ORIGINAL RESEARCH

Sex Determination Using Diagonal Measurement Of Teeth In A Tribal And An Urban Population: A Comparative Study

Rakesh Kumar Dumpala,[1] Venkateswara Rao Guttikonda,[2] Jayakiran Madala,[3] Sudheer Kanth[3]

ABSTRACT:

Introduction: Sex determination is a vital step in reconstructing an individual profile from unidentified skeletal remnants. Pelvis, skull and mandible were used as traditional sex indicators although teeth can also be useful when such segments are not available. The objective of the present study was to assess the dimorphic status of mesiobuccal to distolingual (MB-DL) and disto-buccal to mesio-lingual (DB-ML) widths of right maxillary canines, premolars and first molars in a tribe and an urban population.

Materials and methods: 30 subjects each of the urban and tribal population in equal gender ratio were selected from Khammam district, Telangana state. Maxillary study models were cast and maximum MB-DL and DB-ML of permanent right maxillary canines, premolars and first molars in a tribe and an urban population were measured using digital vernier calipers. Data obtained was subjected to statistical analysis.

Results: All measures were found to show statistically significant differences between tribal and urban population according to student's t-test ($P< 0.006$) with respect to teeth measured except for first premolar. Statistically significant difference ($P<0.01$) was found between the diagonal dimensions of teeth measured in males and females of tribal population, except for the first premolar. There was no statistically significant difference between the diagonal dimensions of teeth measured in males and females of urban population.

Conclusion: Among the four teeth evaluated, maxillary first molar showed the highest percentage of sexual dimorphism in tribal population, suggesting a high reliability rate for using these tooth in estimation of sex.

Key words: Diagonal measurement, Odontometrics, Sex determination, Sexual dimorphism

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Conflict of Interest: None

INTRODUCTION

Sex determination of skeletal remnants is a vital step in reconstructive identification, considering that it excludes one-half of the population, thereby aiding a more precise search of the identity of the deceased. [1,2] Sex determination in forensic investigations utilises skeletal parameters such as the pelvis and skull bones to produce accurate results. [3] Although, DNA analysis provides irrefutable evidences on sex identification, such a technique is relatively prolonged and quite exhaustive. [1]

The coronal morphology and dimension of permanent tooth remain unchanged during growth and development except for specific conditions like nutritional abnormality, inherited disorders and other pathological conditions. Hence, Odontometric features can be used in determining the sex after the tooth has erupted.[2]

Teeth play a fundamental role in the process of identification of skeletal human remains subject to deterioration by chemical or physical agents. Eruption time of the teeth, the colour, wear, abrasions, specific traits, alterations of the enamel and various dental positions help in determining cultural, professional and individual practices. The difference in size and shape of the teeth helps in identification of sex. [4]

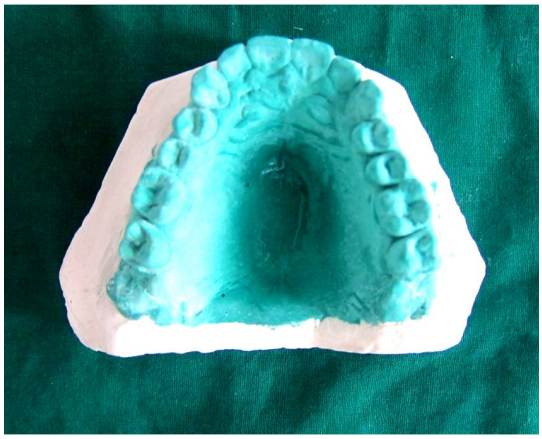
Sexual dimorphism is the systematic difference in form between males and females of the same species. [2] Sexual dimorphism in tooth size can be estimated by measurement of mesiodistal and buccolingual crown diameters, distances of molar cusps and diagonal dimensions. The rationale for sexual dimorphism in crown morphology and size of the permanent dentition is the difference in amount of enamel, dentin and pulp tissue between males and females. [5]

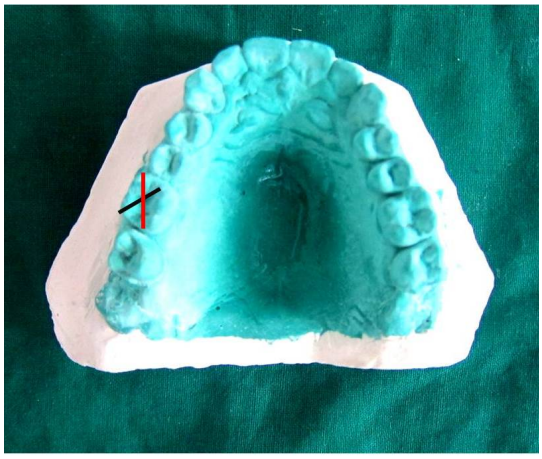
Therefore, the present study was aimed at identifying the accuracy of diagonal measurements of permanent teeth in sex determination in a tribe and an urban population. The rationale for selecting two different populations is because of the fact that the dimensions of the teeth are population dependent and the accuracy in sex determination may vary in different populations due to environmental factors and also different food habits.

MATERIALS AND METHODS

In a previous pilot study conducted by us on sex determination using linear odontometrics of the teeth in 30 subjects of urban population, maxillary right canine showed the highest percentage of sexual dimorphism. So a total 30 subjects were selected by simple random sampling from a tribal population with a parent population of 180 subjects. The parent population included subjects in different age groups from 10-70 years. The objective of limiting the sample to young adults was to ensure that dentitions were relatively intact, free of pathology and occlusal wear, thereby maximising the odontometric information. 30 subjects were selected from an urban population visiting the outpatient department of our dental college hospital by simple random sampling. All the 60 subjects enrolled in the study had no morphological abnormalities in their teeth and had a fully erupted dentition without attrition, caries and restorations. Ethical clearance was obtained from Mamata Dental College and after obtaining informed consent from the subjects, alginate impression of the upper dental arch was made using perforated trays and study models were cast in type IV dental stone. A digital Vernier calliper calibrated to 0.01mm was used for obtaining the measurements. Teeth considered for measurement were right maxillary canine, first premolar, second premolar and first molar.

Diagonal measurements were measured by placing the calliper parallel to the occlusal surface. MB-DL dimension was measured as the greatest distance between mesiobuccal and distolingual surfaces of the crown and DB-ML dimension was measured as the greatest distance between distobuccal and mesiolingual surfaces of the crown. [Figure 1 and 2]





The percentage of sexual dimorphism for the diagonal measurements of different teeth was measured using the formula: [(M-F) /F] ×100, [2] where M is the mean male tooth dimensions and

F is the mean female tooth dimension. Dimorphic ranking was then attributed, allotting the first rank to the tooth presenting the highest dimorphism and the last rank to the one presenting the lowest dimorphism.

STATISTICAL ANALYSIS

Mean, standard deviation, t-value, p-value and percentage of dimorphism were calculated between tribal and urban population, tribal males and females, urban males and females. A $p<0.05$ was considered statistically significant. Student t test was used for the comparison between the diagonal measurements of tribal and urban, tribal male and female, urban male and female populations.

RESULTS

Table 1 shows a comparison of diagonal measurements of permanent right canine (13), first premolar (14), second premolar (15) and first molar (16) between tribal and urban population.
In case of MB-DL diameter, there was a statistically significant difference between tribal and urban population in 13, 15 and 16, whereas 14 did not show a statistically significant difference. In case of DB-ML diameter, there is a statistically significant difference between tribal and urban population of 13, 14, 15 and 16.
The highest percentage of dimorphism was noticed irt to the DB-ML dimension of 16. Table 2 shows a comparison of diagonal measurements of permanent right canine (13), first premolar (14), second premolar (15) and first molar (16) in between males and females of tribal population.In the case of the MB-DL and DB-ML diameter, there was a statistically significant difference between tribal males and females for 13, 15 and 16. First molars showed the maximum percentage of sexual dimorphism in tribal population. The most dimorphic dimension was MB-DL dimension when compared to the DB-ML dimension except for 13. Table 3 shows a comparison of diagonal measurements of permanent right canine (13), first premolar (14), second premolar (15) and first molar (16) in between males and females of urban population. No statistically significant results were found on comparison of diagonal measurements between males and females of urban population in 13, 14, 15 and 16. Figure 3 shows a comparison of diagonal measurement of teeth 13, 14, 15 and 16 between males and females of tribal and urban population.

Tooth	Variable	Group	Mean	SD	t-value	P-value	% of dimorphism
13	MB-DL	Tribal	7.20	0.34	5.2608	0.00001*	6.40
		Urban	6.77	0.30			
	DB-ML	Tribal	7.08	0.42	3.5033	0.0009*	5.20
		Urban	6.73	0.36			
14	MB-DL	Tribal	6.59	0.57	1.6558	0.1032	3.20
		Urban	6.38	0.40			
	DB-ML	Tribal	6.80	0.69	2.4614	0.0168*	5.75
		Urban	6.43	0.47			
15	MB-DL	Tribal	6.80	0.57	2.8518	0.0060*	5.75
		Urban	6.43	0.41			
	DB-ML	Tribal	6.78	0.48	4.0319	0.0002*	7.27
		Urban	6.32	0.40			
16	MB-DL	Tribal	10.87	0.76	5.0309	0.00001*	7.94
		Urban	10.07	0.41			
	DB-ML	Tribal	9.86	0.69	7.3736	0.00001*	11.16
		Urban	8.87	0.25			

*$p<0.05$

Table-1: Comparison of tribal and urban groups by t test

Tooth	Variable	Gender	Mean	SD	t-value	P-value	% of dimorphism
13	MB-DL	Male	7.37	0.31	3.1535	0.0038*	4.83
		Female	7.03	0.28			
	DB-ML	Male	7.27	0.32	2.6946	0.0118*	5.51
		Female	6.89	0.43			
14	MB-DL	Male	6.77	0.60	1.8195	0.0795	5.60
		Female	6.41	0.48			
	DB-ML	Male	6.99	0.73	1.5245	0.1386	5.58
		Female	6.62	0.61			
15	MB-DL	Male	7.06	0.45	2.7094	0.0114*	7.95
		Female	6.54	0.58			
	DB-ML	Male	7.02	0.41	2.9813	0.0059*	7.17
		Female	6.55	0.45			
16	MB-DL	Male	11.29	0.67	3.6087	0.0012*	8.10
		Female	10.44	0.62			
	DB-ML	Male	10.20	0.73	3.1305	0.0041*	7.25
		Female	9.51	0.45			

*p<0.05

Table-2: Comparison of male and females in tribal group by t test

Tooth	Variable	Gender	Mean	SD	t-value	P-value	% of dimorphism
13	MB-DL	Male	6.84	0.19	1.3105	0.2007	2.06
		Female	6.70	0.37			
	DB-ML	Male	6.83	0.31	1.5336	0.1364	3.01
		Female	6.63	0.39			
14	MB-DL	Male	6.50	0.35	1.7079	0.0987	3.83
		Female	6.26	0.42			
	DB-ML	Male	6.50	0.40	0.8227	0.4176	2.20
		Female	6.36	0.55			
15	MB-DL	Male	6.49	0.33	0.7145	0.4808	1.72
		Female	6.38	0.49			
	DB-ML	Male	6.37	0.38	0.7160	0.4799	1.59
		Female	6.27	0.44			
16	MB-DL	Male	10.01	0.44	-0.8486	0.4033	1.28
		Female	10.14	0.38			
	DB-ML	Male	8.95	0.23	1.9066	0.0669	1.93
		Female	8.78	0.24			

*p<0.05

Table 3: Comparison of male and females in urban group by t -test

DISCUSSION

Sexual dimorphism in the size and shape of the permanent teeth differs from one population to another and hence the standard set for one population cannot be applied on to the another.[2] The variation among populations is the result of genetic and environmental factors. [6] Dental features in sex identification can be broadly grouped into non-metrical and metrical methods. Non-metric features of the crown and root such as upper incisor shovelling, cusp of Carabelli,

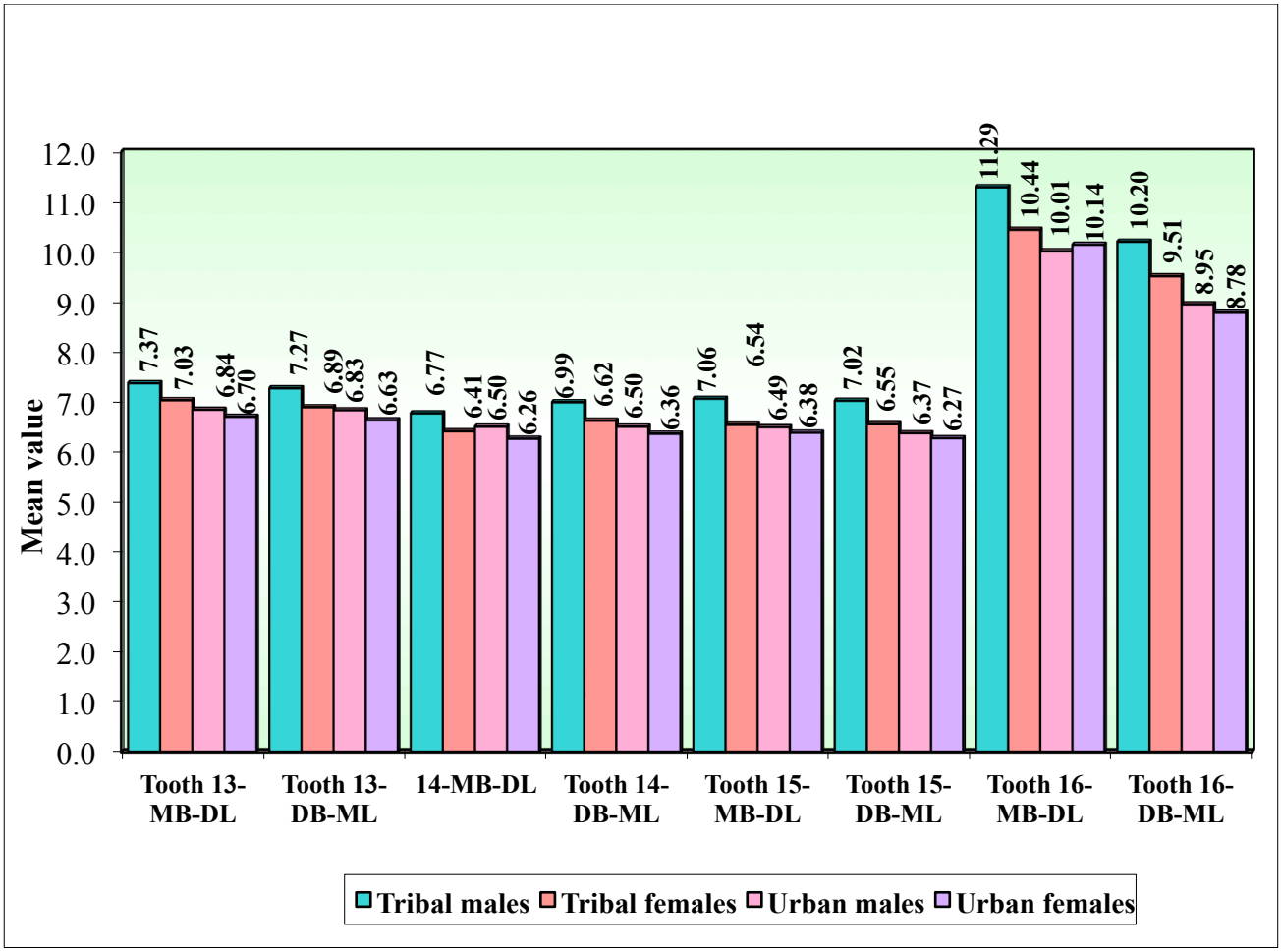


Figure-3: Comparison of tooth 13, 14, 15 and 16 in male and females of tribal and urban groups

hypocone and protostylid are heritable, and therefore help in identification of a population group or ethnicity. Canine distal accessory ridge, located between medial lingual ridge and distal marginal ridge in both upper and lower canines may be useful in sexing of a population as males show a higher frequency of its presence when compared to females. [7]

Metric methods of analysis include mesiodistal and buccolingual tooth dimensions which are known as linear measurements for sex determination. [7] These linear measurements are affected by attrition, tooth rotation, crowding and orthodontical anomalies, [2] and it is difficult to take measurements when the teeth are still held in the tooth socket. As a result, the diagonal measurements of teeth were developed in sex determination as they are less affected by these problems. [6]

In the present study, both the diagonal measurements were found to have significant sexual dimorphism in the case of tribal population, but significant sexual dimorphism was not observed in the case of urban population. The percentage of sexual dimorphism in the case of tribal population ranged from 4.83 to 8.10%. When compared with other populations[1, 2], the percentage of sexual dimorphism was in the different range, which is in accordance with the fact that the odontometric feature are population specific.[2] In a study conducted by da Costa YTF et al[1] linear and diagonal measurement of canines in all the

four quadrants were compared between males and females and the results showed statistically significant differences. Similarly in our study statistically significant difference was noticed in the diagonal measurements of permanent right canine, second premolar and first molar.

Vodanovic M et al, have conducted a study on sex determination using craniofacial features and odontometric features (linear measurements) in

an archaeological skeletal population. They found statistically significant difference between males and females in relation to their linear measurements of teeth. [8]

In a related study, Thapar R et al. reported that a combination of odontometrics with cranial anthropometry measurements give better results in sexing of a population.[9]

Omar A et al have conducted a study on determination of gender based on the odontometric measurements of canines in Egyptian population. The results were conclusive and showed significant sexual dimorphism between odontometric measurements of canines. [10]

Kapila R et al.[11] and kaushal S et al.[12] conducted a study on sex determination based on linear measurement of canines and reported that mandibular canines can be used in sexing of a population. In a related study on a Nigerian population, Eboh DEO proved that linear measurements of maxillary first molar can be used for sexing of a population. [13]

In a study conducted by Vanaki SS et al on sex determination using linear measurements of incisors, canines, premolars and first molars in both maxilla and mandible, canines showed statistically significant difference between males and females. [14] In a related study, Prabhu S et al have found that mandibular first molar shows greatest sexual dimorphism among all the teeth, followed by mandibular canines. [15]

In our study we measured diagonal measurement of teeth in estimating the sex in a tribal population and an urban population and found that except for the first premolar; canine, second premolar and first molar can be used in evaluating the sex in the case of tribal population, whereas no significant sexual dimorphism was noticed in urban population.

CONCLUSION

According to the results obtained in the present study, the diagonal measurements of male teeth, except for the first premolar were more when compared to females in the tribal population. The diagonal measurements of tribal population were more when compared to the urban population irrespective of the sex. Maxillary first molar tooth showed highest dimorphism among all the four teeth evaluated. The MB-DL measurements showed greater sexual dimorphism when compared to DB-ML measurements in case of tribal population. These results suggest a high reliability rate on the diagonal measurement of maxillary first molar teeth in the estimation of a gender.

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