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Human Mesiodistal Tooth Width Measurements and Comparison with Dental Cast in a Bangladeshi Population

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ABSTRACT

Aim: This analysis was aimed to determine the mesiodistal tooth width of human teeth and to compare with the measurements on plaster model in a Bangladeshi population.

Materials and methods: The samples of 2,892 teeth of Bangladeshi subjects were collected for this purpose. This article presents mesiodistal tooth width measurements made on all types of teeth and compares with the mesiodistal tooth width measurements of dental cast collected from Bangladeshi subjects between the ages of 18 and 24 years. The mesiodistal dimension was recorded, involving the maximum mesiodistal dimension of each tooth when measurement was rendered parallel to the occlusal and labial surfaces. Descriptive and comparative statistics were applied.

Results: The mean, standard deviation and 95% confidence interval of mesiodistal tooth width measurements were determined and have been with the mesiodistal tooth width measurements of dental cast. Significant differences have been observed between mesiodistal tooth size of direct measurement on tooth (DMT) and measurement on plaster model (MPM) for the maxillary first molar ($p < 0.001$) and mandibular incisors to first premolar ($p < 0.001$).

Conclusion: These data should prove to be helpful to the practitioner for performing successful orthodontic treatment in Bangladeshi population.

Clinical significance: Direct measurement of mesiodistal tooth width and individual variation of maxillary and mandibular permanent central incisor to first molar of the Bangladeshi individuals showed some distinguishable features, which will certainly help an orthodontist for diagnosis and treatment plan of an orthodontic case.

Keywords: Human tooth, Dental cast, Bangladeshi, Mesiodistal width.

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INTRODUCTION

One of the most important essential criteria to diagnose an orthodontic case is to know the mesiodistal tooth width.[1] Mesiodistal tooth width has an anthropological significance, because it provides valuable information on human evolution with its technological and dietary changes.[1] A proper balance should exist between the mesiodistal tooth size of the maxillary and mandibular arches to ensure proper interdigitation, overbite, and overjet at the completion of orthodontic treatment.[2,3] The size of the teeth is generally believed to be determined by genetic factors.[4,5] Environmental factors, including neonatal factors, are also important in determining permanent tooth crown dimensions.[6] On a clinical level, mesiodistal tooth width is correlated to the arch alignment and large teeth are associated with crowded dental arches.[7] Differences in tooth size have been associated with different ethnic backgrounds and malocclusions.[8] To date, no studies have been found in the literature to measure mesiodistal tooth width of Bangladeshi individuals using human teeth.

Most of the studies measured tooth size on plaster model. Is there a tendency of differences in tooth size

between different samples? Unfortunately, there have been few reports on tooth size in a Bangladeshi population.[9,10] Therefore, we previously investigated[9] tooth size discrepancy in a Bangladeshi population and a graphical overview of global tooth size ratios. The following results were obtained: (1) Gender differences in the anterior and overall ratios were not significant, (2) The following may be predictors of tooth size discrepancy: subjects with dental mid-line discrepancy (for the anterior ratio) and those with decreased overjet or decreased overbite (overall ratio), (3) A graphical presentation of the anterior ratios from the present study and using global data showed variations between populations and the overall ratios, albeit with some similarities. No study has been undertaken to compare between the direct measurement of human teeth and measurement on plaster model in a Bangladeshi population. Therefore, the aim of this study was to measure mesiodistal tooth width of human teeth and to compare with the measurement on dental cast.

MATERIALS AND METHODS

Sample

Six thousand maxillary and mandibular permanent central incisor to first molar tooth were collected from different clinic and hospital of Dhaka city. All teeth were preserved in hydrogen per oxide – water mix solution for 7 days for asepsis and were dried in sunlight. The criteria of accession were: (1) all teeth assessed to be morphologically normal, (2) absence of any decay, (3) absence of any interproximal restoration, (4) absence of any attrition, (5) absence of any erosion, (6) absence of any abrasion, (7) absence of any broken down crown, (8) absence of any crack, fracture. Finally, 1446 maxillary teeth and 1446 mandibular teeth, 241 teeth for each were selected for the measurement.

Subjects

Dental casts of 220 Bangladeshi individuals, comprising 95 males and 125 females (18 to 24 years, mean age = 20). The records belonged to 100 subjects with class I normal occlusion (Class I NO). Sixty subjects with class I malocclusion (Class I MO), including those who showed crowding more than 5 mm and 30 subjects each with class II and III malocclusion.[11] Dental cast was randomly chosen from dental students and orthodontic patients in the Orthodontic Department of the Bangladesh Dental College.

The inclusion criteria were the following: (1) subjects of confirmed Bangladeshi ethnic background, (2) existing and erupted permanent central incisors to the first permanent molar in each quadrant, (3) no previous orthodontic treatment, (4) all teeth assessed to be morphologically normal, and (5) absence of any decay, interproximal restorations, attrition, erosion, abrasion, broken down crowns, cracks and/or fractures.

Tooth Size Measurements

All measurements were taken by a single calibrated operator using a sliding calliper with vernier scale and a graded gauge (Mitutoyo, Japan). For each of the 2892 teeth measurement named 'direct measurement on tooth (DMT)' and for the cast measurement named 'measurement on plaster model (MPM). Measurements were carried out with a reading accuracy of 0.1 mm. The mesiodistal dimension was recorded, involving the maximum mesiodistal dimension of each tooth when measurement was rendered parallel to the occlusal and labial surfaces.

ETHICAL APPROVAL WAS OBTAINED FROM THE COLLEGE COMMITTEE, BANGLADESH DENTAL COLLEGE

Statistical Analysis

A descriptive statistical analysis of the mesiodistal dimension of maxillary and mandibular permanent central incisor to first molar was accomplished. The individual data were summarized as ranges and mean values of these ratios. The data were reviewed for normal distribution. Variations were analyzed as standard deviations. Independent t-test was used to determine statistically significant differences of tooth size measurement between DMT and MPM with a probability level of 0.05 considered statistically significant. The reliability of the method was analyzed by the student t-test between examiners. The method deviation can thus be considered negligible. Twenty four teeth for each (a total of 288 teeth) and 40 pairs (ten pairs from each group) of dental casts were randomly selected and remeasured 1 month after the initial measurements.

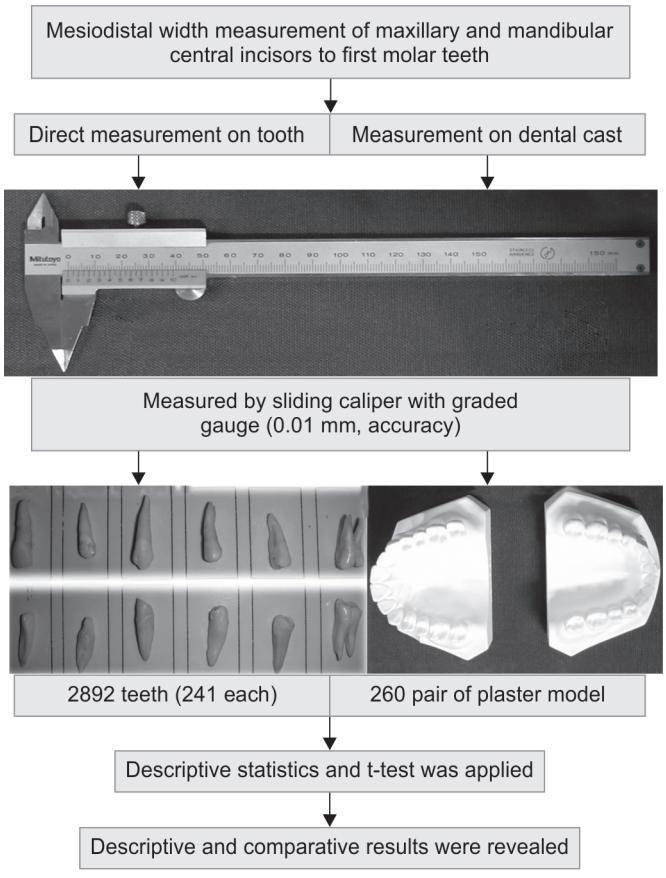
Graphical flow chart of the study was shown in Flow Chart 1.

RESULTS

The agreement between the first and repeat measurement was acceptable in all the parameters analyzed, there were no statistically significant differences between the two sets of measurements. The average measure of intraclass coefficient correlation (ICC) were 0.91 - 0.97 and 0.92 - 0.97 for DMT and MPM respectively.

Table 1 summarizes the mean values, standard deviations, ranges, 95% confidence interval and comparison p-value for the DMT and MPM of maxillary teeth. No

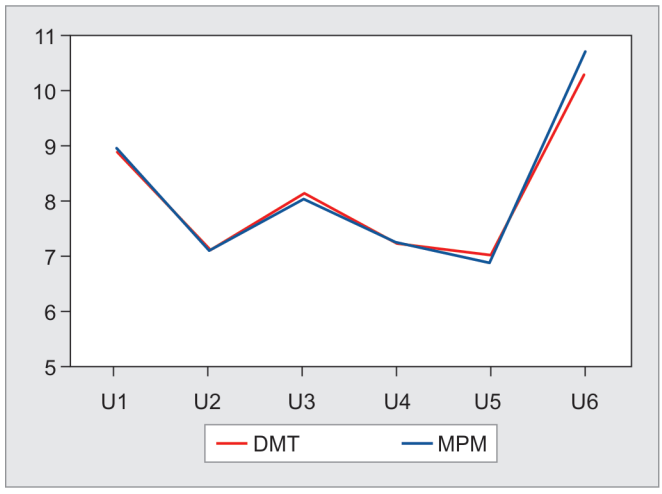
Flow Chart 1: Graphical flow chart of the study



significant differences have been observed between mesiodistal tooth size measurements of DMT and MPM except for the first molar which showed highly significant differences ($p < 0.001$).

Table 2 summarizes the mean values, standard deviations, ranges, 95% confidence interval and comparison p value for the DMT and MPM of mandibular teeth. Significant differences have been observed between mesiodistal tooth size measurements of DMT and MPM incisors to first premolar ($p < 0.001$) except for the first molar.

Graphical comparison between mesiodistal tooth size measurements of DMT and MPM of maxillary and mandibular teeth were shown in Graphs 1 and 2 respectively.



Graph 1: Comparison between mesiodistal tooth size measurements of DMT and MPM of maxillary teeth

DISCUSSION

Orthodontist should be aware of tooth size discrepancies before beginning orthodontic treatment.[12] The mesiodistal tooth size of the maxillary and mandibular arches must relate to each other to obtain an optimal occlusion at the completion of the orthodontic treatment.[2,13,14] If a patient has significant tooth size discrepancy, orthodontic alignment into optimal occlusion may not be possible. Many studies have been conducted to measure tooth size.[2,3,7,8,15,16] The results of the odontometric studies are useful not only in anthropologic research but for the practicing dentist too; since every known relationship or variation should be considered in daily patient care.[16]

Anthropometric studies reveal the variability between different races and between different ethnic groups within a race. For this reason, this information is useful not only for the determination of the evolutionary progress for a given population, but also for the evaluation of the biologic distance between races or ethnic groups, since some characteristics could serve as indicators of genetic differences between population.[17] Clinical perceptions favored the idea that heredity played a major role in both craniofacial structure and tooth based malocclu-

Table 1: Descriptive and comparative results between mesiodistal tooth size measurements of DMT and MPM of maxillary teeth

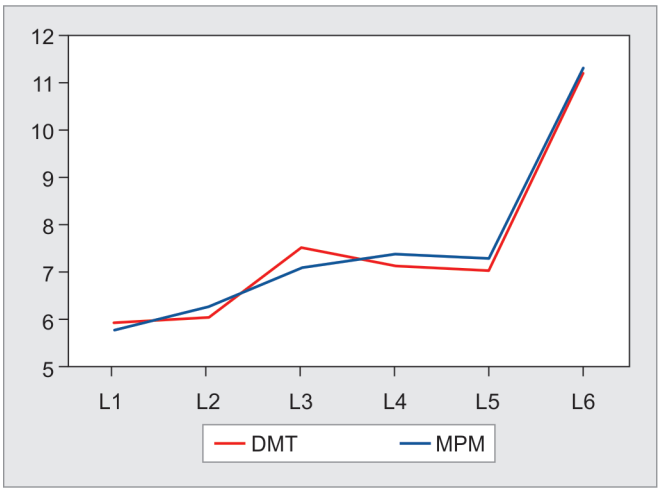
	Direct measurement on Tooth		*Measurement on plaster model*		*95% confidence interval*		
Tooth variables	*Mean*	*SD*	*Mean*	*SD*	*Lower*	*Upper*	*p-value*
U1	8.907	0.718	8.956	0.654	–0.071	0.170	0.423
U2	7.098	0.755	7.109	0.619	–0.110	0.132	0.859
U3	8.151	0.654	8.050	0.512	–0.204	0.002	0.054
U4	7.203	0.550	7.240	0.627	–0.067	0.141	0.483
U5	6.992	0.650	6.889	0.587	–0.212	0.005	0.062
U6	10.301	0.680	10.704	0.694	0.282	0.524	0.000***

$p < 0.05$: Significant; SD: Standard deviation; U1: Upper central incisor; U2: Upper lateral incisor; U3: Upper canine; U4: Upper first premolar; U5: Upper second premolar and U6: Upper first molar: ***$p \leq 0.001$

Table 2: Descriptive and comparative results between mesiodistal tooth size measurements of DMT and MPM of mandibular teeth

	Direct measurement on Tooth		*Measurement on plaster model*		*95% confidence interval*		
Tooth variables	*Mean*	*SD*	*Mean*	*SD*	*Lower*	*Upper*	*p-value*
L1	5.941	0.513	5.767	0.472	–0.260	–0.087	0.000***
L2	6.044	0.355	6.276	0.468	0.159	0.306	0.000***
L3	7.529	0.678	7.092	0.565	–0.546	–0.327	0.000***
L4	7.129	0.676	7.373	0.489	0.142	0.347	0.000***
L5	7.017	0.726	7.267	0.583	0.135	0.365	0.000***
L6	11.210	0.657	11.296	0.795	–0.042	0.215	0.186

$p < 0.05$: Significant; SD: Standard deviation; L1: Lower central incisor; L2: Lower lateral incisor; L3: Lower canine; L4: Lower first premolar; L5: Lower second premolar and L6: Lower first molar; ***$p \leq 0.001$



Graph 2: Comparison between mesiodistal tooth size measurements of DMT and MPM of mandibular teeth

sion.[18] Tooth size is largely determined by heredity. Other factors which contribute to the variability of permanent tooth are race, sex, environment, etc. Environmental variation such as nutrition, disease or climate affect dentition during the prenatal period but seem to have little influence on normal dental variation.[19]

Our study do not support tooth size differences in different malocclusion groups. Crosby and Alexander,[20] John and Donald,[21] Nie and Lin,[22] found no diffe-rence in tooth size in different malocclusion groups. As well as our findings also does not support gender diffe-rences which were considered in the studies of Smith et al,[23] and Uysal and Sari[24] because we compared DMT and MPM in total population.

Tooth size mesiodistal width measured via plaster dental cast,[25-27] digital dental models,[28,29] and 3D CBCT acquisitions[12,30] for various dental investigation were ascertained valid. Current study compare between the direct measurement of human teeth and measurement on plaster model and found significant difference for the various variables. To avoid the unscrupulous consequence, measurement method difference in relation to patient treatment should be considered.

One of the most perplexing phenomena in orthodontics is the crowding and spacing before, as well as following, the completion of orthodontic treatment.[15,16] By knowing the individual variation in the mesiodistal tooth width of maxillary permanent central incisor to first molar, an orthodontist even a dental surgeon can decide tooth size discrepancy in the maxillary arch which is very much essential to diagnose and to decide treatment plan of an orthodontic case. If a patient has significant tooth size discrepancy, orthodontic alignment into optimal occlusion may not be possible.[2,15,16] The results found from the two different types of Bangladeshi samples are quite discrete. The disparities may be due to precise measurement can be carried out in DMT rather than obstacle to penetrate the contact point while measurements in dental cast. The results of these odontometric studies are useful for the practicing dentist, since every known variation or relationship should be considered in daily patient care.

CONCLUSION

The results of this study showed some distinguishable features from direct measurement of mesiodistal tooth width and individual variation of maxillary and mandibular permanent central incisor to first molar of the Bangladeshi individuals which will certainly help an orthodontist for diagnosis and treatment plan of an orthodontic case.

Clinical Significance

Direct measurement of mesiodistal tooth width and individual variation of maxillary and mandibular permanent central incisor to first molar of the Bangladeshi individuals showed some distinguishable features, which will certainly help an orthodontist for diagnosis and treatment plan of an orthodontic case.

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