

# Mandibular Canine Index to Determine the Sex of the Individual- A Population based Study

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## Abstract

**Introduction:** The uniqueness of dental morphology plays an important role in Forensic Odontology, especially for human identifications. Mandibular canines may be considered vital for personal identification.

**Objective:** This study aims to establish the effectiveness of the Mandibular canine index in predicting the sex of an individual in a given population.

**Materials and Methods:** 400 participants (200Male, 200Female) were randomly selected from a given population between the age group 13 to 30years. Using Digital Vernier calipers, the greatest mesio-distal crown width of both left and right Mandibular canines and Inter canine arch distance was measured.

**Results:** It show that canine dimensions and inter-canine distance were statistically larger in males compared to females and were statistically significant ( $p < 0.001$ ).

**Conclusion:** Canine dimensions can be considered as an adjunct for sex determination in our population

**Keywords:** Canine; Identification; Mandibular canines; Mandibular Canine Index; Odontology.

## Introduction

Every human being has the right to protect their identity, whether living or dead. Forensic identification is the application of forensic science and technology to identify specific objects from the trace evidence often left at the scene.<sup>1</sup> Establishment of the sex of an individual is a significant component of the identification process.<sup>2</sup> Different odontometrical techniques are proven to be helpful in identification when the bodies are damaged beyond recognition.<sup>3</sup>

Teeth are hard structures chemically stable and proven to be a good material for research and forensic identification.<sup>4</sup> Role of teeth in the past dates back to centuries ago where teeth were used primarily for the identification or distinguishing a person from the rest based on their peculiarity.<sup>5</sup> The identification of dental remains is of primary importance when the deceased person is skeletonized, decomposed, burned, or dismembered.<sup>6</sup> Among all teeth; mandibular canines is known to exhibit good sexual dimorphism. Canine teeth are most likely to survive trauma. Hence, they can be considered as key teeth for personal identification.<sup>7</sup>

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Time and again, Forensic Odontology has proved that it has application with single identification or disasters with many people. The importance of forensic dentistry is increasing in the field of identification and solving crimes.<sup>8</sup> The technique applied has started from the evolution beginning from the Garden of Eden to

the present where all the identification of the accused of a rape trial in the state capital.<sup>9</sup> It has an incredibly significant role, although the professional nature and its practices have evolved only in recent times and are still in progress.

This study aims to determine whether sex estimation is possible using mandibular canine tooth and investigate the reliability of canines in predicting sex in a given population.

### Materials and Methods

This study group comprised of four hundred subjects (200 male, 200 female) from ages ranging from 13-30 years were randomly included from a given population. This age group was selected as all canine teeth would have erupted by this age, and intercanine distance would have been fixed. The attrition is expected to be minimal within this age group. All the participants included in the study had caries free teeth, normal overbite, absent spacing of teeth and no history of previous orthodontic treatment.

#### Exclusion Criteria:

- Absent canines or partially erupted or ectopically erupted teeth.
- Dental and occlusal abnormalities.
- Spacing in teeth.
- Physiological wear and tear (attrition, erosion, abrasion).
- Deleterious oral habits (bruxism).
- Bad/ poor oral hygiene.

- Previous orthodontic treatment.

**Ethical Clearance:** was taken from Yenepoya university ethics committee before starting the study. The participants who fit the criteria for this prospective study were randomly selected from a given population. The aims, objectives and procedure were clearly explained to each participant, and informed consent was obtained from the participant. All the measurements were taken intra-orally in a clean and well-illuminated room, keeping all the aseptic precautions in mind. A proforma filled with a detailed history including sex, age, address, date of birth, previous dental history, and the measurements of the teeth dimensions. Digital Vernier Calipers (Bruder Mannesmann, Germany), which is calibrated to 0.01mm, was used to take the teeth measurements.

**Mandibular canine width** was measured as the greatest mesiodistal dimension of mandibular canine on either side of the jaw using Digital Vernier calipers.

**The Intercanine distance** was measured as the linear distance between the cusp tips of the right and left mandibular canine using Digital Vernier calipers.

All these measurements were taken using the Hunter and Priest method.<sup>10</sup> Two such measurements from both sides i.e., Right mandibular canine and Left mandibular canine are taken and then average of the two measurements is taken as the final value. This was done to rectify intra-observer error.

The measurement readings obtained were lay open to analysis to come to conclusions. The mandibular canine index was calculated using the formula:

$$MCI = \frac{\text{Mesio-distal crown width of the mandibular canine}}{\text{Mandibular canine arch width}}$$

Further the Standard canine index was calculated for the mandibular canines using the formula derived by Rao et al.<sup>11</sup>

$$\text{Standard MCI} = \frac{(\text{Mean male MCI} - \text{SD}) + (\text{Mean female MCI} + \text{SD})}{2}$$

According to Rao et al the calculated MCI was compared to standard MCI. The result obtained were both compared if the value was higher than the Standard MCI then it is considered a male canine tooth and lesser than standard MCI then it is considered a female canine tooth.<sup>11</sup>

All data were tabulated in the excel sheet and subjected to statistical analysis. SPSS software 16 was used and t test and multivariant discriminant analysis was applied and to develop a regression formula from this study.

### Results

A total of 400 subjects participated in the study. The study included males and 200 females and 200 males. The parameters that were recorded were-

- a) The Mesiodistal dimension of Left mandibular canine
- b) The Mesiodistal dimension of Right mandibular canine
- c) The Intercanine arch distance

Among the 400 participants, the mean value left mandibular canine was found to be 6.58 for males and 6.30 for females. The p value for this index is < 0.001 which is statistically highly significant as shown in Table No 1.

The mean value of the width of right mandibular canine was found to be 6.61 for males and 6.34 for females. The p value for this index is < 0.001 which is statistically as shown in Table No 1.

The intercanine distance of mandibular canines was measured for all subjects intra orally. The 400 participants the mean value of the intercanine distance of mandibular canines was found to be 27.51 for males and 26.31 for females. The p value for this index is < 0.001 which is statistically highly significant as depicted in Table No 1.

Multi variant Discriminant analysis was applied on the 400 samples from the participant to derive a formula for accurate of sex prediction.

The result is as follows: (Table 2)

1. In direct method, the percentage of accuracy using left mandibular canine, right mandibular canine and intercanine distance values the sex prediction is 63.60%.

Hence, the regression formula for direct method is,

$$Y = 1.549 * LMWidth + 0.704 * RMwidth + 0.145 * IC - 18.41$$

2. In step wise method, it could be calculated only for left mandibular canine and intercanine distance because the right mandibular canine vales were insignificant. Hence using this method sex prediction for left mandibular canine and intercanine distance is 64.80%.

Hence, the regression formula for step wise method is,

$$Y = 2.064 * LMwidth + 0.177 * IC - 18.05$$

**Table no 1: RESULTS OF SEX WISE DISTRIBUTION OF MEAN OF CANINE MEASUREMENTS**

PARAMETERS	SEX (200 FEMALES 200 MALES)	MEAN	SD	RANGE (95% confidence interval)		P value
				Lower bound	Upper bound	
LEFT MANDIBULAR CANINE	FEMALES	6.30	0.42	6.24	6.36	P<0.001 HIGHLY SIGNIFICANT
	MALES	6.58	0.31	6.53	6.62	

**Cont... Table no 1: RESULTS OF SEX WISE DISTRIBUTION OF MEAN OF CANINE MEASUREMENTS**

RIGHT MANDIBULAR CANINE	FEMALES	6.34	0.45	6.28	6.40	P<0.001 HIGHLY SIGNIFICANT
	MALES	6.61	0.30	6.56	6.65	
INTERCANINE DISTANCE	FEMALES	26.31	1.99	26.04	26.58	P<0.001 HIGHLY SIGNIFICANT
	MALES	27.51	2.11	27.21	27.81	

**Table no 2: RESULTS OF DISCRIMINANT ANALYSIS**

	Independent variables	Unstandardized coefficients	Standardized coefficients	Constant	Centroid	Section point	Accuracy
DIRECT METHOD	left mandibular mesio-distal canine width	1.549	0.574	-18.41	M=0.406	0.013	63.60%
	right mandibular mesio distal canine with	0.704	0.270		F=-0.380		
	intercanine distance	0.145	0.297				
STEPWISE METHOD	left mandibular mesio-distal canine width	2.064	0.765	-18.050	0.401	0.013	64.80%
	intercanine distance	0.177	0.364		-0.376		

### Discussion

In forensic cases teeth can be an important deciding factor in the identification of an individual. Canines are different from other teeth with respect to survival and sex dichotomy. Although canine survival and sex

dichotomy are not related to each other still they are useful in the process of identification.<sup>12</sup>In the present study 400 participants were randomly selected from a community between the age group 13- 30 years. The mean age for eruption of canine tooth is 10.87 years<sup>7</sup>and

according to literature is fully erupted by the age of 11 to 12 years and also inter canine distance is usually fixed by 12 years of age. Hence the age minimum limit in this study was taken to be 13 years. The age group maximum limit to avoid teeth which has gone for attrition and other age-related teeth queries is 25 years.<sup>13</sup> Hence the age maximum limit in this study was taken to be 30 years. However, participants who had visible attrition of teeth were excluded from the study irrespective of their age. In studies conducted by Rao et al<sup>11</sup>, Muller Met al<sup>3</sup> the study participants consisted of students from a particular college rather than a targeted population. In this study 400 participants who were selected were from a targeted population who had similar ethnic, cultural, and behavioral backgrounds.

In a preliminary study conducted by Rao et al in 1989 on 766 participants randomly selected between in age group 15 to 21 years, Multi variant discriminate statistical analysis showed 85.9% accuracy in sex determination which was highly significant<sup>11</sup> however, in our study with sample size of 400 randomly selected from a given community between the age groups 13-30 years showed multivariate discriminant analysis of 64.80%. This difference in result could be attributed to the fact that Rao et al study was not a population-based study and the measurements of the teeth taken were using dividers which could lead to errors.

In another study conducted by Muller et al in France 2001 among 424 students at university of Nice Sophia Antipolis with 210 females and 214 male participants in the age group 20.4 + 2.9 years. The aim of the study was to calculate mandibular canine index for sex determination as done by Rao et al but by taking occlusion into consideration. There was effort made by the author to find out the reliability of the method and its influence when there is lower anterior dental crowding. In cases of correct alignment, the values were higher for males compared to females however the study showed lower sex predictability value of 59.57%<sup>3</sup> which coincides with our study with sex predictability of on 64.80% only which is not significant.

In a study conducted by Vishwakarma and Guha in 2011 in Gwalior medical college among 180 participants (90 females and 90 males) between the age group 17-23 years using vernier calipers study comments on left mandibular canine being a better parameter to identify sex. In their study the mesiodistal width of mandibular canine of males and females were found to be statistically significant for left mandibular canine compared to the right.<sup>4</sup> But in our study mean value of right mandibular canine is higher compared to the mean of left mandibular canine. However, when using step wise selection in multivariate discriminant analysis for right mandibular canines the data was invalid, and no accuracy or result could be obtained.

In a study conducted in 2014 by Bakkanavar S et al among 500 students (250 females and 250 males) randomly selected of age group 15 – 25 years of South India using a digital calipers to take measurements of both maxillary and mandibular canine to see if this could be used as a tool for sex determination. The results showed that the mesio-distal crown width of both right and left mandibular canines in males were more than the females. The sex predictability according to the study was poor for mandibular canine index which was 74.8%.<sup>13</sup> In comparison to our study where the value was 64.80% the value of Bakkanavar S et al seems higher. This can be attributed to the fact that unlike our study which is based on a particular population Bakkanavar S et al study participants were students from diverse and from different backgrounds which could have contributed to the higher values. However, Bakkanavar S et al study shows that results obtained show poor sex predictability which is similar to our study.<sup>13</sup>

## Conclusion

The developing field of forensic dentistry in India relies a lot on easy and inexpensive methods for identification. Forensic dentistry helps in investigation when other means fail to do so. A dentist can be asked upon to render on their expertise in the field of forensics, when in need during investigation. A data base could be created with morphometric measurements

with the purpose to determine if there is significance among larger population. This data may be beneficial for anthropological, genetic, legal, and forensic applications. It is recognized that canines among other teeth exhibit sexual dimorphism. This study measured linear dimensions of teeth. However more accuracy can be obtained by using sophisticated equipments and also the use of more standardized and complex mathematical equation. This might increase the accuracy of the prediction. However, one must not forget that only when more parameters are considered the more accurate the determination of sex will be. For this reason, clues from dentition must be correlated with other clues.

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