

# Comparative Evaluation of Odontometric Parameters for Determining Gender

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## Abstract

**Background and Aim:** Sex estimate is a crucial component of human identification in a forensic setting. Due to the sexual dimorphism of human teeth, odontometrics – the measuring and analysis of tooth size standards – is most frequently utilized in age and sex determination. The aim of this study was to assess the degree of sexual dimorphism in mandibular canine using mandibular canine index using mesiodistal (MD) and buccolingual (BL) dimensions of the crown and inter canine distance measured.

**Material and Methods:** The study sample included 200 people (100 men and 100 women), ages 18 to 35, with an average age of 22 years. The distance between the mesial and distal contact points was used to calculate the mesiodistal dimension of the mandibular canine (CMD). Each subject's right mandibular canine index and left mandibular canine index were used to construct the canine index. The standard canine index (SCI) value was used as a cutoff point to differentiate males from females.

**Results:** Men's right and left mandibular canines mesio-distal crown widths were found to be significantly greater than those of their female counterparts. The current study demonstrates a very high significance of p value seen in the left mandibular canine and a significant difference in mesiodistal breadth between males and females of the right mandibular canine of p value. The total probability of sex determination for the right mandibular canine is 55% and for the left canine is 59.5% based on the conventional MCI calculations for the right mandibular canine (0.22) and for the left mandibular canine (0.21), suggesting that the left mandibular canine is more relevant for sex determination.

**Conclusion:** It has been proven beyond a reasonable doubt that mandibular canines exhibit significant sexual dimorphism when it comes to sex determination, and it is clear from the study that this breed is a more trustworthy source for sex determination.

**Key Words:** Canine, Crown, Sexual dimorphism, Standard Canine Index

## Introduction

Every human being has three defining characteristics: age, sex, and race. Sex estimate is

a crucial component of human identification in a forensic setting. Identifications are made easier when the sex is predicted since only absent people who

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fit the predicted sex need to be taken into account. Following that, sex-specific age estimation can be done.<sup>1,2</sup>

Due to the sexual dimorphism of human teeth, odontometrics—the measuring and analysis of tooth size standards—is most frequently utilized in age and sex determination. “Sexual dimorphism” is the term for differences in the shape, size, and appearance of teeth between men and women that can be used to determine gender.<sup>3,4</sup>

A person must be identified in order to receive a death certificate and for other personal, social, and legal reasons. Numerous factors, such as age, sex, dactylography, footprint, size, tattoos, scars, and more are used to identify identity. Determining a person’s gender is the first stage in the forensic identification process.<sup>5,6</sup>

Gender discrimination has benefited from odontometry. Mesiodistal and buccolingual crown measurements, or linear measurements, are typically used for gender identification. However, linear odontometry would not be attainable in teeth with caries, attrition, or incomplete eruption. Alternative measurements, such as diagonal or cervical measurements, will thus be needed.<sup>7,8</sup>

Because they may be used to study anthropology, genetics, and odontology, teeth are a great forensic resource. Compared to other body parts, the measurements of the teeth and skull have a number of advantages since the anatomical landmarks are uniform, well-established, and simple to find. The aim of this study was to assess the degree of sexual dimorphism in mandibular canine using mandibular canine index using mesiodistal (MD) and buccolingual (BL) dimensions of the crown and inter canine distance measured.

### Material and Methods

Present study was performed at the department of Forensic Medicine, Tertiary care Institute of India from January 2022 to January 2023. During this period, 1254 subjects in age range of 18-35 visiting outpatient department of Tertiary care Institute of Gujarat but only 200 subjects met the inclusion criteria applied for the study. The Institutional Ethical Committee gave their approval (GMERS/Narmada/1824) to the

study protocol. After receiving the subjects’ written agreement, the study was conducted. The entire maneuver was described to the individuals, and they were informed of any unanticipated dangers that might arise throughout the course of the study. Alginate imprints of both arches were taken after receiving the subjects’ written consent, and then castings were placed in dental stone.

**Inclusion criteria:** Since subjects between the ages of 18 and 35 have generally intact dentitions and experience less physiological and pathologic tooth wear at this time, this age group was chosen.

**Exclusion criteria** Individuals with fractured, missing, malformed or restored first molars were excluded.

### Measurements

Using Type II dental stone right away to prevent any distortion, an impression of the maxillary arch was taken after receiving written agreement from the participants. The analysis was then conducted using the mandibular arch research models. To ensure easy reproducibility, all measurements were carried out by a single observer using digital callipers with a resolution of 0.01 mm on the casts.

The distance between the mesial and distal contact points was used to calculate the mesiodistal dimension of the mandibular canine (CMD). Both the left and right canine’s MD width were measured, and the average value was used in the calculations.

### Canine Index

Each subject’s right mandibular canine index and left mandibular canine index were used to construct the canine index. The mandibular canine index (MnCI) formula was modified from that developed by Rao and colleagues to determine sex identification.

Canine Index CI = Mesiodistal crown width of canine / Inter canine distance

### Standard Canine Index

The standard canine index (SCI) value was used as a cutoff point to differentiate males from females. Each canine tooth will therefore have its respective SCI. It is calculated using the following formula adapted from Rao and colleagues.

Standard CI =  $([\text{mean male CI} - \text{SD}] + [\text{mean female CI} + \text{SD}]) / 2$ .

If the subject's CI value is less than or equal to the standard CI, the individual is thought to be female. If the CI value was higher than the typical CI, the patient is assumed to be male. Using the formula provided by Garn et al. (1967), sex dimorphism in the right and left mandibular canines was estimated as follows:

Sexual dimorphism =  $(X_m - X_f / 1) \times 100$  (Mean male canine width ( $X_m$ ) and mean female canine width ( $X_f$ )). The obtained dimensions were subjected to statistical analysis to assess sex differences using an unpaired t-test. Statistical analysis was performed regarding MD, CI, LL, and Man ICW, and canine index for teeth 33 and 43, and standard CI and sexual dimorphism were also calculated. Percentage accuracy of reporting sex identity by this method was then checked as the actual sex of each subject was known by comparing means and median for teeth 33 and 43.

## Results

Men's right and left mandibular canines' median mesio-distal crown widths were found to be greater than those of their female counterparts. ( $p < 0.05$ ) This value was statistically significant. The mesio-distal crown width of the right and left mandibular canines also showed results with statistically significant values. ( $p < 0.05$ )

The current study demonstrates a very high significance of p value (0.0001) seen in the left mandibular canine and a significant difference in mesiodistal breadth between males and females of the right mandibular canine of p value (0.002). Using standardized criteria, the distance between the cusp points of the right and left mandibular canines was measured. The results showed that the mean intercanine distance for males were 24.30 and for females it was 22.01, with a p-value of 0.130 indicating non significant.

A uniform formula was used to determine the MCI. The mean MCI in men was found to be 0.22 mm on the right side and 0.22 mm on the left. The MCI was found to be 0.21 mm on the right side of females, compared to 0.20 mm on the left. Right canine MCI is

very significant compared to left canine MCI, which is not significant.

The total probability of sex determination for the right mandibular canine is 55% and for the left canine is 59.5% based on the conventional MCI calculations for the right mandibular canine (0.22) and for the left mandibular canine (0.21), suggesting that the left mandibular canine is more relevant for sex determination. And for the right and left canines, respectively, males have a higher percentage accuracy of 59% and 66%, while females demonstrate 49% and 55%. The percentage of sexual dimorphism determined by the formula is 4.05 for the right canine and 7.30 for the left canine.

Overall, it was discovered that males with sexual dimorphism had considerably larger values for the right canine width, left canine width, right MCI, and left MCI. Additionally, the left mandibular canine has a wider profile than the right mandibular canine when it comes to reliability.

**Table 1: Probability of sex determination (MCI - Right canine)**

| Gender  | Number of cases studied | No. of cases with correct gender prediction by MCI |
|---------|-------------------------|--|
| Females | 100                     | 49   |
| Males   | 100                     | 59   |
| Total   | 200                     | 55   |

**Table 2: Probability of sex determination (MCI - Left canine)**

| Gender  | Number of cases studied | No. of cases with correct gender prediction by MCI |
|---------|-------------------------|--|
| Females | 100                     | 55   |
| Males   | 100                     | 65   |
| Total   | 200                     | 59.5   |

**Table 3: Sexual dimorphism in Maxillary and Mandibular canine**

| Mandibular canine | Percentage |
|-------------------|------------|
| Right canine      | 4.05       |
| Left canine       | 7.30       |

## Discussion

No two people are the same and all are unique, and the human identification processes make use of this idea of uniqueness. Even though standard methods like DNA profiling, finger prints, anthropometric data, and dental records are available, there are times when it makes sense to use ancillary techniques like cheiloscopy, palatoscopy, and other odontometric measurements because they can produce results that are reasonably reliable when carried out consistently. In order to generate a biological profile from the skeletal and dental remains and to reconstruct the faces of unidentified people, gender discrimination is a crucial component of human identification techniques.<sup>9</sup>

Even with burned and decayed carcasses, forensic and anthropological investigations using teeth can determine a person's race, sex, and age. Studies on sexual dimorphism provide insight into both population and, by extension, individual evolution. In the study of Spitz W et al (2020)<sup>10</sup> an effort was made to identify a person's sex among the Iranian population using the mesio-distal breadth of canine teeth and the corresponding inter-canine lengths.

Although other studies evaluated indices using both study models and intraoral measures, we did not record any value clinically to minimise patient discomfort and to facilitate easy measurement replication. We have also come across research where the effectiveness of the right and left sides was compared, however we have taken the average of both sides and used it in the formulas. To establish dimorphism in our work, we only employed maxillary odontometric indices to replicate crime scenes or other situations where only a skull with a maxilla was available.<sup>11,12</sup>

They also noticed that men's values were greater than those of their female counterparts. Al-Rifaiy and Abdullah found that the average width of the mandibular and maxillary canines and the intercanine distance were both greater in men than in women in the Saudi population. They reported no statistical significance in the canine widths, but a significant difference between male and female in the intercanine distance (p 0.0001).

In contrast to the MD width of canine and CI values, Paramkusam et al. discovered that conventional mandibular CI was more accurate at estimating gender. They discovered that the accuracy rate while utilising the standard canine indices for the maxilla and mandible was >70%.<sup>13,14</sup>

In the current investigation, only linear measurements were used for the morphometric analysis, which was conducted by the authors using tooth casts. Such studies are advised because of their affordability, dependability, and simplicity. There would have been some bias in the dimensions and conclusions if there had been a lower sample size and only one examiner participated in the measurements. Therefore, it is impossible to generalise the study's conclusions. Every group has different tooth dimensions that are impacted by ethnic, environmental, and cultural factors. To the best of the authors' knowledge, this is the first study to apply morphometric analysis involving MD, CI, LL, and IC widths as well as CI. These results can serve as a guide for future research on canine measures.

## Conclusion

It has been proven beyond a reasonable doubt that mandibular canines exhibit significant sexual dimorphism when it comes to sex determination, and it is clear from the study that this breed is a more trustworthy source for sex determination. In situations where other sophisticated factors for sex determination are not easily accessible, the standard canine index is quite helpful and would act as a rapid approach for sex determination. To reliably detect sex, SCI should be used in conjunction with other factors as it has limited utility alone.

Ethical approval was taken from the institutional ethical committee and written

Informed Consent was taken from all the participants.

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**Conflict of Interest:** None declared

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