

# Evaluation of canine sexual dimorphism in deciduous and permanent dentition

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## Abstract

**Introduction:** Teeth are an excellent material in living and nonliving populations for anthropological, genetic, odontologic and forensic investigations. Among the various calcified structures in the human body, teeth have gained lot of popularity in estimating the sex of an individual as they are highly resistant to destruction and decomposition. The present study aims to assess the importance of canines in sexual dimorphism in both primary and permanent dentition as well as to describe the dimensional characteristics of canines among the population of Bagalkot district of Karnataka, India.

**Materials and Methods:** One hundred and fifty participants belonging to Bagalkot district of Karnataka population, 100 adults (50 males and 50 females) in the age group of 17–30 years and 50 children (25 boys and 25 girls) in the age group of 3–6 years were included in the study. Impressions were made using alginate and study models were prepared using dental stone. Clinical crown height (CCH), maximum mesiodistal diameter (MMD) and maximum buccolingual width (MBL) of maxillary and mandibular canines of both dentitions were measured using digital vernier caliper.

**Results:** In deciduous dentition, significant differences were noted between maxillary and mandibular deciduous canines in male and female children using three dimensions, except mandibular canine, i.e., CCH did not show a significant difference. In permanent dentition, CCH and MMD showed significant differences except mandibular canines not showing significant differences in MBL ( $P < 0.05$ ).

**Conclusion:** Thus, canines can act as a valuable tool in gender determination as there is significant sexual dimorphism in maxillary and mandibular deciduous and permanent dentition.

**Keywords:** Canines, mesiodistal diameter, sexual dimorphism

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## INTRODUCTION

Identification of living as well as the dead using skeletal remains and dentition is of paramount importance in

routine forensic practice. The only method that can give the most accurate result is DNA technique, but it cannot be employed in all cases. Teeth being hardest and

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chemically the most stable tissue in the body are selectively preserved and fossilized, thereby providing the best record for evolutionary change and forensic investigation. Their durability in the phase of fire and bacterial decomposition makes them invaluable for identification of age, sex and race based on odontometric parameters.<sup>[1]</sup>

“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.<sup>[2]</sup>

Sex determination using dental features is mainly based on the comparison of tooth dimensions in males and females. Canines are least frequently extracted teeth being less affected by periodontal disease. Mesiodistal diameter of mandibular and maxillary canines provides evidence of sex determination due to dimorphism.<sup>[3]</sup> According to Suazo *et al* (2008), teeth are known to have sexual dimorphism.<sup>[4]</sup> Tooth crowns being larger in males than in females may be because of longer period of amelogenesis for both temporary and permanent dentitions in males.

The present study shows that there are significant differences between maxillary and mandibular deciduous and permanent canines in males and females, and thus, canines are key teeth in gender determination and may act as a valuable tool in cases of mass disaster and when the bodies are decomposed or in extreme burnt cases.

## MATERIALS AND METHODS

The study group consisted of 150 participants from Bagalkot district. Out of which, 100 were adults (50 males and 50 females) in the age group of 17–30 years and 50 were children (25 boys and 25 girls) in the age group of 3–6 years. The inclusion criteria for the study are as follows:

- No diagnosed dental or periodontal disease
- No worn tips at the cervical thirds
- No cultural or cosmetic modification
- No restoration—cervical thirds—mesial/distal surface
- No crown restoration, orthodontic treatment and/or trauma.

Partially erupted/ectopically erupted teeth, patients with dental/occlusal abnormalities, teeth showing physiologic/pathologic wear and tear as with bruxism were excluded from the study.

Maxillary and mandibular impressions of all the samples were made with alginate and the study models were prepared in dental stone [Figure 1]. On the study model, the

following measurements were taken for all the participants using digital vernier caliper.

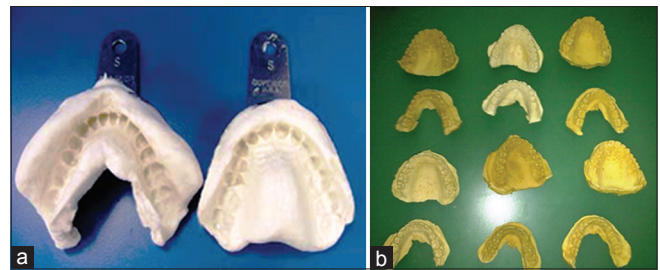
- Clinical crown height (CCH)
- Maximum mesiodistal diameter (MMD)
- Maximum buccolingual width (MBL).

### Clinical crown height

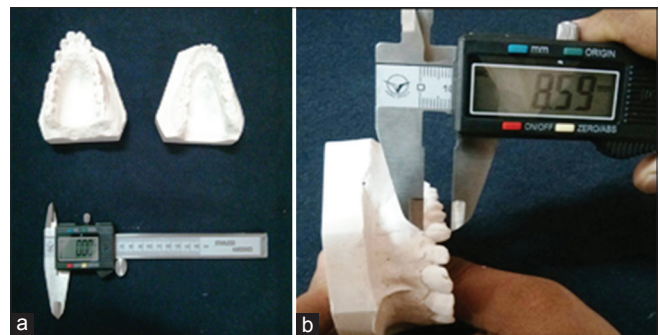
The CCH was measured from the tip of the cusp to the cervical line of canine using digital vernier caliper [Figure 2].

### Maximum mesiodistal diameter

The maximum width of canine teeth was taken as greatest mesiodistal width on either side of the jaw [Figure 3].



**Figure 1:** (a and b) Maxillary and mandibular impressions of all the samples made with alginate and study models were prepared in dental stone



**Figure 2:** (a and b) The clinical crown height was measured from the tip of the cusp to the cervical line of canine using digital vernier caliper



**Figure 3:** The maximum width of canine teeth was taken as greatest mesiodistal width on either side of the jaw

**Table 1: Comparison of males and females with respect to clinical crown height, maximum mesiodistal diameter and maximum buccolingual width in the right and left sides of maxillary and mandibular teeth of deciduous by *t*-test**

Quadrants	Sides	Variables	Male		Female		<i>t</i>	<i>P</i>
			Mean	SD	Mean	SD		
Maxillary	Right	CCH	6.01	0.51	6.68	0.42	-6.8522	0.00001*
		MMD	7.14	0.48	6.83	0.17	3.9757	0.0001*
		MBL	6.57	0.28	6.37	0.30	3.1906	0.0020*
	Left	CCH	6.01	0.51	6.68	0.42	-6.8522	0.00001*
		MMD	7.14	0.48	6.83	0.17	3.9757	0.0001*
		MBL	6.57	0.28	6.37	0.30	3.1906	0.0020*
Mandibular	Right	CCH	6.36	0.56	6.39	0.52	-0.2684	0.7890
		MMD	6.38	0.28	6.18	0.32	3.0933	0.0026*
		MBL	6.03	0.35	5.81	0.21	3.4925	0.0007*
	Left	CCH	6.36	0.56	6.39	0.52	-0.2684	0.7890
		MMD	6.38	0.28	6.18	0.32	3.0933	0.0026*
		MBL	6.03	0.35	5.81	0.21	3.4925	0.0007*

\**P*<0.05. CCH: Clinical crown height, MMD: Maximum mesiodistal diameter, MBL: Maximum buccolingual width, SD: Standard deviation

**Maximum buccolingual width**

The maximum width of canine buccolingually was measured using digital vernier calipers [Figure 4].

**Sexual dimorphism**

According to Garn and Lewis,<sup>[5]</sup> sexual dimorphism:  $(X_m/X_f) - 1 \times 100$

- $X_m$  = mean value of measurement for males
- $X_f$  = mean value of measurement for females.

All the measurements were noted, and the statistical analysis was done using SPSS graduate pack 11.5 for windows, (SPSS Inc., Chicago III, USA) to evaluate the data using Student’s *t*-test and discriminant function analysis.

**RESULTS**

Table 1 shows a comparison of males and females with respect to CCH, MMD and MBL in the right and left sides of maxillary and mandibular deciduous teeth by *t*-test. Table 2 with discriminant function analysis between male and female deciduous maxillary canine teeth is showing statistically significant value, whereas Table 3 showing discriminant function analysis between male and female deciduous mandibular canine teeth did not show statistically significant value. Table 4 shows a comparison of males and females with respect to CCH, MMD and MBL in the right and left sides of maxillary and mandibular teeth of permanent dentition by *t*-test. Tables 5 and 6 show discriminant function analysis between male and female maxillary and mandibular teeth of permanent dentition.

Applying student’s *t*-test results showed a significant difference. Significant differences were found between maxillary and mandibular deciduous canines in males

**Table 2: Maxillary canine teeth of deciduous dentition**

Variables	Raw coefficient	Standardized coefficients	<i>P</i>	Sectioning point
Constant	10.6332			
CCH	2.3430	1.1041	0.00001*	-1.2325
MMD	-1.4630	-0.5363	0.0051*	1.2325
MBL	-2.3594	-0.6986	0.0008*	

\**P*<0.05 is considered as statistically significant. CCH: Clinical crown height, MMD: Maximum mesiodistal diameter, MBL: Maximum buccolingual width

**Table 3: Mandibular canine teeth of deciduous dentition**

Variables	Raw coefficient	Standardized coefficients	<i>P</i>	Sectioning point
Constant	19.7289			
CCH	1.1371	0.6306	0.1295	-0.4546
MMD	-2.6927	-0.8133	0.0730	0.4546
MBL	-1.7000	-0.5109	0.1919	

\**P*<0.05 is considered as statistically significant. CCH: Clinical crown height, MMD: Maximum mesiodistal diameter, MBL: Maximum buccolingual width



**Figure 4:** The maximum width of canine buccolingually was measured using digital vernier calipers

and female children using three dimensions, except mandibular canines CCH did not show a significant difference.

**Table 4: Comparison of males and females with respect to clinical crown height, maximum mesiodistal diameter and maximum buccolingual width in the right and left sides of maxillary and mandibular teeth of permanent by *t*-test**

Quadrants	Sides	Variables	Male		Female		<i>t</i>	<i>P</i>
			Mean	SD	Mean	SD		
Maxillary	Right	CCH	9.21	0.82	8.31	1.06	4.7448	0.00001*
		MMD	7.70	0.64	7.21	0.49	4.2748	0.00001*
		MBL	5.87	0.69	5.56	0.64	2.3565	0.0204*
	Left	CCH	9.62	1.00	8.53	1.00	5.4575	0.00001*
		MMD	7.35	0.92	7.21	0.65	0.8679	0.3875
		MBL	5.62	0.72	5.55	0.70	0.4791	0.6329
Mandibular	Right	CCH	9.26	1.15	8.27	0.96	4.6543	0.00001*
		MMD	6.90	0.70	6.24	1.11	3.5506	0.0006*
		MBL	5.22	1.05	5.40	1.00	-0.8674	0.3879
	Left	CCH	9.04	1.12	8.25	1.04	3.6657	0.0004*
		MMD	6.94	0.62	6.54	0.62	3.2523	0.0016*
		MBL	5.43	0.92	5.17	0.61	1.7102	0.0904

\**P*<0.05. CCH: Clinical crown height, MMD: Maximum mesiodistal diameter, MBL: Maximum buccolingual width, SD: Standard deviation

**Table 5: Maxillary canine teeth of permanent dentition**

Variables	Raw coefficient	Standardized coefficients	<i>P</i>	Sectioning point
Constant	-13.0908			
CCH	0.8466	0.8015	0.0005*	0.5816
MMD	1.2078	0.6848	0.0035*	-0.5816
MBL	-0.5821	-0.3878	0.1453	

\**P*<0.05 is considered as statistically significant. CCH: Clinical crown height, MMD: Maximum mesiodistal diameter, MBL: Maximum buccolingual width

**Table 6: Mandibular canine teeth of permanent dentition**

Variables	Raw coefficient	Standardized coefficients	<i>P</i>	Sectioning point
Constant	-7.0429			
CCH	0.7990	0.8474	0.00001*	0.7151
MMD	0.7319	0.6786	0.0010*	-0.7151
MBL	-0.8986	-0.9200	0.00001*	

\**P*<0.05 is considered as statistically significant. CCH: Clinical crown height, MMD: Maximum mesiodistal diameter, MBL: Maximum buccolingual width

In permanent dentition applying discriminant function analysis, CCH and MMD showed significant differences except maxillary canines not showing significant differences in MBL (*P* < 0.05).

## DISCUSSION

Identification is the basis of individuality of a person. Numerous methods of identification are in use. Although these methods have their own merits, there are limitations too, as they might not fit in all situations. Dentition is one part of the body that resists all environmental insults for maximum time and thus can be a valuable tool in identification.<sup>[1]</sup>

“Morphological characteristic” data of deciduous teeth are very valuable tools for pediatric dentists, orthodontists and anthropologists in treating malocclusion and in identification of the diseased in crimes.<sup>[6]</sup> A study by

Richardson and Malhotra revealed that both the mean mesiodistal and buccolingual dimensions were larger in boys than in girls.<sup>[7]</sup> Margetts and Brown showed that mesiodistal and buccolingual dimensions of the deciduous dentition of males were larger than that of females for all primary tooth types.<sup>[8]</sup> Koorra *et al.* in their study revealed that the mean mesiodistal and buccolingual dimensions of maxillary and mandibular canines showed a greater significant difference in males than in females.<sup>[6]</sup> Black, in his study, proved the sexual dimorphism in the tooth crown diameter of the deciduous teeth.<sup>[9]</sup> Similar results were reported in this study in case of deciduous teeth, and the results were found to be statistically significant, except mandibular canine, wherein CCH does not show a significant difference (*P* < 0.05). This study did not employ univariate statistics (Al Ri Faiy *et al.* 1997, Boaz and Gupta 2009<sup>[10]</sup> and Potter *et al.*, 1981) of measurements. As it is concerned with the three dimensions and their interactions which is more useful in predicting sex.

According to the present study, there exists a significant sexual dimorphism in all canine dimensions, both maxillary and mandibular, as shown by the results. However, among all dimensions, CCH and MMD show very significant difference among permanent canines. Similarly in case of deciduous dentition significant differences were found between maxillary and mandibular canine in male and females using three dimensions except mandibular canine CCH did not show a significant difference. However the study with larger samples can increase the accuracy of the findings.

Multivariate methods in sex determination based on teeth measurements have been explored by Ditch and Rose<sup>[11]</sup> and Acharya and Mainali.<sup>[12]</sup> However, the studies are multivariate not only in dimensions but also in terms of teeth – their formulae cannot be applied on human remains



with incomplete or missing teeth. The present study, on the other hand, can be useful in cases even when only one canine in good condition is present.

## CONCLUSION

From the present study, it can be concluded that there is a significant sexual dimorphism in maxillary and mandibular in both permanent and deciduous dentition canines of the Bagalkot population. There is no evidence of reverse dimorphism in permanent teeth where dimensional measurements are greater in females than in males.

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## Conflicts of interest

There are no conflicts of interest.

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