

# A comparison of crown size dimensions of the permanent teeth in a Nigerian and a British population

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**SUMMARY** This investigation was undertaken to compare the mesio-distal and bucco-lingual crown dimensions of the permanent teeth in Nigerian and British populations. The study sample consisted of 30 pairs of study models of children from each of the two populations. The children were matched for sex. The mean age for the Nigerian and British samples was  $12.5 \pm 1.4$  years and  $12.9 \pm 1.2$  years respectively. No left-right side differences were observed ( $P > 0.05$ ). The results indicate that the mesio-distal crown diameters were consistently larger in the Nigerian sample. With the exception of mandibular central incisors and maxillary canines there were no statistically significant differences in bucco-lingual crown diameters in the two populations.

## Introduction

Information concerning tooth size in human populations is of importance to clinical dentistry as well as other sciences such as anthropology and anatomy. In orthodontics, the diagnosis and treatment of malocclusions require accurate knowledge of tooth dimensions as a stable occlusion is often reliant on the correct intercuspal relationship of the teeth (Andrews, 1972). Correct space analysis is essential if an optimal occlusion is to be achieved during orthodontic treatment (Bishara and Staley, 1984) and the goal of an ideal static and functional occlusion are to be reached (Andrews, 1972; Roth, 1972).

Several studies have reported tooth size variation between and within different racial groups. Keene (1971, 1979) reported racial differences in tooth sizes among the American Negroes and their Caucasian counterparts in caries-free naval recruits. Turner and Richardson (1989) also observed significant differences in mesio-distal tooth width in Kenyan and Irish populations. In another related study Bishara *et al.* (1989) compared the mesio-distal 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 statistically significant differences in the mesio-distal dimension between the three popu-

lations. Apart from racial differences, the other factors associated with tooth size variability are gender (Ghose and Baghdady, 1979; Lysell and Myrberg, 1982; Bishara *et al.*, 1989), hereditary factors (Townsend and Brown, 1978), bilateral differences (Ballard, 1944; Lundström, 1964), environment (Guagliardo, 1982) and secular changes (Harper, 1994). In Nigerian populations, however, little information is available on tooth size dimensions (Mack, 1981).

The purpose of this investigation was to compare the mesio-distal and bucco-lingual crown dimensions of a group of Nigerian children to a matched British population sample.

## Materials and methods

The material for the present study consisted of 30 pairs of study models of randomly-selected Nigerian children (15 boys and 15 girls) residing in Ile-Ife, Nigeria. The children were mainly from two major ethnic groups (Yoruba and Hausa). Their mean age was  $12.5 \pm 1.4$  years. The British sample was also obtained from study models of 15 boys and 15 girls enrolled for orthodontic treatment at the Department of Orthodontics, Mount Vernon Hospital, Middlesex, UK. Their mean age was  $12.9 \pm 1.2$  years. The children were Caucasians of Northern European ancestry. Impressions for

all participants were made in irreversible hydro-colloid or alginate impression material. These impressions were cast immediately in plaster to prevent dimensional changes.

#### Case selection criteria

These included:

1. Presence and complete eruption of all permanent teeth in both arches to include first molars.
2. Absence of any deciduous teeth.
3. Intact dentition with no caries or fracture.
4. No conservative treatment other than Class I occlusal restoration.
5. No developmentally missing teeth in any of the segments.

The study models were numbered for easy identification and measurements were carried out using an electronic digital caliper (Mitutoyo, Japan). The maximum mesio-distal and bucco-lingual dimensions were recorded for premolars, molars, canines and incisors. These measurements were taken to the nearest 0.01 mm. To establish consistency of recorded measurements, a method described by Bishara *et al.* (1989) was adopted. A predetermined intra-examiner reliability was fixed at 0.2 mm. Double measurements were recorded for each parameter. Discrepancies greater than this limit necessitated a new set of measurements and the nearest three measurements were averaged.

#### Statistical analysis

Statistical analysis was carried out using the Arcus Pro-stat DOS version 3 software package (Medical Computing, West Lancashire, UK).

The mean, SD and coefficient of variation ( $cv = SD \times 100/\text{mean}$ ) were computed for the two populations. Paired *t*-tests were used for the left-right side comparisons. The mean values for the two populations were compared using unpaired *t*-tests. A probability  $>5$  per cent ( $P > 0.05$ ) was taken as not significant (NS);  $<5$  per cent ( $P < 0.05$ ) as significant (\*);  $<1$  per cent ( $P < 0.01$ ) as highly significant (\*\*); and  $<0.1$  per cent ( $P < 0.001$ ) as very highly significant (\*\*\*)

#### Results

The descriptive statistics on the mesio-distal and bucco-lingual crown dimensions of the Nigerian and British children are presented in Tables 1–4. The Nigerian sample consistently exhibit larger mesio-distal tooth widths than the British sample in both arches. With respect to the bucco-lingual diamensions, only the mandibular central incisors in the British sample and the maxillary canines in the Nigerian group showed greater crown width ( $P < 0.05$ ). The results also showed no significant left-right side differences in either racial group ( $P > 0.05$ ).

Mesio-distal tooth size variability as expressed by coefficient of variability was found to be least for mandibular first permanent

**Table 1** Descriptive statistics for the maxillary mesio-distal tooth diameters (mm).

Tooth	side	Nigerian			British			<i>t</i> -value	Significance
		Mean	SD	CV	Mean	SD	CV		
I <sub>1</sub>	R	8.96	0.51	5.69	8.47	0.49	5.79	3.75	***
	L	8.96	0.50	5.58	8.53	0.44	5.16	3.54	***
I <sub>2</sub>	R	7.24	0.37	5.11	6.55	0.39	5.95	6.99	***
	L	7.26	0.35	4.82	6.54	0.39	5.96	7.41	***
C	R	7.82	0.42	5.37	7.53	0.34	4.52	2.96	**
	L	7.82	0.40	5.12	7.53	0.34	4.52	3.21	**
PM <sub>1</sub>	R	7.33	0.43	5.87	6.89	0.46	6.68	3.90	***
	L	7.34	0.42	5.72	6.90	0.44	6.38	3.94	***
PM <sub>2</sub>	R	6.87	0.37	5.39	6.48	0.44	6.79	3.65	***
	L	6.88	0.37	5.38	6.49	0.44	6.78	3.67	***
M <sub>1</sub>	R	10.52	0.50	4.75	10.04	0.45	4.48	3.83	***
	L	10.52	0.50	4.75	10.07	0.47	4.67	3.59	***

\*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

I = incisor; C = canine; PM = premolar; M = molar.

**Table 2** Descriptive statistics for the mandibular mesio-distal tooth diameters (mm).

Tooth	side	Nigerian			British			<i>t</i> -value	Significance
		Mean	SD	CV	Mean	SD	CV		
I <sub>1</sub>	R	5.67	0.43	7.58	5.26	0.30	5.70	4.29	***
	L	5.69	0.43	7.56	5.26	0.30	5.70	4.46	***
I <sub>2</sub>	R	6.19	0.40	6.46	5.77	0.31	5.37	4.57	***
	L	6.20	0.40	6.45	5.76	0.33	5.73	4.55	***
C	R	7.26	0.38	5.23	6.74	0.37	5.49	5.36	***
	L	7.26	0.38	5.23	6.74	0.37	5.49	5.40	***
PM <sub>1</sub>	R	7.39	0.38	5.14	6.84	0.42	6.14	5.32	***
	L	7.40	0.37	5.00	6.89	0.43	6.20	4.90	***
PM <sub>2</sub>	R	7.59	0.45	5.93	6.98	0.42	6.02	5.45	***
	L	7.58	0.45	5.93	7.00	0.41	5.86	5.19	***
M <sub>1</sub>	R	11.34	0.43	3.79	10.84	0.70	6.46	3.38	**
	L	11.34	0.42	3.70	10.85	0.67	6.18	3.39	**

\*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .

I = incisor; C = canine; PM = premolar; M = molar.

**Table 3** Descriptive statistics for the maxillary bucco-lingual tooth diameters (mm).

Tooth	side	Nigerian			British			<i>t</i> -value	Significance
		Mean	SD	CV	Mean	SD	CV		
I <sub>1</sub>	R	7.33	0.39	5.32	7.30	0.48	6.58	0.26	NS
	L	7.33	0.40	7.46	7.30	0.46	6.30	0.25	NS
I <sub>2</sub>	R	6.36	0.35	5.50	6.49	0.41	6.32	1.39	NS
	L	6.35	0.34	5.35	6.45	0.42	6.51	1.00	NS
C	R	8.25	0.45	5.45	7.95	0.44	5.53	2.58	*
	L	8.26	0.43	5.21	7.97	0.42	5.27	2.68	*
PM <sub>1</sub>	R	8.79	0.62	7.05	8.81	0.65	7.38	0.13	NS
	L	8.79	0.62	7.05	8.82	0.64	7.26	0.19	NS
PM <sub>2</sub>	R	8.98	0.42	4.68	9.03	0.53	5.87	0.41	NS
	L	8.97	0.41	4.57	9.02	0.52	5.76	0.42	NS
M <sub>1</sub>	R	10.60	0.76	7.17	10.77	0.60	5.57	0.99	NS
	L	10.59	0.74	6.99	10.82	0.58	5.36	1.34	NS

NS = not significant, \*  $P < 0.05$ .

I = incisor; C = canine; PM = premolar; M = molar.

molars and highest for mandibular central incisors in Nigerians. In the British sample however, variability was least in maxillary permanent canines and maxillary first permanent molars, but highest in the maxillary second premolars. For the bucco-lingual dimension, Nigerians expressed the greatest variability in the mandibular first premolars and the least in mandibular first molars, while the British sample showed the greatest variability in the mandibular lateral incisors and the least in the mandibular canines. The mean crown size variability was greater in the bucco-lingual

than the mesio-distal dimension in the two populations.

### Discussion

There has been no comprehensive comparative study of tooth size dimensions in the two racial groups since that reported by Mack (1981) which compared the maxillary incisor mesio-distal width of Nigerian and British populations. The present investigation compared the mesio-distal and bucco-lingual crown diameters of the two racial groups. It was difficult to find subjects

**Table 4** Descriptive statistics for the mandibular bucco-lingual tooth diameters (mm).

Tooth	side	Nigerian			British			t-value	Significance
		Mean	SD	CV	Mean	SD	CV		
I <sub>1</sub>	R	5.78	0.42	7.27	5.99	0.37	6.18	2.01	*
	L	5.78	0.42	7.27	5.99	0.38	6.34	2.09	*
I <sub>2</sub>	R	6.13	0.40	6.53	6.17	0.49	7.94	0.38	NS
	L	6.12	0.40	6.54	6.14	0.46	7.49	0.15	NS
C	R	7.01	0.43	6.13	7.07	0.30	4.24	0.68	NS
	L	7.00	0.41	5.86	7.06	0.28	3.97	0.63	NS
PM <sub>1</sub>	R	7.39	0.61	8.25	7.42	0.49	6.60	0.27	NS
	L	7.39	0.60	8.12	7.44	0.53	7.12	0.40	NS
PM <sub>2</sub>	R	7.59	0.61	8.04	8.14	0.63	7.73	1.19	NS
	L	7.95	0.60	7.55	8.14	0.62	7.61	1.26	NS
M <sub>1</sub>	R	10.44	0.44	4.21	10.22	0.53	5.19	1.78	NS
	L	10.43	0.43	4.12	10.26	0.52	5.07	1.37	NS

NS = not significant, \* $P < 0.05$ .

I = incisor; C = canine; PM = premolar; M = molar.

with near normal occlusions in the British sample and therefore a sample from those attending a hospital department for orthodontic treatment were selected. Patients with malocclusions have been shown to have no differences in tooth size compared with those with no malocclusions (Howe *et al.*, 1983; Crosby and Alexander, 1989). It was therefore accepted that Caucasian patients presenting for orthodontic treatment would be a suitable comparison group.

Although measurements on dental cast, are reported to be on average 0.1 mm larger than those of the actual teeth, dental cast measurements seem more reliable than those made directly in the mouth (Hunter and Priest, 1960) and therefore analysis of study models seems appropriate to this form of investigation.

The results of this study indicate that the mean mesio-distal tooth sizes for all the teeth were significantly larger in Nigerians than in their British counterparts. The difference varies between 0.29 mm for the maxillary canines to 0.72 mm for the maxillary left lateral incisor. In the mandibular arch it ranges from 0.41 mm for the mandibular right central incisor to 0.61 mm for the mandibular right second premolar. The Nigerian sample therefore demonstrated larger mesio-distal tooth mass of approximately 5.5 mm and 6.0 mm in the maxillary and mandibular arches respectively. Reports of increased dental arch width in Nigerians (Mack, 1981; Bassey and Odunsi, 1988) and bimaxillary proclination (Awofala, 1986; Isiekwe, 1989) provide the space needed

to accommodate the large tooth mass space requirements.

Merz *et al.* (1991) reported a difference of approximately 4 mm in tooth mass between the samples of black and white patients in the USA, although no significant differences were demonstrated in the mean mesio-distal diameters of the incisors between the two groups. The American study may not be directly comparable to the present study because of differences in the racial subgroups (Harper, 1994). The ancestors of black Americans originate in Africa, England, Ireland, Germany and many parts of the Caribbean (Garner and Butt, 1985) while most of the white population is a genetic admixture of people of northern European ancestry (Bishara *et al.*, 1989). The populations in the present study are much more homogenous and stable.

Surprisingly, with the exception of larger mandibular central incisors and maxillary canines in the British and the Nigerian groups respectively, no statistically significant differences were demonstrated in bucco-lingual crown diameter.

Variability in tooth size may occur according to tooth type and location in the dental arch. In this study, the least variability of tooth dimensions was found in first permanent molars. This is in agreement with the results obtained by other investigators (Lunt, 1969; Murshid and Hashim, 1993). Generally, there is greater variation in the bucco-lingual than in the mesio-distal dimension in the two racial groups

studied. This is also consistent with the report of Bishara *et al.* (1989) who showed similar variation among three populations from Egypt, Mexico and the USA. No statistically significant differences were found between left and right sides. This supports other studies concerning the lack of asymmetries in dental arches and tooth dimensions (Hunter, 1953; Noss *et al.*, 1983; Alavi *et al.*, 1988). It is postulated that racial background may be the main factor for the differences.

The results of the mesio-distal tooth diameters in Nigerians could provide useful clinical information for orthodontists and restorative dentists in Nigeria and Britain.

### Conclusions

Mesio-distal crown dimensions of the Nigerian sample were significantly larger than their British counterparts.

With the exception of the mandibular central incisors and maxillary canines, there were no significant differences in bucco-lingual crown dimensions between the two populations.

Further work with a larger sample should be undertaken to compare the three major Nigerian tribal groups with their British counterparts.

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