Original Article

Determination of sexual dimorphism via maxillary first molar teeth in Himachali population

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Abstract

Context: Sex determination of skeletal remains forms part of archaeological and medicolegal examinations. It is an aspect of forensic odontology. Forensic odontology primarily deals with identification, based on recognition of unique features present in an individual's dental structures. Correct sex determination limits the pool of missing persons to just one half of the population. **Aim of Study:** Purpose of this study is to evaluate the existence of sexual dimorphism and variation in left and right maxillary first molars using bucco-lingual and mesio-distal dimensions in population of Sirmour District, H.P. **Materials and Methods:** Base sample comprised 100 subjects (50 males and 50 females) of an age group ranging from 17 to 25 years. **Statistical Analysis Used:** Unpaired *t*-test. **Results:** It was observed that the comparison of mean values of bucco-lingual and mesio-distal parameters showed highly statistically significant differences between males and females, measured both intraorally and on study casts. There were no significant differences between the mean values of both the parameters on the left side as compared to right side. **Conclusion:** The study concludes that *sexual dimorphism is population specific.* Among Himachali people, mesio-distal dimensions and bucco-lingual dimensions of first molar can aid in sex determination.

Key words: Bucco-lingual, mesio-distal, sexual dimorphism

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Introduction

Sex determination in forensic anthropology is an essential step for medico-legal purposes.[1] Teeth are an excellent material for anthropological, genetic, odontological and forensic investigations as they are known to resist a variety of ante-mortem and post-mortem insults.[1,2]

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Moreover, differences in odontometric features exist in specific populations and within same population. So, it is necessary to determine specific population values in order to make identification possible on the basis of dental measurements.[3]

This study evaluates the existence of sexual dimorphism and variation in left and right maxillary first molars using bucco-lingual and mesio-distal dimensions measured both intraorally and on study casts.

Materials and Methods

Armamentarium used were digital vernier caliper, alginate and type-II dental stone. The base sample comprised 100 subjects (50 males and 50 females) of an age group ranging from 17 to 25 years. This was attributed to minimum

rates of attrition and abrasion at this age, affecting occlusal and proximal tooth surfaces. The study was done in Sirmour district, H.P.

The inclusion criteria taken into consideration were healthy state of periodontium, caries-free teeth and the presence of bilateral maxillary first molars. Maxillary first molars have been chosen for the study as they are the first permanent teeth to erupt into the oral cavity at the mean age of 6-7 years and are less commonly impacted as compared to canines.[4]

The exclusion criteria included the patients undergoing and who have undergone the orthodontic treatment.

Method
Following informed consent, impressions of maxillary arch were made with irreversible hydrocolloid (alginate) material and casts poured immediately in type II dental stone to minimize dimensional change. Bucco-lingual (BL) and mesio-distal (MD) diameters of maxillary first molars were measured using digital vernier calipers (resolution 0.01 mm) both intraorally and on study casts.[5]

MD diameter of the crown
This measurement is the greatest mesiodistal dimension between the contact points of teeth on either side of jaw[5] [Figures 1 and 2].

BL diameter of the crown
This measurement is the greatest distance between buccal and lingual surfaces of crown, taken at right angles to the plane in which mesiodistal diameter is taken[5] [Figures 3 and 4].

The measurements were performed by one person and all values were rounded to two decimal places. In order to assess the reliability of the measurements, intra-observer error was tested. Same measurements were obtained. The mean values of BL and MD dimensions of males and females were subjected to the formula to calculate sexual dimorphism: [6]

$$\text{Sexual dimorphism} = \frac{Xm}{Xf} -1 \times 100$$

Where,
Xm = mean value for males and
Xf = mean value for females

A *reference point* was obtained to differentiate males from females, by using the following procedure:[7]

Reference point = [(mean male dimension - SD) + (mean female dimension + SD)] % 2.

If the linear values of bucco-lingual and mesio-distal dimensions are higher than their respective reference points, the individual is considered to be a male otherwise a female.[7]

The data obtained were subjected to statistical analysis with the Microsoft Excel, using descriptive statistics. The unpaired *t*-test was applied to compare the dimensions measured for males and females. A $P \leq 0.05$ was considered statistically significant.

Results

Following parameters were determined intraorally and on study casts in males and females:
a. BL diameter of right and left maxillary first molars.
b. MD diameter of right and left maxillary first molars.

- It was observed that the comparison of mean values of bucco-lingual and mesio-distal parameters showed
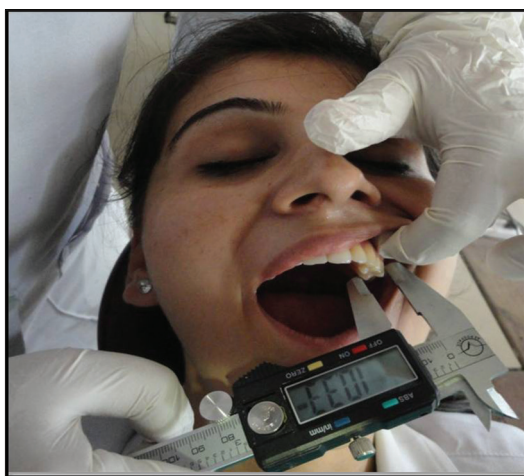

Figure 1: Bucco-lingual dimension of maxillary first molar tooth measured intraorally

Figure 2: Bucco-lingual dimension of maxillary first molar tooth measured on study casts

Figure 3: Mesio-distal dimension of maxillary first molar tooth measured intraorally

Figure 4: Mesio-distal dimension of maxillary first molar tooth measured on study casts

highly statistically significant differences between males and females, with *P* < 0.05, measured both intraorally [Table 1, Graph 1] and on the study casts [Table 2, Graph 2]

- The present study showed no significant differences between the mean values of both the parameters on the left side as compared to right side
- Then, the reference points were calculated separately for mesio-distal and bucco-lingual dimensions, both intra-orally and on the study casts. The results were found to be 95% reliable [Table 3].

Result percentage = (380/400)*100 = 95%

Discussion

Sex determination is one of the prime factors employed to assist with the identification of an individual. The accuracy of sex determination using diverse parameters of the body such as craniofacial morphology and measurements on the pubis ranges from 96% to 100%.[8]

The human dentition has a complement of 32 teeth; at least a few teeth may be recovered. Hence, they are routinely used in comparative identification of human remains. Moreover, the fact that most teeth complete development before skeletal maturation makes the dentition a valuable sex indicator, particularly in young individuals.[4]

The present study established the morphometric difference of maxillary first molars in both males and females and its role in sex determination. Bucco-lingual and mesio-distal diameters of right and left maxillary first molars in males and females were measured both intraorally and on study casts.

The comparison of mean values of parameters measured between males and females showed highly statistically

Table 1: Dimensions of mesio-distal and bucco-lingual parameters of males and females measured intraorally

Intra-oral measurements						
Parameter	Gender	Side	Mean (mm)	SD	*P* (R/L)	*P* (M/F)
Mesio-distal (MD)	Male (M)	Right (R)	10.94	0.541	0.42	0.00**
		Left (L)	10.97	0.559		0.00**
	Female (F)	Right (R)	10.56	0.523	0.15	0.00**
		Left (L)	10.45	0.539		0.00**
Bucco-ligual (BL)	Male (M)	Right (R)	10.23	0.600	0.37	0.01**
		Left (L)	10.19	0.660		0.04*
	Female	Right (R)	9.96	0.522	0.36	0.01**
		Left (L)	10.00	0.565		0.01**

(**-Highly singnificant, *-Significant)

Table 2: Dimensions of mesio-distal and bucco-lingual parameters of males and females measured on study casts

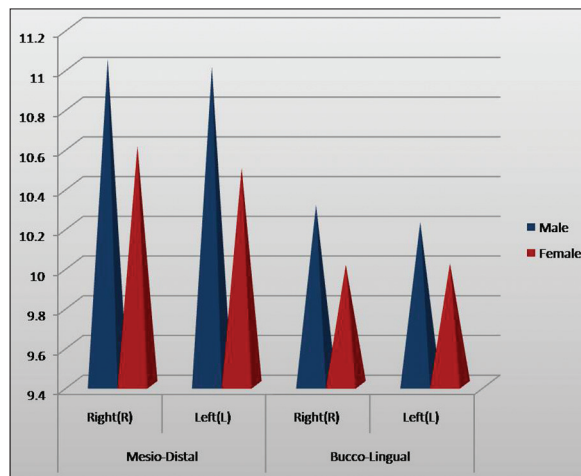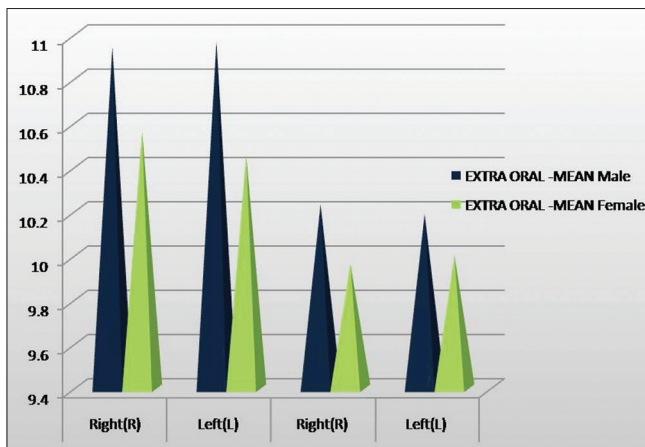| Measurements on study casts						
Parameter	Gender	Side	Mean (mm)	SD	*P* (R/L)	*P* (M/F)
Mesio-distal (MD)	Male (M)	Right (R)	11.04	0.579	0.36	0.00**
		Left (L)	11.00	0.545		0.00**
	Female (F)	Right (R)	10.60	0.539	0.16	0.00**
		Left (L)	10.49	0.582		0.00**
Bucco-ligual (BL)	Male (M)	Right (R)	10.31	0.698	0.26	0.01**
		Left (L)	10.23	0.649		0.04*
	Female	Right (R)	10.00	0.591	0.47	0.01**
		Left (L)	10.01	0.622		0.04*

(**-Highly singnificant, *-Significant)

significant differences with *P* < 0.05 and these results were in agreement with the studies done by Rai *et al*.,[9] in which they have observed that the males had larger teeth than females in all the dimensions.

This could be attributed to differences in enamel thickness due to the long period of amelogenesis in males.

Table 3: Reference points for mesio-distal and bucco-lingual parameters

Parameter	Measurements	Side	Sexual dimorphism	Reference point	Number of cases (more than reference point)	Number of cases (less than reference point)
Mesio-distal (MD)	Extraoral	Right (R)	4.15	10.80	49	51
		Left (L)	4.87	10.77	54	46
	Intraoral	Right (R)	3.61	10.74	50	50
		Left (L)	4.92	10.70	51	49
Bucco-ligual (BL)	Extraoral	Right (R)	3.02	9.51	51	49
		Left (L)	2.02	10.11	54	46
	Intraoral	Right (R)	2.68	10.06	56	44
		Left (L)	2.22	10.08	55	45
					420	380

Graph 1: Dimensions of mesio-distal and bucco-lingual parameters of males and females measured intraorally

Graph 2: Dimensions of mesio-distal and bucco-lingual parameters of males and females measured on study casts

However, in females the completion of calcification of the crown occurs earlier in both deciduous and permanent dentition.[10]

Sex chromosomes are also known to cause different effects on tooth size. Y chromosome increases the mitotic potential of the tooth germ and induces dentinogenesis; whilst the X chromosome induces amelogenesis owing to the greater dentin and enamel thickness respectively in males as compared to females.[4]

The present study showed that the comparison of mean values of all parameters on the left and right side was statistically insignificant whether measured intraorally or on study casts. The results were in agreement to the study conducted by Narang *et al.*,[10] and were in disagreement to the study conducted by Rai *et al.*[9] and Sonika *et al.*,[4] who found the left bucco-lingual dimensions of maxillary first molars to be greater than its counterparts. Studies conducted by different researchers on various populations have shown a varied percentage of dimorphism in the maxillary teeth.[4,-6,10]

Conclusion

The study concludes that *sexual dimorphism is population specific*. Among Himachali people, mesio-distal dimensions and bucco-lingual dimensions of first molar can aid sex determination. *Sex determination using linear dimensions of maxillary first molar teeth among Himachali people is lacking in literature. The gap in literature is what this study intends to fill.* It is recommended to conduct similar studies on various populations taking greater sample size for further confirmation.

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