

Mesiodistal Crown Dimensions and Tooth Size Discrepancy of the Permanent Dentition of Dominican Americans

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Abstract: The purpose of the study was to establish normative data on the mesiodistal crown dimensions of Americans of Dominican background. The Bolton tooth size analysis was performed on a sample of 54 Dominican Americans. The mean, range and standard deviation were calculated for the size of the teeth, and a coefficient of variation was obtained for the tooth size ratio. A 2-sample *t*-test was used to test for the statistical difference between means. In general, the values obtained for the Dominican American sample closely resembled previous data available for the African American population. The tooth size ratios obtained were compared to the Bolton ratios. The overall ratio was found to be 91.3, equivalent to the Bolton overall ratio, whereas the anterior ratio was 78.1, larger than the 77.1 Bolton ratio. The frequency of tooth size discrepancy outside 2 standard deviations from the Bolton mean was also calculated. An overall tooth size discrepancy was found in 11% of our sample, and 28% of the sample presented an anterior tooth size discrepancy. (*Angle Orthod* 2000;70:303–307.)

Key Words: Tooth size; Tooth size discrepancy; Bolton ratios; Dominican Americans

INTRODUCTION

Tooth size ratios represent a valid diagnostic tool that allow for an educated prediction of treatment outcomes and may also limit the necessity for diagnostic setups for complex cases. A proper relationship of the total mesiodistal width of the maxillary dentition to the mesiodistal width of the mandibular dentition will favor an optimal post treatment occlusion.

Treatment planning should always take into consideration a discrepancy of the tooth size ratios and should include compensating esthetic procedures such as composite bonding, prosthetic reconstruction, stripping, and crown recontouring. A lack of information about tooth size could also compromise the final results in extraction cases if the cho-

sen extraction pattern leads to a clinically significant maxillo-mandibular tooth size discrepancy.

Pioneer investigations on tooth sizes were conducted by Black in 1902¹ and Neff in 1949.² These studies were followed by the classic work of Bolton,^{3,4} who quantified the maxillary-to-mandibular tooth size relationship and provided the accepted normative data. Bolton selected 55 cases with optimal occlusions and compared the sums of the mesiodistal widths of the maxillary and mandibular teeth, including the first molars. An overall ratio of 91.3 was obtained, with a standard deviation of 1.91. He also calculated that the ratio for the anterior teeth from canine to canine was 77.2, with a standard deviation of 1.65.

Using data from the Center for Human Growth and Development at the University of Michigan, Moyers and colleagues⁵ established normative data for the dentition of North American white subjects. Similar data are available in the literature for African American,⁶ Norwegian Lapp,⁷ and Japanese⁸ subjects.

A paper published by Eduardo and Garcia-Godoy⁹ in Santo Domingo, Dominican Republic is the only study available on the mesiodistal widths of the permanent teeth in a sample of 101 Dominican children, but no attempt was made by the authors to provide tooth size ratios. However, Americans of Dominican background already constitute the majority of the dental patients in many dental care institutions located in metropolitan areas. The paucity of pertinent data regarding this fast-growing community needs to be addressed.

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For other populations, data are available in the literature regarding the incidence of Bolton tooth size discrepancy among orthodontic patients.^{10,11} Discrepancies outside 2 standard deviations from the mean are likely to be correlated with a failure to achieve an optimal occlusion. Simple percentage calculations demonstrate that a mean value outside that range translates to 2 to 3 mm of discrepancy, an amount great enough to be clinically relevant.¹⁰

In 1996 Freeman and colleagues¹¹ studied the frequency of tooth size discrepancies in a sample of 157 orthodontic patients and found that 13.4% of them had an overall ratio outside 2 standard deviations from the Bolton mean, and 30.6% of the sample presented an anterior ratio discrepancy outside 2 standard deviations from the mean. Crosby and Alexander¹⁰ reached similar conclusions because 22% of their sample of orthodontic patients presented an anterior ratio outside 2 standard deviations from the Bolton mean.

In the present study, the mean values of a Dominican American sample were compared to the Bolton means to detect the presence of any specific tooth size problem in this selected population. The purposes of the study were the following:

1. Establish normative data on the mesiodistal crown dimension of the permanent dentition of Dominican Americans.
2. Compare the results to data obtained from previous data available from the Dominican Republic.
3. Compare our results to similar studies obtained on African American and North American white populations.
4. Compare the tooth size ratios of Dominican Americans to the ratios available from the Bolton analysis.
5. Determine the frequency of tooth size discrepancies in the Dominican population outside 2 standard deviations from the Bolton means.

MATERIALS AND METHODS

The data for this study were obtained from dental cast measurements. The sample consisted of a total of 54 Dominican American orthodontic patients, 36 men and 18 women. In the Dominican American population, wide variations of racial characteristics can be detected, but a demographic study performed by Weil et al in 1973¹² concluded that, on average, 75% of the residents of the Dominican Republic are racially mixed. From photographic records confirmed by clinical examination, it was established that our sample of orthodontic patients—second or third generation Dominicans residing in the New York City area—was composed of racially mixed subjects, with homogeneous skin pigmentation and craniofacial features.

A Boley gauge with a Vernier scale and precision reading to the nearest 0.1 mm was used to measure the teeth. The sharp tips of the calipers facilitated accuracy. The mesiodistal length was obtained by measuring the maximum distance between the mesial and distal contact points of the

tooth on a line parallel to the occlusal plane. A single investigator measured each arch twice, from right first molar to left first molar. If the second measurement differed by more than 0.2 mm from the first measurement, the tooth was remeasured. The criteria for selection of the models were that pretreatment orthodontic models have all permanent teeth present and fully erupted from first molar to first molar and that there be no mesiodistal loss or excess of tooth material as a result of caries, restorations, or prosthetic replacement. Casts showing gross dental abnormalities were rejected.

The mean, range, and standard deviation were calculated for the size of the teeth. The Bolton anterior ratio (the ratio between the mesiodistal widths of the 6 anterior mandibular teeth and the mesiodistal widths of the 6 anterior maxillary teeth) and the Bolton overall ratio (the ratio between the mesiodistal widths of the 12 mandibular teeth and the mesiodistal widths of the 12 maxillary teeth, from first permanent molar to first permanent molar) were calculated. The coefficient of variation was calculated for the tooth size ratios. A 2-sample *t*-test was used to test for statistical difference between means. The measurement error amounted to 0.2 mm.

RESULTS

The results are summarized in Tables 1 to 4. Table 1 reports the mean, range, and standard deviation of the width of the maxillary and mandibular teeth in the male and female subgroups. In the Dominican American sample, both male and female measurements follow a similar pattern distribution, with the men having slightly larger dental dimensions. The overall ratio was 91.1 for men and 91.2 for the women. The anterior ratio was 78.0 for men and 78.2 for women.

Table 2 compares the mesiodistal widths of the maxillary and mandibular teeth in this sample to the only similar study available on Dominican Republic residents.⁹ The reported mean mesiodistal dimensions of the maxillary and mandibular teeth were calculated, including male and female subjects. The *P* value (significance < .05) is provided for the 2 sets of data.

Tables 3 and 4 compare the mean mesiodistal crown diameters of the sample with data available for North American white and African American subjects.^{5,6} Only the mandibular and maxillary first molar, the mandibular canine, and the second premolars present a statistically significant difference between the Dominican American sample and the African American population (*P* < .05). On the other hand, the mesiodistal widths in the present sample differed from the mesiodistal widths of North American white subjects for all teeth measured except the maxillary incisors and the mandibular central incisor. A tooth size analysis was then carried out on the Dominican American sample and compared to the Bolton ratios (Table 5).

TABLE 1. Mean, Range, and Standard Deviation for the Dominican American Sample^a

Tooth	Men			Women		
	Mean	Range	SD	Mean	Range	SD
Maxillary						
I ₁	8.96	7.3–10.0	0.67	8.72	7.7–10.0	0.56
I ₂	6.98	5.3–8.1	0.69	6.99	5.5–9.0	0.56
C	8.15	7.2–9.0	0.518	7.84	6.9–9.0	0.48
P ₁	7.54	6.4–8.5	0.49	7.37	6.4–8.1	0.44
P ₂	7.10	6.0–8.1	0.417	6.97	5.9–8.0	0.49
M ₁	10.81	9.8–12.0	0.70	10.51	9.2–12.2	0.66
Mandibular						
I ₁	5.56	4.6–6.0	0.36	5.47	5.0–6.1	0.35
I ₂	6.16	5.1–6.9	0.42	6.08	5.2–6.9	0.36
C	7.12	5.8–8.2	0.55	6.82	6.0–8.0	0.40
P ₁	7.48	6.5–8.4	0.52	7.44	6.3–8.5	0.51
P ₂	7.53	6.7–8.9	0.56	7.34	6.4–8.5	0.49
M ₁	11.32	10.0–12.6	0.60	11.02	9.6–12.5	0.67

^a I₁ indicates central incisor; I₂, lateral incisor; C, canine; P₁, first premolar; P₂, second premolar; and M₁, first molar.

TABLE 2. Mean Mesiodistal Crown Lengths of the Teeth of the Dominican American Sample, Compared to Previous Data Collected in the Dominican Republic^{9,10}

Tooth ^a	Dominican American	Dominican Sample	Republic P Value
Maxillary			
I ₁	8.79	8.63	>0.05
I ₂	6.98	6.80	>0.05
C	7.94	7.77	<0.05
P ₁	7.42	7.22	<0.05
P ₂	7.01	6.89	>0.05
M ₁	10.6	10.6	>0.05
Mandibular			
I ₁	5.49	5.16	<0.01
I ₂	6.10	5.49	<0.01
C	6.92	7.00	>0.05
P ₁	7.44	7.34	>0.05
P ₂	7.40	7.34	>0.05
M ₁	11.11	11.20	>0.05

^a I₁ indicates central incisor; I₂, lateral incisor; C, canine; P₁, first premolar; P₂, second premolar; and M₁, first molar.

TABLE 3. Mean Mesiodistal Crown Lengths of the Dominican American Sample, Compared with Previous Data for the North American Caucasian Population⁵

Tooth ^a	Dominican American Sample	North American Caucasians	P Value
Maxillary			
I ₁	8.79	8.80	>0.05
I ₂	6.98	6.83	>0.05
C	7.94	7.76	<0.05
P ₁	7.42	6.69	<0.01
P ₂	7.01	6.60	<0.01
M ₁	10.6	10.39	<0.05
Mandibular			
I ₁	5.49	5.50	>0.05
I ₂	6.10	5.98	<0.05
C	6.92	6.78	<0.05
P ₁	7.44	6.84	<0.01
P ₂	7.40	7.16	<0.01
M ₁	11.11	10.51	<0.01

^a I₁ indicates central incisor; I₂, lateral incisor; C, canine; P₁, first premolar; P₂, second premolar; and M₁, first molar.

DISCUSSION

Mesiodistal crown widths

The mesiodistal dimensions of the maxillary teeth showed a higher variability than the mandibular teeth, with the first molar dimensions showing the greatest variability. The size of the maxillary central and lateral incisors also presented high variability. This suggests that they could be responsible for incongruity in the anterior ratio and should, therefore, be examined clinically at the beginning of treatment to detect any major size and shape variation. It is interesting to note that the first and second mandibular premolars in our sample are about the same size, whereas the second mandibular premolar is usually larger in African American and North American white populations (Tables 3 and 4).

Sex differences

The mesiodistal width of the mandibular teeth followed a similar distribution pattern in the male and female samples, with the dental measurements in the men being slightly larger than those in the women. In general, higher variability was found in the male group. However, the findings did not substantiate the need for sex-specific standards.

Comparison with previous samples

The values obtained for the present sample resemble very closely the data available from the Dominican Republic. In general, all the values were slightly larger in Dominicans residing in the New York City area. The only statistically

TABLE 4. Mean Mesiodistal Crown Lengths of the Dominican American Sample, Compared with Previous Data for the African American Population^a

Tooth ^a	Dominican American Sample	African Americans	P Value
Maxillary			
I ₁	8.79	8.92	>0.05
I ₂	6.98	7.17	>0.05
C	7.94	7.96	>0.05
P ₁	7.42	7.51	>0.05
P ₂	7.01	7.10	>0.05
M ₁	10.6	10.81	<0.05
Mandibular			
I ₁	5.49	5.45	>0.05
I ₂	6.10	6.06	>0.05
C	6.92	7.11	<0.05
P ₁	7.44	7.58	>0.05
P ₂	7.40	7.73	<0.01
M ₁	11.11	11.53	<0.01

^a I₁ indicates central incisor; I₂, lateral incisor; C, canine; P₁, first premolar; P₂, second premolar; and M₁, first molar.

TABLE 5. Statistical Parameters Obtained in the Present Study Compared to the Bolton Parameters

Tooth	Bolton's Values	Dominican American Sample
Overall Ratio		
Sample size	55	54
Mean	91.3	91.3
Range	87.5–94.8	85.5–97.1
Standard deviation	1.91	2.22
Coefficient of variation	2.09	2.43
Anterior Ratio		
Sample size	55	54
Mean	77.2	78.1
Range	74.5–80.4	71.4–86.6
Standard deviation	1.65	2.87
Coefficient of variation	2.12	3.68

significant differences ($P < .05$) between the 2 groups were between the diameters of the maxillary canine and first premolar and the diameters of the mandibular central and lateral incisors. These differences could be attributed to differences in the measurement techniques between the 2 studies or even to different nutrition regimens followed by the 2 groups.

Comparison with other ethnic groups

In general, the Dominican American sample in this study resembles more closely the African American sample than the white sample. The Dominican sample presented maxillary and mandibular tooth dimensions slightly smaller than those of the African American sample, with the exception of the mandibular central and lateral incisors, which

were larger. On the other hand, the crown widths of the Dominican sample were consistently larger than the crown widths of the North American white sample.

American Dominican tooth ratios compared to Bolton ratios

In both the overall ratios and the anterior ratio, the range, standard deviation, and coefficient of variation were larger in the present study than in Bolton's study. The probable reason for this finding may be the type of population that constitutes the sample (patients with orthodontic problems versus the Bolton individuals, who had optimal occlusions). Similar results were obtained in previous studies.¹⁰

The 91.3 overall ratio, from first molar to first molar, was equivalent to that found by Bolton (Table 5). The anterior ratio, from canine to canine, had a larger value (78.1 compared with Bolton's 77.2). Assuming that an ideal Class I canine was obtained during treatment, an anterior ratio of 78.1 ideally implies the necessity of either removal of tooth structure in the mandibular arch (interproximal recontouring) or the addition of tooth structure in the maxillary arch (veneers or composite buildups) to achieve an acceptable overjet and overbite.

However, in clinical practice these procedures rarely represent the only solution to the problem. In Dominican Americans, the excess of tooth material in the mandibular anterior segment is usually compensated for by the presence of a mandibular second premolar, which is approximately the same size of the mandibular first premolar (Table 1). A smaller than usual maxillary second premolar usually compensates for the slightly oversized mandibular incisors and brings the overall ratio to normal values.

On the other end, a balanced overall ratio does not guarantee an optimal intercuspation. The combination of mandibular premolar width differences and the higher Bolton anterior ratio leads to a typical trait of the final occlusion of American Dominican patients—the tendency to a Class II canine in the presence of acceptable overjet and overbite and a Class I molar. The improvement of the canine relationship implies either an exaggeration of the Class I molar to a Class III or an interproximal recontouring of the maxillary premolars. To finally restore a balanced anterior ratio, both solutions need to be followed by the interproximal recontouring of the mandibular incisors or by prosthetic procedures to increase the widths the maxillary incisors, usually the lateral incisor.

Frequency of tooth size discrepancy

The frequency of tooth size discrepancy outside 2 standard deviations from Bolton's was used as the index of the clinical significance of tooth size imbalance in our sample. A discrepancy in the overall ratio was found in 11% of Dominican American patients, compared to an incidence of 13.4% in other samples. The discrepancy in the anterior

ratio outside 2 standard deviations from the Bolton mean amounted to 28% of our sample, whereas in other populations values of 30.6% and 22.9% have been reported.^{10,11}

CONCLUSIONS

In establishing normative data for tooth size and tooth size ratios for a sample of 54 Dominican American orthodontic patients, the following conclusions may be drawn.

1. In general, male crown measurements were slightly larger and showed a higher variability than the female measurements but follow the same distribution pattern.
2. The data were consistent with the values available from a previous study on residents of the Dominican Republic. Dominican Americans' mesiodistal dental lengths resemble more closely those of African Americans, with larger mesiodistal dental lengths when compared to white Americans. However, the overall tooth size ratio was equivalent to the original Bolton overall ratio, but the anterior tooth size ratio was larger than the Bolton anterior ratio. The difference was statistically significant and suggests the need for more specific standards for the Dominican population.
3. A higher variability was found in the maxillary teeth as compared to the mandibular teeth. The first molars and the maxillary central and lateral incisors presented significant variability and should be examined clinically to exclude any major size and shape discrepancy.
4. A statistically and clinically significant overall tooth size discrepancy was found in 11% of the patients, whereas 28% of them exhibited a statistically and clinically significant anterior discrepancy. Even if the values are not

significantly higher than previous ones available in the literature for other groups, a careful analysis of interarch relationships should be included in the diagnostic procedures.

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