Research Article

Mesiodistal width of maxillary central incisors between different genders in Indian population – A cross cone-beam computed tomography study

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ABSTRACT

Background: Many anatomical structures in humans such as palatal rugae and lip prints have been studied for gender determination, although the teeth and their measurements seem to be one of the commonly employed methods. However, differences in tooth size, variations in root length and crown diameter, dental index, odontometric differences, Barr bodies, and using enamel protein have also been tried for sex determination. Teeth, which are the hardest and chemically the most stable tissue in the body are excellent material in living and non-living populations for anthropological, genetic, odontologic, and forensic investigations. **Aim:** To determine whether is there any differences in mesiodistal (MD) width of permanent maxillary central incisors between different genders. **Materials and Methods:** The sample consisted of 50 cone-beam computed tomography (CBCT) (25 male, 25 female, and aged 18–40) which is required from Department of Oral Medicine. The total number of teeth involved is 100. The MD width was measured by the use of scale in CBCT software at three regions which are apical third, middle third, and cervical third region. The measurement was repeated 3 times for each measurement. Data were analyzed. Mean and standard deviation values were calculated for each variable. All the measurement was done by a single examiner and each reading was taken 3 times, and the average of the values was obtained to minimize calculative error. **Results:** Males showed greater mean MD dimension for both of the teeth if compared to females. Statistical analysis of the tooth showed that MD dimension of right and left maxillary central incisors for male is significantly different in males compared to those in females. **Conclusion:** Sex determination using measurement of the teeth is an inexpensive and easy method of gender identification from fragmented jaws and dental remains. The results of the present study revealed that maxillary central incisors showed statistically highly significant sexual dimorphism and could be used as adjuncts for the determination of gender in individuals, as well as in groups, such as in mass disasters and archaeological sites.

KEY WORDS: Females, Males, Mesiodistal dimension, Permanent central incisors, Sex determination

INTRODUCTION

Sex determination of remaining skeletal forms part of archaeological and medicolegal examinations. The methods depend on the available bones and their condition.[1] Sex identification plays important role in cases of mass fatality incidents where bodies are damaged beyond recognition.[2] The only method that can give a totally accurate result is the DNA technique, but in many cases for several reasons it cannot be used.[3] Furthermore, in situations where only fragments of jawbones with teeth (or teeth alone) are found, then sex determination is possible only with the help of teeth. Many anatomical structures in humans such as palatal rugae and lip prints have been studied for gender determination, although the teeth and their measurements seem to be one of the commonly employed methods.[4] However, differences in tooth size, variations in root length and crown diameter, dental index, odontometric differences, Barr bodies, and using enamel protein have also been tried for sex determination. Teeth, which are the hardest and chemically the most stable tissue in the body are an excellent material in living and non-living populations for anthropological, genetic, odontologic, and forensic investigations.[2] Tooth size standards based on odontometric investigations can be used in age and sex determination.[5] According to the tooth

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size standards, whenever, it is possible to predict the sex, identification is simplified because then only missing persons of one sex need to be considered. In this sense, identification of sex takes precedence overage.[6] Sex determination using dental features is based on the comparison of tooth dimensions in males and females or on the comparison of frequencies of nonmetric dental traits such as Carabelli's trait of upper molars, deflecting wrinkle of the lower first molars, distal accessory ridge of the upper and lower canines, or shoveling of the upper central incisors.[7] The two most commonly used and researched features in determining sex based on dental measurements are the mesiodistal (MD) and buccolingual (BL) crown diameters of particular teeth. This is actually based on the fact that although the morphology of the tooth structure is similar in males and females, the size of the tooth does not necessarily remain the same, as the tooth size is determined by cultural, environmental, racial, and genetic factors.[8] "Sexual dimorphism" refers to those differences in size, structure, and appearance between males and females that can be applied to dental identification because no two oral cavities will be alike.[9] Commonly, the sexual dimorphism is more pronounced in permanent dentition than in deciduous teeth. The magnitude and pattern of sexual dimorphism in the size of permanent teeth also differ from one population to another. The purpose of this study was to evaluate the existence of sexual dimorphism using both MD dimensions of maxillary central incisors.[10] Further, sex can also be determined accurately in mature individuals if the postcranial skeleton is intact. However, in young children, determination of sex from the skeleton is difficult.[11]

History of Cone-beam Computed Tomography (CBCT)

The development of medical X-ray CT is generally credited to two physicians known as Drs. G. N. Hounsfield and Cormack.[12] In 1955, Cromack was asked to spend 1.5 days/week working at Groote Schuur Hospital (Cape Town South Africa) to attend the use of isotopes after the hospital physicist resigned. He came to realize the importance of knowing the X-ray attenuation coefficient distribution inside the body while observing the planning of radiotherapy treatments. Later in 1956, Cormack formulated a mathematical theory for image reconstruction and tested his theory in laboratory stimulation when he returned in South Africa. In September 1971, the first CBCT device was installed at Atkinson Morley Hospital (London, England). In October 1971, the first patient with a large cyst was scanned and the pathology was clearly visible.[13] Both of them shared the Nobel Prize in physiology and medicine in 1979. CBCT scanners are based on volumetric tomography, which used a two-dimension extended digital array providing an area detector. This will be combined with a three-dimension (3D) X-ray beam. The cone-beam technique comprises a single 360° scan in which the X-ray source and a reciprocating area detector synchronously move around the patient's head, which is stabilized by a head holder. At certain degree intervals, single projection images, which are known as "basis" images, are acquired. These are quite similar to lateral cephalometric radiographic images, each slightly offset from one another. This series of basis projection images are referred as projection data. Software programs including back-filtered projection are applied to these image data to generate a 3D volumetric data set, which can be used to provide primary reconstruction images in three orthogonal planes, which are axial, sagittal, and coronal. Some of the advantages of CBCT are due to image accuracy, X-ray beam limitation, rapid scan time, and reduced image artifact.

MATERIALS AND METHODS

The sample consisted of 50 CBCT (25 male, 25 female, and aged 18–40) which is required from Department of Oral Medicine. The total number of teeth involved is 100. The MD width was measured by the use of scale in CBCT software at three regions which are apical third, middle third, and cervical third region. The measurement was repeated 3 times for each measurement. Data were analyzed. Standard deviation and mean values were calculated and evaluated for each variable. All the measurement was done by a single examiner and each reading was taken 3 times, and the average of the values was obtained to minimize calculative error.

RESULTS

Table 1 shows the description of the tooth involved selected for the study such as mean value and standard deviation and *P* value for males and females separately.

Males showed a greater mean MD dimension for both of the teeth if compared to females. Statistical analysis of the tooth showed that MD dimension of the right and left maxillary central incisors for males is significantly different in males compared to those in females.

DISCUSSION

The morphology and general structure of teeth in both men and women are quite similar; however, there are subtle differences such as variation in dental size that can provide a clue about the differences present between the sexes. Following this pattern, teeth can be regarded as paramount step for sex determination as they are resist to postmortem destruction and fragmentation. Identification is simplified whenever it is possible

Table 1: Mean values and standard deviation of maxillary central incisors between different genders

Tooth	Mean value male	Mean value female	SD male	SD female	*P* value
11	8.57	8.37	0.821	0.526	0.11379
21	8.57	8.51	0.521	0.518	0.28448

SD: Standard deviation

to predict the sex because then missing persons of only that sex need to be considered.[14] Even though DNA profile gives accurate results but measurement of linear dimensions such as arthopometric or odontometric parameters can be used for determine sex or genders in large populations because the technique is quite simple, easy to measure, and inexpensive. Furthermore, it is necessary to determine specific population values to make identification possible on the basis of dental measurement considering the fact that there are differences in odontometric features in specific populations even within the same population in historical and evolutional context.[15] Therefore, the study evaluated MD dimension of permanent maxillary central incisors for males and females of South Indian population. According to Doris *et al*., it was indicated that the early permanent dentitions provide the best sample for tooth size measurements because early adulthood dentition has less mutilation and less attrition in most individuals. Consequently, the effect of these factors would be minimum.[16] Various odontometric dimensions have been used for the purpose of sex estimation such as mandibular canine index,[17] BL dimension of the teeth,[15], and height of the tooth.[7] In this study, the MD width of the permanent maxillary central incisors was measured based on CBCT. Based on the results also, it was showed that MD dimension of male dentition is greater than those of females which is accordance with previous studies. Based on Richardson and Malhotra, it was found that the teeth of males tend to be larger than those of females for each type of tooth in both the arches.[18] Even among good occlusion cases, it was reported by Sanin and Savara that there are differences in crown size patterns.[19] Apart from that, Howe *et al.* found MD width for males to be more in comparison to the females population.[20] Statistically significant dimorphism was exhibited by only two permanent maxillary anterior teeth which are right and left maxillary central incisors. Several studies have investigated the possible reasons for the morphological and developmental difference in teeth between men and women. According to animal model studies, it was suggested that specific genetic factors might get involved with specific types of tooth development.[21] The previous study was done by Schwartz and Dean[22] clarified that sex hormone concentrations during development could influence dental tissue proportions in teeth forming at different times or moments. Saunders *et al*.[23] obtained histological sections from molars and observed that males showed significantly greater dentin area, enamel-dentin junction length, and bi-cervical diameter in specific tooth types, whereas women presented significantly thicker average enamel. Sexual dimorphism can be explained through some theories. One of the theories is due to the longer period of amelogenesis in males compared to females, which leads to greater thickness in enamel in males. Apart from that, sex chromosomes also influenced the different effects on tooth size. Compared to the "X" chromosome, the "Y" chromosome influences the timing and rate of body development, thus producing slower male maturation. Another important aspect of local factors that can be taken into consideration is the ethnicity differences.

CONCLUSION

Sex determination using the measurement of the teeth is an inexpensive and easy method of gender identification from fragmented jaws and dental remains. The results of the present study revealed that maxillary central incisors showed statistically highly significant sexual dimorphism and could be used as adjuncts for the determination of gender in individuals, as well as in groups, such as in mass disasters and archaeological sites.

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