Mesiodistal Crown Dimensions of Permanent Dentition in Sudanese Population

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Abstract

Introduction: Difference in tooth size is influenced by genetic and environmental factors. Biometric norms however, may be specific to an ethnic group and cannot be always applied to other ethnic types. *Objectives:* To find nominative data on the mesiodistal crown dimensions of permanent teeth in Sudanese population and to compare the findings with those reported in other populations. *Methods:* This cross-sectional study was done in Faculties of AL-Neelain university, Khartoum, Sudan. A total of 104 Sudanese subjects presented with normal occlusion (52 males and 52 females), aged 16–26 years (mean 20.1 years) were included in the study. The mesiodistal width of the teeth were measured with a digital Vernier caliper. *Results:* Males had significantly larger teeth than females ($p < 0.05$) in all teeth except upper lateral incisors and upper left second premolar. The maxillary second premolar in female showed the greatest variability [coefficient of variation (CV) 10%] and the maxillary first premolar in female the least (CV 5.375%) in mesiodistal crown dimension. Maxillary canines displayed greater sexual dimorphism (0.4535 mm) in mesiodistal crown size than in any other tooth classes. Comparisons of the mesiodistal crown dimensions between population groups showed that Sudanese have tooth sizes close to those of North Indians and Jordanians but smaller than those of Nigerian. *Conclusions:* From this study, a standard for the mesiodistal crown dimensions of permanent dentition of Sudanese males and females are obtained.

Keywords: Crown dimension; Mesiodistal width; Permanent dentition.

Introduction

Mesiodistal tooth size measurement is an important step in the diagnostic process, especially in management of complex cases.[1]

Teeth size variations can be caused by multiple factors such as heredity,[2] gender[3] and environment.[4] Many reports in literature emphasize the racial differences.[5–8] For example, Fernandes et al.[9] conducted a study to compare the mesiodistal width of the teeth in Caucasian, African and Japanese individuals with Brazilian ancestry not orthodontically treated and with normal occlusion, he found that there was a tendency for negroids to present greater mesiodistal distance, followed by Japanese and Caucasians, respectively. Keene[10] reported racial differences in tooth sizes among the American Negroes and Caucasian, tooth size is consistently larger in the Negro sample. Bishara[11] compared the mesiodistal and bucco-lingual crown dimensions of the permanent teeth in three populations from Egypt, Mexico and the United States. The results from this study indicated

statistical significant differences in the mesiodistal dimension among the three populations.

The genetic basis for this variation is best explained by a polygenic model of inheritance by Lundstrom (1964). He compared 97 pairs of like-sex monozygotic and dizygotic twins and found a stronger correlation in mesiodistal tooth size between monozygotic twins.

He concluded that tooth size with in a given population is determined to a large extent by genetic factors.[6] Before we can know if a tooth is under or oversize it is necessary to have data on tooth sizes for the relevant ethnic, gender and malocclusion group.[2,12,13] Without information about the size of individual teeth and groups of teeth, it is difficult for a clinician to make a diagnosis and plan treatment and to carry out a plan of therapy.[5]

Very little information is available about mesiodistal crown dimensions of permanent dentition in Sudanese population.

In order to improve the quality of dental care available, there is a great need for data on the mesiodistal crown dimensions of the individual permanent teeth of Sudanese population. The main purpose of the study was to assess whether the diagnostic criteria derived from the mesiodistal crown dimensions of permanent dentition of other populations can be used in Sudanese population.

Materials and Methods

This cross-sectional study was done in Al-Neelain University, Khartoum, Sudan. One hundred and four students (52 male subjects, 52 female subjects, ages 16–26 years) were randomly chosen from Faculties at Al Neelain University, according to the following inclusion criteria:

- The subject had to be Sudanese.

- The subject had an Angle Class I canine and molar relationship.

- All teeth were present and fully erupted from first molar to first molar.

- No dental anomalies

- No evidence of tooth wear lesions, e.g. attrition

- No interproximal caries or restorations

- No previous or ongoing orthodontic treatment

- No prosthetic tooth replacements or crowns.

Ethical Approval was obtained from Central Institutional Review Board in Al-Neelain University. Written consent was also obtained from the students participated in this study. Alginate impressions of both upper and lower arches were made on each subject with Impression Material Alginate (ALGINMAX P.S.P Dental Co. Ltd, UK) using appropriately sized, sterile, impression trays. To ensure dimensional stability, the impressions were covered with damp gauze, during the short interval between when the impressions were taken, and the pouring of the models. The models were poured immediately after taking the impressions using dental stone, taking care to avoid air bubbles, defective borders or breakages. They were then labelled appropriately for easy identification.

A digital sharpened points Vernier calipers that provided a precision reading to the nearest 0.01 mm was used to measure the teeth. The sharp tips of the calipers facilitated accuracy of measurement. The MD crown width was measured as the greatest distance between the contact points of the proximal surfaces of the dental crown, with the calipers parallel to the occlusal and buccal surfaces[10]
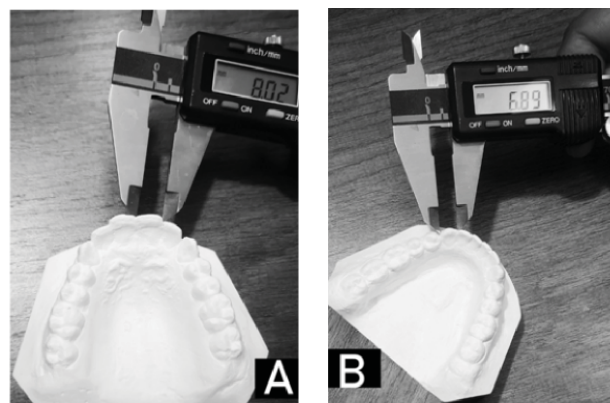

Fig. 1(A and B): Measurement of mesiodistal tooth dimension.

(Fig. 1.). One investigators measured each arch from the right first molar to left first molar.

Assessment of measurement errors: Double measurements were performed in 18 orthodontic study casts randomly selected at 15 days' interval from the collected sample by the same operator. This was to test the reliability of measurement. Data was entered into the Statistical Package for Social Sciences Software SPSS® for Windows version 20, SPSS Inc., Chicago, Ill., USA on a personal computer. The descriptive statistics used were frequency mean and standard deviation. Comparisons between the groups were made by unpaired *t*-test as the data presented in this were continuous in nature. Level of significance was set at 0.05 and *p*-value < 0.05 was considered significant.

Results

Measurement Errors

The comparison was drawn between first and second measurements using Student's *t*-test. No significant differences were found between the two sets of measurements ($p > 0.05$).

Mesiodistal Crown Dimensions in Sudanese Population

Of the 104 students, 52 (50%) were female and 52 (50%) were male. Age of the male students ranged from 16 to 26 years (Mean 20.5 ± SD 2.2) and in female ranged from 18 to 24 years (Mean 19.6 ± SD 1.4) (Table 1).

Table 1: Demographic characteristic of students

Gender	Mean	Std. Deviation	Range	
Male	20.5	2.2	16	26
Female	19.6	1.4	18	24
Total	20.1	1.9	16	26

The data on mesiodistal crown dimensions of the permanent maxillary and mandibular teeth of the Sudanese population studied are summarized in Tables 2 and 3 respectively.

The differences between the mean mesiodistal dimension of any individual tooth on the right and left-hand sides ranged from 0.004 to 0.131 mm.

The mean mesiodistal crown dimension of the maxillary canines was greater than that of the mandibular canines, with an average of 1.1 mm in males and 0.9 mm in females. In both sexes the upper first premolars were wider than the upper second premolars, averaging 0.5 mm in male and 0.4 mm in female. Also, the lower first premolars were wider than the second premolars 0.1 mm both in male and female. In the mandible, the lateral incisors were wider than the central incisors, by an average dimension of 0.5 mm both in males and females. In the maxillary arch, the mean mesiodistal crown dimension of the central incisors was larger than that of the lateral incisors averaging 1.8 mm in male and 1.7 mm in female.

In both males and females, the SD and coefficient of variation (CV = 100 × SD/Mean) of tooth size measurement showed that variability differed between individual teeth, with the maxillary second premolar in female showing the greatest variability (10%), the lower second premolar in male the next greatest (9.45%), and the maxillary first premolar in female the least (5.375%).

Comparison of mesiodistal crown dimension of maxillary and mandibular permanent dentition between males and females were summarized in Tables 4 and 5 respectively. The mean mesiodistal crown dimensions of the permanent dentition of males were larger than that of females for each

Table 2: Mesiodistal crown dimensions of maxillary permanent dentition

No. Tooth	Gender	Side	N	Mean	SD	SEM	Range		CV (%)	Overall Mean
CI	Male	R	52	8.692	0.492	0.068	7.70	10.10	5.66	8.689
		L	52	8.687	0.525	0.073	7.40	10.10	6.04	
	Female	R	52	8.494	0.491	0.068	7.20	9.40	5.78	8.444
		L	52	8.394	0.648	0.090	6.20	9.40	7.72	

(Contd.)

No. Tooth	Gender	Side	N	Mean	SD	SEM	Range		CV (%)	Overall Mean
LI	Male	R	52	6.885	0.531	0.074	6.00	8.60	7.71	6.854
		L	52	6.823	0.481	0.067	6.00	8.30	7.05	
	Female	R	52	6.767	0.612	0.085	5.40	8.90	9.05	6.705
		L	52	6.642	0.499	0.069	5.60	7.70	7.51	
C	Male	R	52	7.900	0.482	0.067	6.50	9.00	6.10	7.898
		L	52	7.896	0.437	0.061	6.50	8.80	5.53	
	Female	R	52	7.477	0.450	0.062	6.40	8.60	6.01	7.444
		L	52	7.412	0.465	0.064	6.40	8.60	6.27	
PM1	Male	R	52	7.156	0.480	0.067	6.10	8.30	6.71	7.119
		L	52	7.083	0.475	0.066	6.20	8.20	6.70	
	Female	R	52	6.917	0.359	0.050	6.00	7.60	5.19	6.897
		L	52	6.877	0.382	0.053	6.10	7.80	5.56	
PM2	Male	R	52	6.638	0.372	0.052	5.90	7.50	5.60	6.609
		L	52	6.579	0.387	0.054	5.70	7.60	5.88	
	Female	R	52	6.448	0.419	0.058	5.60	7.40	6.50	6.513
		L	52	6.579	0.888	0.123	5.50	10.20	13.50	

CI = Central Incisor, LI = Lateral Incisor, C = Canine, PM1 = First Premolar, PM2 = Second Premolar. SD = Standard deviation, SEM = Standard error of mean, CV = Coefficient of variance, Overall mean = Combined mean of right and left hand sides.

Table 3: Mesiodistal crown dimensions of mandible permanent dentition

No. Tooth	Gender	Side	N	Mean	SD	SEM	Range		CV (%)	Overall Mean
CI	Male	R	52	5.527	0.391	0.054	4.70	6.50	10.10	5.518
		L	52	5.510	0.405	0.056	4.60	6.50	6.50	
	Female	R	52	5.319	0.348	0.048	4.40	6.40	9.40	5.316
		L	52	5.313	0.335	0.046	4.40	6.10	6.40	
LI	Male	R	52	5.969	0.429	0.060	5.00	7.10	7.10	6.000
		L	52	6.031	0.406	0.056	5.20	6.80	6.80	
	Female	R	52	5.806	0.406	0.056	5.00	6.80	6.80	5.830
		L	52	5.854	0.425	0.059	5.00	6.80	6.80	
C	Male	R	52	6.848	0.406	0.056	6.10	7.60	7.60	6.863
		L	52	6.879	0.404	0.056	6.20	7.60	7.60	
	Female	R	52	6.494	0.400	0.055	5.70	7.60	7.60	6.538
		L	52	6.581	0.409	0.057	5.40	7.60	7.60	
PM1	Male	R	52	7.125	0.498	0.069	6.20	8.40	8.40	7.128
		L	52	7.131	0.461	0.064	6.10	8.40	8.40	
	Female	R	52	6.806	0.434	0.060	6.10	7.80	7.80	6.814
		L	52	6.823	0.424	0.059	6.10	7.80	7.80	
PM2	Male	R	52	6.985	0.437	0.061	6.20	8.00	8.00	7.021
		L	52	7.058	0.697	0.097	6.10	10.90	10.90	
	Female	R	52	6.662	0.425	0.059	5.80	7.60	7.60	6.715
		L	52	6.769	0.745	0.103	5.70	11.10	11.10	

CI = Central Incisor, LI = Lateral Incisor, C = Canine, PM1= First Premolar, PM2 = Second Premolar. SD = Standard deviation, SEM = Standard error of mean, CV = Coefficient of variance, Overall mean = Combined mean of right and left hand sides.

type of tooth in the maxillary and mandibular arches. Analysis showed that all teeth in males, with the exception of the upper lateral incisors and upper left second premolar have significantly greater mesiodistal crown dimensions than those in females (from $p < 0.049$ for the mandibular right lateral incisors to $p < 0.001$ for the upper right and left canine, lower right and left canine, left lower

first premolar and right lower second premolars). The largest sexual dimorphism in mesiodistal crown dimension was exhibited by the maxillary canines (0.4535mm) with the mandibular canine next in order of difference (0.326 mm).

Discussion

The age range of the subjects in the present study was between 16 and 26 years. Early permanent dentitions offer the best example for tooth size

Table 4: Comparison of mesiodistal crown dimension of maxillary permanent dentition between males and females

Gender		N	Mean	Std. Deviation	*p*-value
Right CI	Male	52	8.692	0.492	0.042
	Female	52	8.494	0.491	
Left CI	Male	52	8.687	0.525	0.013
	Female	52	8.394	0.648	
Right LI	Male	52	6.885	0.531	0.299
	Female	52	6.767	0.612	
Left LI	Male	52	6.823	0.481	0.063
	Female	52	6.642	0.499	
Right C	Male	52	7.900	0.482	<0.001
	Female	52	7.477	0.450	
Left C	Male	52	7.896	0.437	<0.001
	Female	52	7.412	0.465	
Right PM1	Male	52	7.156	0.480	0.005
	Female	52	6.917	0.359	
Left PM1	Male	52	7.083	0.475	0.017
	Female	52	6.877	0.382	
Right PM2	Male	52	6.638	0.372	0.016
	Female	52	6.448	0.419	
Left PM2	Male	52	6.579	0.387	0.999
	Female	52	6.579	0.888	

*$p < 0.05$ = significant, $p > 0.05$ = not significant.

Table 5: Comparison of mesiodistal crown dimension of mandibular permanent dentition between males and females

Gender		N	Mean	Std. Deviation	*p*-value
Right CI	Male	52	5.527	0.391	0.0049
	Female	52	5.319	0.348	
Left CI	Male	52	5.510	0.405	0.008
	Female	52	5.313	0.335	
Right LI	Male	52	5.969	0.429	0.049
	Female	52	5.806	0.406	
Left LI	Male	52	6.031	0.406	0.032
	Female	52	5.854	0.425	
Right C	Male	52	6.848	0.406	<0.001
	Female	52	6.494	0.400	
Left C	Male	52	6.879	0.404	<0.001
	Female	52	6.581	0.409	
Right PM1	Male	52	7.125	0.498	0.001
	Female	52	6.806	0.434	
Left PM1	Male	52	7.131	0.461	<0.001
	Female	52	6.823	0.424	
Right PM2	Male	52	6.985	0.437	<0.001
	Female	52	6.662	0.425	
Left PM2	Male	52	7.058	0.697	0.044
	Female	52	6.769	0.745	

*$p < 0.05$ = significant, $p > 0.05$ = not significant.

measurements since early adulthood dentition has less mutilation and less attrition in most persons. Therefore, the effect of these elements on the real mesiodistal tooth width will be minimum.[14] In this study direct measurement was done in the study cast. Several studies Hampson[15] and Coleman et al.[16] investigate the accuracy of plaster casts made from alginate impressions as a representation of the actual mesiodistal tooth width, the result of these studies indicated that alginate impressions produce the most accurate if poured immediately. Consequently, it should not be expected that the clinical measurements are necessarily more accurate than those obtained from plaster models.[7]

The differences between the mean mesiodistal dimension of any individual tooth on the right- and left-hand sides were very small and ranged from 0.004 to 0.131 mm. These findings indicate that right- or left side measurements, for both sexes, could be taken to represent mesiodistal crown dimensions in this population. These findings are in agreement with those reported in other population groups.[5,12]

The mean mesiodistal crown dimensions of the permanent dentition of Sudanese males were larger than that of Sudanese females for each type of tooth in the maxillary and mandibular arches (Tables 4 and 5). These findings are in agreement with those reported in other population groups Bangladesh,[5] Kerala[8], North Indian[7], Iraqi[17], Jordanian[12] but contradicting to those of other Bangladesh study[18] who found no significant difference between males and females.

Both males and females exhibited a similar pattern of tooth size (Tables 3 and 4).

Comparisons of data relating to Sudanese population were made with those of Nigerian,[19] Jordanian,[12] Iraqi,[17] North Indian[7] (Table 6).

The mesiodistal crown dimensions of permanent teeth of Sudanese population are in close proximity to those of North Indian population and Jordanian population. The mean difference in mesiodistal crown dimensions' maxillary teeth between Sudanese population and Indian population is 0.1 mm. In case of Jordanian population mean differences are 0.2 mm.

Nigerian showed largest mesiodistal crown dimensions than Sudanese population. In case of Nigerian the mean difference is 0.6 mm.

Table 6: The mean mesiodistal diameter (left + right/2) in mm of maxillary and mandibular permanent dentition in Sudanese and other population

Tooth	Sudanese Present study		Nigerian[19]		Jordanian[12]		Iraqi[17]		North Indian[7]	
	M	F	M	F	M	F	M	F	M	F
Maxilla										
CI	8.6	8.4	9.6	9.3	8.9	8.6	9.3	8.8	8.7	8.5
LI	6.8	6.7	7.7	7.4	6.9	6.7	6.9	6.8	6.9	6.7
C	7.8	7.4	8.2	7.9	8.0	7.6	8.0	7.8	7.9	7.6
PM1	7.1	6.8	7.8	7.6	7.2	7.0	7.1	7.0	7.1	6.9
PM2	6.6	6.5	7.1	7.0	7.0	6.8	6.9	6.9	6.7	6.6
Mandible										
CI	5.5	5.3	5.9	5.8	5.6	5.5	5.5	5.6	5.3	5.2
LI	5.9	5.8	6.5	6.4	6.2	6.0	6.1	6.1	5.9	5.8
SC	6.8	6.5	7.6	7.3	7.0	6.6	7.0	6.8	6.9	6.6
PM1	7.1	6.8	7.8	7.7	7.3	7.0	7.1	7.0	7.0	6.9
PM2	7.0	6.7	7.7	7.6	7.4	7.2	7.3	7.2	7.1	6.9

Conclusion

From the findings, it could be concluded that:

1. The differences between antimeres were of small magnitude and were not clinically significant.

2. Male- female comparisons indicate the presence of sexual dimorphism although they exhibited a similar pattern of tooth size. The largest sexual dimorphism in mesiodistal crown dimension was exhibited by the maxillary canines (0.4535 mm) with the mandibular canine next in order of difference (0.326 mm).

3. A higher variability was found in the

maxillary second premolar in female showing the greatest variability (10%), as compared to other teeth. Followed by the lower second premolar in male (9.45%). These teeth should be examined carefully to exclude any major size and shape discrepancy.

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