeth and a short dental arch length exists. In contrast, it may result in spacing and diastema between the teeth if the arch length is more and teeth are small. In either case, it is the problem of space analysis, which is of great interest to the prosthodontist and orthodontist, as well as the general dentist. The tooth size ratio also plays an important roleinesthetics, facial harmony and in balanced occlusion [21]-[23].

Most studies done in this field do not include Iraq, no measurements of tooth sizes have been made on Iraqi population. So, this study was planned to measure the mesiodistal width of natural teeth in Iraqi adults aged 18-28 years. It also investigates variations in the size of left and right maxillary and mandibular anterior and posterior teeth

and differences between male and female.

This age range is considered as the best age for assessment and measurement of teeth size because under 18 years, the skeleto-dental growth may affect the measurement. Above 30 years on the other hand, effect of aging like attrition may act as a factor that affect tooth size discrepancy and measurement [24].

Tooth selection is mainlycenteredon the premise that teeth are equalin size on each side of the dental arch, which is not the case in the natural dentition [25]. The result of this study showed not significant difference in tooth size between left and right sides. In the case of selecting teeth size, the common thing to do is to accept sets of comparative sizes decided on by the manufacturer [26].

The average mesiodistal width of maxillary central incisor according to textbooks is 8.5 mm [27] and 8.6 mm [28] and past researches showed it varied from 8.36 to 9.33 mm [23], [29]-[32] in different ethnic groups. In this study, the mean mesiodistal width of maxillary central incisor was 8.84 mm for male and 8.58 mm for female which is well within the average of different ethnic group.

The mesiodistal width of mandibular central incisor according to standard textbooks is 5.0 and 5.3 mm [27], [28] whereas studies have stated that the avenger width of mandibular central incisor was 5.22 and 5.7 mm for different racial groups [29], [30], [33]. The present study showed that this width is 5.46 mm for male and 5.44 mm for female, which is well within the average of other studies.

The difference between right and left central incisor (both maxillary and mandibular and in both male and female subjects) are less than 1 mm (table 2) which is considered normal in appearance as stated by AlWazzan [34].

It is imperative to emphasize the ratio of maxillary teeth to the mandibular teeth especially in cases of missing teeth in one arch are opposed by natural teeth. Orthodontic treatment for cosmetic purpose makes this relationship a matter of prime concern when delivering a successful treatment [13].

In our study, the mean ratio of maxillary anterior teeth mandibular anterior teeth for male subjects is 1.29, whereas in female subjects it is 1.28. This ratio is very close to that mentioned in other studies for Iranian and Indian populations[35], [36]. McArthur [31] suggested a ratio of 1.30 for denture teeth that to be set with about 1 mm of horizontal overjet and 1 mm of vertical overlap.

There is no mention in textbook about difference between male and female in teeth size. Males have greater mesiodistal width than females; this depends largely on genetic predisposition. This study found that Iraqi male subjects have larger teeth than Iraqi female subjects. The difference in tooth size between sexes is believed to be chromosomally determined and Y influenced size difference wheresteroid mediation is not involved [33].

Limitations of this study:
1) Measurement of mesiodistal width was done directly on stone models where human error can occur and expansion of the model is possible.
2) The size of the sample used in this is study was relatively small and subjects were only selected with normal occlusion; further studies are suggested for people with other occlusal relationships and malocclusions.

Conclusion

Within the limitations of this study, measuring mesiodistal width of teeth is useful to be a guide in selecting the correct size of artificial teeth for partially edentulous patients and it has an essential role in space analysis for providing a successful orthodontic treatment.

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