3D MORPHOMETRICS OF PERMANENT DENTITION IN GHAZIABAD (U.P, INDIA) POPULATION

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ABSTRACT

Introduction: Dental Anthropology is the study of teeth in a perspective beyond clinical science. That perspective includes the study of dental growth, theories on dental origin, primate dentition and population variation, Tooth size has been studied in subjects to study the influence of sex and to assess the variation in magnitude of sexual dimorphism and patterning of sexual dimorphism in permanent tooth size in various populations.

The size of the teeth is of great importance not only to indicate the different activities related to the occlusion or determine the frequency of dento-tooth anomalies applied to the orthodontic treatment, but also to establish sexual dimorphism.

Aim: To assess normal data of crown dimension(cervico-incisal, mesio-distal andlabio-lingual/bucco-lingual dimension) in Ghaziabad population.

Methodology: This study was done on patients visiting the outpatient department of Shree Bankey Bihari Dental College and Hospital, Masuri, Ghaziabad, also from various colleges and camps. Total number of sample included in present study was study models of 90 people (45 males and 45 females) with Age group of 18 – 30 years. All the study models in which anomalies were found were recorded separately.

Result: Total number of study models included in present study was 90. Measurement was done on study models made of Dental stone by means of Digital Vernier calipers Results were discussed in view of scientific knowledge and following conclusions are drawn:-

1. Cast availability is easy.

2. The size of the teeth is of great importance to establish sexual dimorphism.

3. Standard Odontometric data for one population should not be used for other population for the purpose of Forensic Dentistry and Dental Anthropology

4. Microdontia were the common anomalies and the least common was taurodontism.

Conclusion: Our study provides normative morphologic data and establishes the existence of statistically significant gender dimorphism among Ghaziabad population, but it is recommended to conduct similar studies on various populations for further confirmation.

INTRODUCTION

Morphometrics plays an important role in determining the gender in cases of major catastrophes when the bodies are often damaged beyond recognition. [1]

As stated by Lombardy, The mouth constitutes the dominant feature of the face by virtue of its size. The central incisor is the dominant tooth of the smile; thus dominance must be considered in harmony with personality.[2]

The foundations of dental science in general can be traced to the seventeenth and eighteenth centuries when Pierre Fauchard and John Hunter made basic observations on the number of human teeth. There were studies of components of teeth, tooth eruption, terminology, and descriptive anatomy.[3]

Dental Anthropology is the study of teeth in a perspective beyond clinical science. That perspective includes the study of dental growth, theories on dental origin, primate dentition and population variation.[3]

The term "Dental Anthropology" first appeared in the title of an article published in 1900 by George Buschan.[4]

Teeth are the most indestructible part and chemically the most stable tissues in the body and exhibit the least turnover of natural structure. Hence, teeth can provide excellent material in both living and nonliving populations for anthropological, genetic, odontological, and forensic investigations. [5]

Odontometry has proved useful in explaining some of the aspects of phylogeny and ontogeny of man's dentition. Odontometry also has proved useful in explaining variation in man's dentition.[6]

Tooth size standards based on odontometric investigations can be used in age and sex determination. [7]

The comparative anatomy of teeth provides crucial evidence for systematic classification and determining biological relatedness.[3]

Considering the fact that there are differences in odontometric features in specific populations, even within the same population in the historical and evolutional context, it is necessary to determine specific population values in order to make identification possible on the basis of dental measurements. It is considered that the odontometric features of teeth are population specific. [8]

The variation in tooth size is influenced by genetic and environmental factors. Some of the factors that contribute to the variability of permanent tooth size are race, sex, heredity, environment, secular changes and bilateral asymmetry. Environmental variables, such as nutrition, disease and climate, affect nutrition during the prenatal period but seem to have little influence on normal dental variation. [9]

Studies of tooth sizes in various races and ethnic groups have been conducted to show the effect of various gene pools on tooth dimensions.[10]

Tooth size has been studied in subjects to study the influence of sex and to assess the variation in magnitude of sexual dimorphism and patterning of sexual dimorphism in permanent tooth size in various populations.[11]

The size of the teeth is of great importance not only to indicate the different activities related to the occlusion or determine the frequency of dento-tooth anomalies applied to the orthodontic treatment, but also to establish sexual dimorphism (Buthz&Ehrhardt, 1938). [12]

According to Marin Vodanović et al., "Sex determination using dental features is primarily based upon the comparison of tooth dimensions in males and females, or upon the comparison of frequencies of non-metric dental traits, like Carabelli's trait of upper molars, deflecting wrinkle of lower first molars, distal accessory ridge of the upper and lower canines or shoveling of the upper central incisors". When analyzing the teeth, one must also take into consideration the differences in odontometric features between different populations, or one may be lead to a false conclusion in sex determination[13]

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There is little information regarding the tooth dimensions of the population in and around Ghaziabad which is intermingled with different cultural groups and to the best of our knowledge no study of this nature has been performed in this part of study.

Hence the study titled "3D Morphometrics of Permanent dentition population in Ghaziabad (U.P, India) population" was done with the following aims and objectives.

METHODOLOGY
SOURCE OF DATA
This study was done on patients visiting the outpatient department of Shree Bankey Bihari Dental College and Hospital, Masuri, Ghaziabad, also from various colleges and camps. Total number of sample included in present study was study models of 90 people (45 males and 45 females) with Age group of 18 – 30 years. All the study models in which anomalies were found were recorded separately.

Subjects included with Presence of all fully erupted permanent teeth up to second molars and age between 18 – 30 years

Subjects excluded in study were having no regressive alterations, No history of previous orthodontic treatment, No presence of faulty restorations or carious tooth. Neither significant gingival recession.

METHOD OF COLLECTING DATA
Dental casts of the subjects was obtained by making alginate impression from the maxillary and mandibular arch which was poured with type II dental stone. A digital Vernier caliper scale read to the nearest 0.01 mm was used to measure the teeth.

For the determination of cervico-incisal height of clinical crown, a vertical reference plane was taken and measured.

The vertical reference plane, for all the teeth up to the second premolars, represented the long axis of the clinical crown and is known as the facial axis of the clinical crown (FACC).

For the molars, the developmental groove between the mesio-buccal and disto-buccal cusps was identified and a line parallel to it running from the mesio-buccal cusp to the gingival margin was described to indicate the vertical reference plane.

The cervico-incisal height of the clinical crowns was measured by digital Vernier calliper using the incisal edge as the occlusal reference point for the incisors, cuspal tips for the canines and the premolars and for the molars the occlusal reference was the mesio-buccal cusp tip.

The mesio-distal diameter was measured from contact point to contact point which was taken at the maximum convexity of the tooth measured parallel to the occlusal plane and a plane parallel to the vestibular surface.

Bucco-lingual diameter was measured from greatest distance between the labial/buccal surface of the crown measured with the help of caliper perpendicular to mesio-distal width.

STATISTICAL ANALYSIS
Descriptive statistics was performed by calculating mean, standard deviation, frequencies and percentages for the Continuous variables. Categorical variables were summarized as frequencies and percentages.

The software used for the statistical analysis were **SPSS (statistical package for social sciences) version 21.0 and Epi-info version 3.0**.

RESULT
In the present study, sample sizes of 90 study models were taken as a study group, among which 45 were male and 45 were female covering age group of 18 to 30. This age group was

selected, as attrition is minimal in this age group. The study was conducted on the patients of Shree Bankey Bihari Dental College and Hospital, Ghaziabad.

The difference in the mean values of the mean values of males and females were analyzed statistically using t-test.

Table: 1   Mean, standard deviation and test of significance of mean values between males and females of maxillary arch for CIH of clinical crowns:

Maxillary arch	Male		Female				
Cervico-incisal height	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Central incisor	10.61	0.28	10.16	0.17	0.45	9.168	<0.001*
Lateral incisor	8.72	0.19	8.47	0.19	0.25	6.362	<0.001*
Canine	9.62	0.21	9.21	0.16	0.40	10.175	<0.001*
1st premolar	7.74	0.25	7.48	0.17	0.27	5.898	<0.001*
2nd premolar	6.73	0.32	6.46	0.15	0.27	5.202	<0.001*
1st molar	5.73	0.44	5.43	0.13	0.30	4.465	<0.001*
2nd molar	5.34	0.43	5.17	0.12	0.16	2.430	0.017*

Unpaired t-test   * Significant difference

The mean cervico-incisal height of maxillary central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was compared between males and females using the **Unpaired t-test**. The mean cervico-incisal height of maxillary central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more among males compared to females.

Table: 2   Mean, standard deviation and test of significance of mean values between males and females of mandibular arch for CIH of clinical crowns:

Mandibular arch	Male		Female				
Cervico-incisal height	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Central incisor	8.35	0.25	8.72	0.33	-0.37	-5.988	<0.001*
Lateral incisor	8.10	0.22	8.05	0.33	0.06	0.939	0.350
Canine	9.64	0.21	9.00	0.22	0.64	14.306	<0.001*
1st premolar	8.64	0.21	8.10	0.22	0.54	12.078	<0.001*
2nd premolar	7.59	0.21	7.05	0.22	0.54	12.078	<0.001*
1st molar	7.05	0.21	6.69	0.21	0.36	7.921	<0.001*
2nd molar	6.54	0.21	6.18	0.21	0.37	8.330	<0.001*

Unpaired t-test   * Significant difference

The mean cervico-incisal height of mandibular central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was compared between males and females using the **Unpaired t-test**. The mean cervico-incisal height of mandibular canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more among males compared to females. The mean cervico-incisal height of mandibular central incisor was significantly more among females.

Table: 3 Mean, standard deviation and test of significance of mean values between maxillary right and left for BLW of clinical crowns:

Maxillary arch	Right		Left		Mean Difference	t-test value	p-value
Bucco-lingual diameter	Mean	Std. Deviation	Mean	Std. Deviation			
Central incisor	6.97	0.36	7.05	0.30	-0.08	-1.538	0.110
Lateral incisor	6.34	0.29	5.74	0.24	0.60	6.604	0.030*
Canine	8.07	0.36	8.30	0.30	-0.23	-5.538	0.042*
1st premolar	9.17	0.32	9.28	0.36	-0.11	-1.718	0.078
2nd premolar	8.69	0.33	8.79	0.30	-0.10	-1.621	0.104
1st molar	10.95	0.38	11.08	0.29	-0.13	-1.437	0.098
2nd molar	10.88	0.31	11.03	0.25	-0.15	-1.607	0.119

Paired t-test   *** Significant difference**

The mean bucco-lingual diameter of maxillary central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was compared between right and left side using the **paired t-test**. The mean bucco-lingual diameter of maxillary lateral incisor was significantly more on right side. The mean bucco-lingual diameter of maxillary canine was significantly more on left side.

DISCUSSION

Identification of humans has been the mainstay of civilization. The identification of the deceased and the living is necessary, and has become an important and integral part of our daily life. The identification of sex is of significance not only in cases of mass fatality incidents where bodies are damaged beyond recognition but also in situations where only fragments of jaw bones with teeth (or teeth alone) are found, where sex determination is possible only with the help of teeth.[14]

Sexual dimorphism refers to the differences in size, stature, and appearance between males and females. This can be applied to dental identification also, because no two mouths are alike. The existence of sexual dimorphism in permanent teeth is a known phenomenon, as observed in several investigations.[15]

Sex determination is one of the important aspects of forensic sciences. Information concerning tooth size aids in sex determination of human remains. Many anthropologists have preferred odontometric techniques for the morphological assessment of differences in size and shape of the human remains.[16]

As compared to other ethnic groups, relatively few measurements on tooth size have been made on Indian population. The study titled- 3D morphometrics of Permanent dentitition in Ghaziabad(U.P India) population was carried out in the department of Oral and Maxillofacial Pathology and Microbiology, SreeBankey Bihari Dental College and Research Centre to assess normal data of crown dimensions [cervico-incisal height(CIH), mesio-distal width(MDW) and labio-lingual dimension] in Ghaziabad population.

Comparison between male & female on the basis of cervico-incisal height of maxillary& mandibular arch:

In the present study we observed the findings in which the mean cervico-incisal height of maxillary central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more among males compared to females. The mean cervico-incisal height of mandibular canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more among males compared to females. The mean cervico-incisal height of

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mandibular central incisor was significantly more among females. This result was similar to the study done by **Sridhar K, Arun AV, Karthikswamy, Kumar PK, Kumar CHS, Verma KVVP (2011)[17]** who concluded that cervico-incisal height are generally larger for male teeth compared to female.

Comparison between male & female on the basis of mesio-distal width of maxillary& mandibular arch:

The mean mesio-distal width of maxillary lateral incisor, canine, 1st molar and 2nd molar was significantly more among males compared to females. The mean mesio-distal width of mandibular central incisor, lateral incisor, canine, 1st molar and 2nd molar was significantly more among males compared to females. This result was similar to the study done by **Dash KC et al (2018)[18]** their study showed larger dimensions of tooth in males when compared to females (maxillary right and left central incisor, 1st and 2nd molar). Interestingly, reverse dimorphism was also observed in few teeth.

Comparison between male & female on the basis bucco-lingual width of maxillary& mandibular arch:

The mean bucco-lingual diameter of maxillary central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more among males compared to females. The mean bucco-lingual diameter of mandibular central incisor, lateral incisor, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more among males compared to females. This result was similar to the study done by **Wankhede PK, Munde AD, Shoeb SS, Sahuji S, Niranjan VR, Meka NJ(2017)[19]** who observed that males showed greater B‑L dimensions of teeth in comparison to females exhibiting statistically significant dimorphism. However, discriminant function analysis derived accuracy of determination of sex using 26 was 69% and 43 was 66.0%.

Comparison between right and left on the basis of cervico-incisal height, mesio-distal width, bucco-lingual width of maxillary & mandibular arch:

The mean cervico-incisal height of maxillary central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more on left side. The mean cervico-incisal height of mandibular central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar was significantly more on left side.

The mean mesio-distal width of maxillary lateral incisor and canine was significantly more on the left side. There was no significant difference in mean mesio-distal width of mandibular central incisor, lateral incisor, canine, 1st premolar, 2nd premolar, 1st molar and 2nd molar between right and left side.

The mean bucco-lingual diameter of maxillary lateral incisor was significantly more on right side. The mean bucco-lingual diameter of maxillary canine was significantly more on left side. The mean bucco-lingual diameter of mandibular 1st molar was significantly more on left side.

Sara Babu S et al (2016)[20] they observed that the mesio-distal (MD) and bucco-lingual (BL) parameters of all permanent teeth in the study group showed sexual dimorphism. Over 39% of the tooth variables showed reverse dimorphism. The comparison of mean values of MD and BL diameters of the maxillary and mandibular, right and left side teeth in male and female groups showed statistical significance in males.

In the present study distribution of anomelous dimensions of teeth:

Microdontia were the common anomalies followed by macrodontiaand taurodontism. Prevalence of Microdontiawas (54.5%). Maxillary teeth were more commonly affected as compared to mandibular teeth. There was involvement of lateral incisor and molar only. Lateral incisor were more commonly involved as compared to molar. Prevalence of Macrodontiawas (27.3%). Maxillary teeth were more commonly affected as compared to

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mandibular teeth. Lateral incisor, premolars and molars were not affected at all. Central incisors were more commonly affected as compared to canine.

We could not come across National prevalence, site preference of these anomalies for India. We recomended collaborative studies to make systemic organized prevalence, site predilections and other features of dental and orofacial anomalies at regional, district, state and National level.

CONCLUSION

The seemingly minor differences in dental traits among and within populations can be of great interest and importance to both anthropologists and practicing dentists. For anthropologists, these differences reflect the ongoing process of evolution and provide a method for studying evolutionary mechanics. For dentists these differences represent the variation that must be considered in the daily care of patients. India is a country of unity in diversity. Though people from different origin reside within one boundary but do exist. Various degrees of admixture within a population can result in a new genetic pool that further can contribute in formation structural variability in individuals. These structural variations are multifactorial and can include both skeletal structures and even the teeth. From an orthodontic point of view, it is important to determine the dental traits as well as the dentofacial relationships that result from this admixture because this data is of immense importance for personal identification specifically sex determination. There was no organized documentation of the variations of tooth size and shape in the populations of Uttar Pradesh. So keeping this view in mind this unique study was conducted to make a compiled cumulative odontometric data of populations in and around Ghaziabad. The study was designed with 90 study models .In result a significant variations was observed in the odontometric data involving male and female. Microdontia was found to be the common anomalies. After proper evaluation of the obtained data it was concluded that cast measurement is easy and acceptable.

Our study provides normative morphologic data and establishes the existence of statistically significant gender dimorphism among Ghaziabad population, but it is recommended to conduct similar studies on various populations for further confirmation.

The anthropologic science of measuring the size and proportion of teeth is called odontometry. Teeth provide by far the best record for evolutionary change. Variation in tooth size is influenced by genetic and environmental factors. Some of the factors are race, sex, heredity, environment. "Sexual Dimorphism" refers to those differences in size, stature and appearance between male and female that can be applied to dental identification because no two mouths are alike. The size of the teeth also determines the frequency of dento-tooth anomalies.

The study was conducted to analyseodontometric data (Mesio-distal crown, Bucco-lingual, Cervico-incisal dimensions) in permanent dentition using dental casts of population in and around Ghaziabad in the Department of Oral Pathology and Microbiology, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad.

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