

Tooth Dimension as a Distinguishing Trait Between Human Sexes

An odontometric study on Bagalkot population

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Abstract

Forensic odontology is a lineage that deals in relation to jaws and teeth as an evidence to law and justice. Tooth serves a prime importance in the context of sex identification. This study is an odontometric analysis performed on dental casts with a sample of 952 teeth (476male: 476 female) which were obtained from Dept. of Orthodontics PMNM dental college Bagalkot. Mesiodistal and Buccolingual dimension of each tooth crown was measured with a caliper device and statistical analysis for significance of sexual dimorphism was done with student's t test. The result showed that sexual dimorphism is significant in relation to mesiodistal diameter of canine ($p=0.007$ maxilla $p=0.003$ mandible) and buccolingual diameter of canine ($p=0.012$ maxilla, $p=0.015$ mandible) followed by mandibular premolar ($p=0.016$) but less significant in case of lower lateral incisors ($p=0.013$). Furthermore, there was statistical significant difference in tooth crown dimension between males and females where the males showed higher mean values. The results of the current investigation are of great value to the anthropologist as well as to the forensic odontologist in understanding dimensional variation in genders.

Key words

Odontometry, Tooth dimensions, Forensic.

Introduction

Forensic dentistry is an interdisciplinary science which in everyday practice applies to all the knowledge of dental science, widely speaking the natural sciences¹. The signs of forensic dentistry deals with relation of teeth and

jaws as evidence to law and justice, and one of the principle objectives in this field are the personal identification and sex determination. The core of personal identification is by recording the post mortem observations, and comparing these with anti mortem records. The presence of restorations, dentures etc. could be compared. But sex determination is rather difficult in examining the destroyed jaws, skeletal remains and tooth of unidentifiable dead bodies. Bodies of people who have been deceased for some time prior to discovery and those found in water also present objectionable and difficult identification. Through the specialty of forensic dentistry, dentist can play a small but significant role in this process. By identifying the victims of crime and disaster through guidelines and standards a dentist can assist those involved in crime investigation. Teeth are known to be unique organs made of the most enduring mineralized tissues in the human body. As such, they are resistant to mechanical, chemical, physical and thermal types of destruction. Therefore, they are very important elements in the identification of skeletal remains, especially in cases when, due to the poor preservation of skeletal remains, the identification is not possible by standard methods.² 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.³Therefore, odontometrics provide exhaustive information on the sex of the deceased. There are numerous studies in which differences in male and female odontometric features have been identified. Considering the fact that there are differences in odontometric features in specific populations, even within the

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same population in the historical and evolutionary context, it is necessary to determine specific population values in order to make identification possible on the basis of dental measurements⁴. Sexual dimorphism of teeth has been studied extensively by means of odontometric analyses, and most studies have shown statistically significant differences.⁵ These values can be of use in determining sex in specific cases: in individual, as well as in group (mass disasters, archaeological sites, etc.).⁶ The present study is an attempt to present odontometrics as an easy-to-use additional technique to determine sex in south indian population without the use of the complicated statistical softwares.

Material and Methods

The study comprised of 952 sample teeth (476Male: 476Female) obtained from dental casts in the age range of 16-27 years selected from the Department of the orthodontics PMNM dental college Bagalkot. The casting was done in a standard way used by dentists. All subjects were free from obvious problems that could disfigure or affect the face and dentition. The impressions were taken with alginate and casts were poured immediately with type IV dental stone to minimize the dimensional changes. Manual vibration was done to eliminate air bubbles.

Inclusive criteria for cast selection were as follows:

1. Presence of all permanent teeth from central incisors to second molars in all four quadrants.
2. No history of previous orthodontic treatment.
3. Absence of malpositioned, heavily worn and carious teeth in the cast.
4. No evidence of bubbles or fractured teeth in dental casts.

Instrument & Measurement Methods

Measurements of the permanent tooth crown were taken with a sliding vernier calliper, which was sensitive to 0.1 mm. The measurements were performed by one person and all values were measured in millimeters and average was rounded to two decimal places. In order to assess the reliability of the measurements,

intraobserver error was tested by notifying multiple readings at its greatest convexity and highest among these was taken. Each tooth was measured in two different dimensions i.e. mesiodistal and buccolingual.

Mesiodistal crown diameter

Mesiodistal diameter of the tooth crown was taken at the greatest mesiodistal dimension parallel to the occlusal and facial surface of the crown.

Buccolingual crown diameter

Buccolingual crown diameter was the greatest distance between the facial and lingual surfaces of the crown, taken at right angles to the plane in which the mesiodistal diameter was taken.

Statistical Analysis

Statistically significant sexual dimorphism in male and female odontometric features was tested by the Student's t-test in Microsoft excel 2007. The level of statistical significance was set at $p < 0.05$.

Results

The measurement of the mesiodistal diameter was conducted on a total of 952 permanent teeth. There was a statistically significant difference in the mesiodistal diameter of the crown of the maxillary canine and mandibular canine. In males the measured value for canine was 8.09 mm in maxilla, 7.11mm in mandible ($p < 0.007$) and females showed 7.49 mm in maxilla, 6.31 mm in mandible ($p < 0.003$), Table 1. The buccolingual diameter of the tooth crown was measured on a total of 952 permanent teeth. There were statistically significant differences between males and females in the buccolingual diameter of the crown of the maxillary canine (males 7.68 \pm 0.70 mm, females 7.16 \pm 0.60 mm, $p < 0.020$), and the mandibular first premolar (males 7.76 \pm 0.75 mm, females 7.06 \pm 0.50 mm, $p < 0.016$), Table 2.

We have also estimated the amount of sexual dimorphism calculated as $100\left(\frac{M}{F} - 1\right)$ for each tooth, as also given in the graph 1& 2. Canines showed maximum percentage of sexual dimorphism in maxilla and mandible (mesiodistally 9.1&10.4, buccolingually 8.6 & 11.4 respectively)

Table 1 : Mesiodistal diameter of the crowns, Average diameter, Standard deviation and p value

MESIODISTAL DIAMETER OF THE CROWN							
	MALE			FEMALE			p-VALUE
	N	AVG (mm)	SD	N	AVG (mm)	SD	
MAXILLA							
CI	34	8.61	0.38	34	8.24	0.70	0.045
LI	34	6.97	0.30	34	6.93	0.43	0.066
C	34	8.09	0.19	34	7.49	0.50	0.007*
PMI	34	7.50	0.38	34	6.90	0.32	0.094
PMII	34	6.89	0.34	34	6.82	0.36	0.166
MI	34	10.80	0.47	34	10.53	0.46	0.156
MII	34	10.17	0.20	34	9.36	0.24	0.095
MANDIBLE							
CI	34	4.95	0.60	34	4.91	0.49	0.015*
LI	34	5.39	0.51	34	5.22	0.62	0.025
C	34	7.11	0.22	34	6.31	0.53	0.003*
PMI	34	7.76	0.43	34	6.97	0.47	0.116
PMII	34	7.36	0.50	34	7.43	0.73	0.062
MI	34	11.79	0.34	34	10.87	0.64	0.060
MII	34	10.59	0.42	34	9.71	0.63	0.053

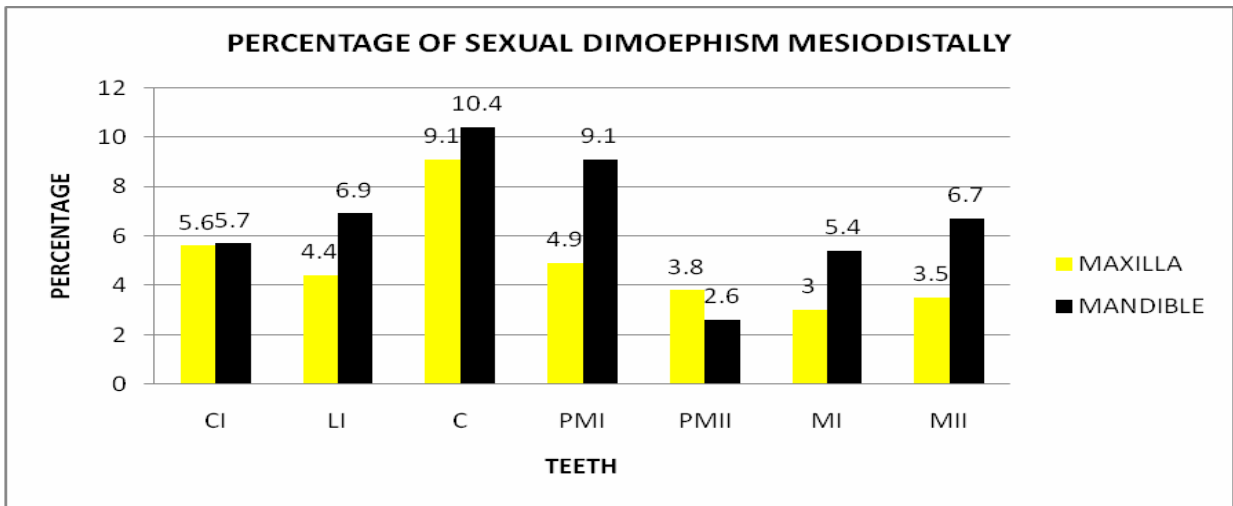
N, number of teeth; A, average; SD, standard deviation; *, statistically significant; CI, central incisor; LI, lateral incisor; C, canine; PMI, first premolar; PMII, second premolar; M1, first molar; MII, second molar

Table 2: Buccolingual diameter of the crowns, Average diameter, Standard deviation and p value

LABIOLINGUAL DIAMETER OF THE CROWN							
	MALE			FEMALE			p-VALUE
	N	AVG (mm)	SD	N	AVG (mm)	SD	
MAXILLA							
CI	34	7.10	0.36	34	6.76	0.68	0.052
LI	34	6.14	0.38	34	5.85	0.53	0.378
C	34	7.68	0.53	34	7.16	0.63	0.020*
PMI	34	8.69	0.41	34	8.46	0.68	0.176
PMII	34	8.67	0.48	34	8.54	0.42	0.264
MI	34	10.98	0.54	34	10.72	0.81	0.039
MII	34	10.16	0.40	34	9.81	0.93	0.069
MANDIBLE							
CI	34	5.42	0.57	34	5.04	0.64	0.395
LI	34	5.81	0.62	34	5.39	0.58	0.083
C	34	7.05	0.45	34	6.39	0.69	0.045
PMI	34	7.76	0.37	34	7.06	0.39	0.016*
PMII	34	8.30	0.36	34	7.97	0.17	0.355
MI	34	10.78	0.47	34	9.78	0.42	0.059
MII	34	9.74	0.53	34	9.42	0.53	0.134

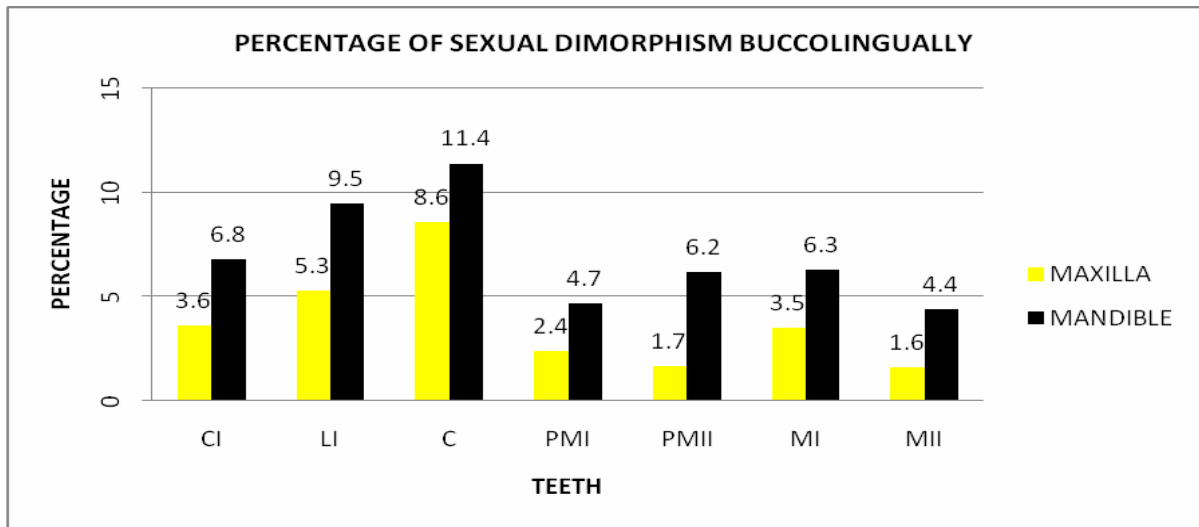
N, number of teeth; A, average; SD, standard deviation; *, statistically significant; CI, central incisor; LI, lateral incisor; C, canine; PMI, first premolar; PMII, second premolar; M1, first molar; MII, second molar

Graph 1 showing percentage of sexual dimorphism mesiodistally in crowns



CI, central incisor; LI, lateral incisor; C, canine; PMI, first premolar; PMII, second premolar; MI, first molar; MII, second molar

Graph 2 showing percentage of sexual dimorphism buccolingually in crowns



Discussion

Sex determination, one of the indispensable features of identification is a much more challenging task. Unfortunately, it is also much less unswerving if performed on poorly preserved remains. Teeth can be reliable marker to raise the percentage of success in sex determination, as they are an excellent material in living and nonliving population for anthropological, genetic, odontologic and forensic investigations. Their robustness in the face of fire and bacterial decomposition makes them of great magnitude for identification.

Although human sexes differ from each other considerably, still there are population based anatomical variations in teeth. Many researchers

have done studies on the parameters of teeth anatomy. The canine index was analyzed by Pettenati et. al. and they proved that the tooth diameters can be successfully used in determining sex in cases with poor skeletal remains. Stroud et al 1994 showed that males have larger mesiodistal diameter of a single tooth, which may be attributed to thicker dentine. The Mesiodistal and Buccolingual diameter of the permanent tooth crown are the two most commonly used and researched features used in determination of sex on the basis of dental measurements. Teschler & Nicola 1998 performed an investigation on French students and confirmed the difference existing between male and female buccolingual diameter of mandibular canine. They concluded that

odontometrics was an immediate and uncomplicated method of sex determination. A study on Chinese population performed by Lew and Keng in 1991 revealed statistically significant difference between male and female in mesiodistal and buccolingual diameter of canine.

The present study was done on Bagalkot population in South India which sustain the earlier studies and emphasize that dental dimorphism may be used for sex identification. This method is easy on the pocket; require no proficiency apart from the fundamental particulars of dentistry. The present study establishes the existence of a noteworthy statistically significant sexual dimorphism in buccolingual and mesiodistal diameter of permanent canines, first mandibular premolar and mandibular lateral incisors. In order to avoid statically errors in this study all teeth exhibiting macroscopic changes were excluded. A number of researchers have shown that males have larger teeth than females (Teschler-Nicola 1998, Muller et al 2001, Lew & Keng 1991). This is confirmed by the present study. It is considered that the odontometric features of teeth are population specific (Iscan & Kedici 2003). India is a large fraction of world population , such studies would generate a raised area for making the dimensional data of Indian population as a standard that may be of beneficial in educational, research and forensic fields in India.

Conclusion

The advantage in determining sex by the means of odontometric features is its easiness, rapidity and cost effectiveness, while the utmost

disadvantage is the leeway of error in the cases where the normal dimension of the teeth is distorted. Statistically significant values in permanent canine obtained in this study strengthen the previous studies in Indian population. This procedure of examination may be of relative importance while determining the sex of an individual but not of absolute certainty. Therefore it can be taken as an adjunct to various other methods of sex identification.

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