



## Decoding Sex through Canine Clues: A Forensic Odontology Insight into Mandibular Canines and Intercanine Distance

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### ABSTRACT:

**Introduction:** This research aims to explore the reliability of using mandibular canine measurements specifically, the mesiodistal crown width and intercanine distance for determining sex in adult individuals. In the field of forensic science, identifying sex based on skeletal remains is essential, especially when traditional means are not possible. Given their high resistance to decay and external damage, teeth often remain intact even in extreme conditions like accidents or natural calamities, making them valuable for forensic identification.

**Objectives:** The present research aims to explore the accuracy of using mandibular canine mesiodistal width and intercanine distance for sex determination in the population of Jamnagar. This investigation is particularly significant as tooth size and shape are known to vary across populations based on genetic, cultural, environmental, and ethnic backgrounds

**Methods:** A total of 100 mandibular study casts were examined, comprising an equal number of male and female subjects aged 18 to 30 years. These casts were retrieved from the departmental records of Orthodontics and Dentofacial Orthopaedics, Jamnagar. Using a digital vernier calliper, precise measurements of the mesiodistal crown width of both mandibular canines and the intercanine distance were obtained. The recorded values were then statistically analysed to identify any significant sex-related differences.

**Results:** The analysis revealed a noticeable difference between males and females in the dimensions of the mandibular canines, with males generally displaying larger values. These findings underline the presence of sexual dimorphism in these dental features.

**Conclusions:** Based on the observed data, it can be concluded that both the mesiodistal width of mandibular canines and the intercanine distance serve as reliable markers for determining sex. These dental measurements are particularly useful in forensic cases involving unidentified remains, where teeth may be the only structures available for analysis.

### 1. Introduction

The Latin word *Forensic*, meaning "forum" or "court," forms the root of the term *Forensic*, while

*Odontology* denotes the scientific study of teeth. Forensic Odontology is a distinct branch that bridges dentistry with legal investigations, often aiding in



personal identification through age estimation, gender determination, and bite mark analysis.<sup>1</sup> This discipline becomes especially vital in situations involving unidentified remains, where only parts of the body are recoverable.<sup>2</sup> In natural calamities such as floods, earthquakes, cyclones, or tsunamis, where bodies may be disfigured or decomposed, teeth and jawbones often remain intact. In such contexts, dental evaluation becomes indispensable for identifying victims.<sup>1</sup>

Sexual dimorphism is the term used to describe the biological and measurable differences between male and female anatomy. Among the various features used to determine sex, dental characteristics—particularly the size and morphology of teeth—have shown significant relevance in forensic and anthropological sciences. Typically, male teeth exhibit larger crowns than those of females. Canine teeth, due to their robust structure and deeply rooted anchorage, are less likely to be destroyed in traumatic events such as severe burns, disasters, or accidents. In instances where bones are missing or fragmented, mandibular canines—measured by crown width and the intercanine distance—offer a reliable parameter for identifying sex. Thus, odontometric assessment proves to be highly useful in sex determination, especially when dealing with compromised or skeletal remains.<sup>3</sup>

Mandibular canines have several qualities that contribute to their forensic value. They are less affected by common dental issues such as plaque buildup, calculus, abrasion from brushing, and strong biting forces. Furthermore, they are more resistant to periodontal disease and tend to be retained longer than other teeth as individuals age. Because of this resilience, mandibular canines often remain intact and are thus dependable indicators in forensic identification.<sup>4</sup>

Monali C et al. introduced a range of methods for identifying sex, including macroscopic inspection, microscopic techniques, and advanced scientific tools. They pointed out that evaluating tooth dimensions and unique crown features presents a straightforward, non-invasive, and effective way of distinguishing sex. These odontometric approaches are especially useful due to their affordability, simplicity, and quick application.<sup>5</sup>

## 2. Objectives

The present research aims to explore the accuracy of using mandibular canine mesiodistal width and intercanine distance for sex determination in the population of Jamnagar. This investigation is particularly significant as tooth size and shape are known to vary across populations based on genetic, cultural, environmental, and ethnic backgrounds.

## 3. Methods

The present study was an in vitro, cross-sectional, analytical, and retrospective investigation. It was conducted in the Department of Oral and Maxillofacial Pathology and Oral Microbiology, Jamnagar. A total of 100 archived mandibular study models were obtained from the Department of Orthodontics and Dentofacial Orthopaedics, comprising 50 male (Group I) and 50 female (Group II) subjects between 18 and 30 years of age.

### Materials

1. 100 study models including 50 males and 50 females.
2. Digital vernier calliper. (Aerospace)

### Methodology

- This study was conducted using 100 mandibular study models.
- Width of the mandibular canines was taken between the contact points of teeth on either side of the jaw. [Figure 1a and 1b] Inter-canine distance was measured between the tips of both the canines in lower jaws. [Figure 2] All the measurements were taken using a digital vernier calliper.
- Digital vernier calliper was used as it gives readings with an accuracy of 0.01 mm.
- Each parameter was measured and later the values were compared and the mean mesiodistal width and the inter-canine distance were taken for calculation.
- To eliminate bias, a single observer performed the measurements. The observer was not aware of the gender.



[Figure 1] a - Measurement of mesio – distal width of left mandibular canine. b - Measurement of mesio – distal width of right mandibular canine in study model using digital vernier calliper



[Figure 2] Measurement of intercanine distance in mandibular arch using digital vernier calliper

#### Inclusion criteria

The following criteria were included in the study:

1. Age between 18 to and 30 years
2. Good quality study models
3. Presence of fully erupted two mandibular canine teeth
4. Absence of crowding or spacing in anterior teeth

#### Exclusion criteria

The following criteria were excluded from the study:

1. Partially erupted teeth
2. Teeth with severe attrition
3. Impacted canines
4. Broken teeth on study models

5. Malaligned canines
6. Crowded or excessive spacing in the anterior teeth
7. Subjects with missing anterior teeth
8. Subjects with missing mandibular first premolar
9. Developmental Abnormalities of Jaws

#### Method of data analysis

The collected data were entered into Microsoft Excel for initial organization and then subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS), version 21.0 for Windows. For each dental parameter - namely, the mesiodistal width of the left and right mandibular canines, and the intercanine width the **Mean and Standard Deviation** were calculated separately for male (Group I) and female (Group II) participants.

An **unpaired t-test** (independent samples t-test) was applied to compare the mean values between the two groups for each parameter. This test was selected to determine whether there were statistically significant differences in the dental measurements between the sexes.

The **level of statistical significance** was set at  $p < 0.05$ . A p-value below or equal to this threshold was considered indicative of a statistically significant difference between the groups. The corresponding **t-values** and **p-values** were computed and documented for each comparison.

#### 4. Results

The mean values of dental parameters between males and females including the mesiodistal width of the left and right mandibular canines, and the intercanine distance are shown in Table I. For the mesio-distal width of the left mandibular canine, males had a mean of  $6.53 \pm 0.33$  mm, while females had a mean of  $6.02 \pm 0.36$  mm. The mesio-distal width of the right mandibular canine was  $6.47 \pm 0.33$  mm for males and  $6.1 \pm 0.34$  mm for females. The intercanine distance was  $26.0 \pm 2.3$  mm for males and  $25.5 \pm 1.44$  mm for females.

Compared to females, males exhibited a greater mean mesiodistal width of the left mandibular canine ( $6.53 \pm 0.33$  mm in males vs.  $6.02 \pm 0.36$  mm in females), as shown in Table II. An unpaired t-test yielded a 't' value of 3.27 and a p-value of 0.004 ( $p < 0.05$ ). This indicates a



statistically significant difference in the left mandibular canine width between males and females, suggesting that this measurement could be used to differentiate between the genders

Males demonstrated a greater mean mesiodistal width of the right mandibular canine ( $6.47 \pm 0.33$  mm) when compared to females ( $6.10 \pm 0.34$  mm), as presented in Table III. The unpaired t-test resulted in a 't' value of 2.46 and a p-value of 0.024 ( $p < 0.05$ ). This also indicates a statistically significant difference in the right mandibular canine width between males and females, suggesting its potential use in gender identification.

The comparison of mean intercanine distance showed that males had a value of  $26.0 \pm 2.3$  mm, while females had  $25.5 \pm 1.44$  mm, as presented in Table IV. The unpaired t-test produced a 't' value of 1.26 and a p-value of 0.221 ( $p > 0.05$ ). This result is not statistically significant.

## 5. Discussion

In recent years, the world has witnessed a noticeable surge in both the frequency and severity of disasters, resulting in significant loss of life and widespread devastation. These calamities, which often occur without prior warning, can be broadly classified into two major categories: natural and human-induced. Natural disasters include phenomena such as earthquakes, floods, and tsunamis, whereas human-made disasters comprise events like wars, riots, and terrorist attacks. In the aftermath of such events, the accurate identification of victims becomes a matter of utmost importance. The process of personal identification typically involves evaluating several biological parameters, including age, sex, and ethnicity. Among these, determining the sex of the individual is a fundamental step, as it significantly narrows the pool of possible matches.<sup>6,7</sup>

Sex determination from damaged, decomposed, or skeletal remains plays a vital role in forensic and legal investigations. This step helps streamline the identification process by reducing the number of potential matches among missing persons.<sup>2</sup> Dental examination is particularly valuable in such contexts, especially when soft tissues are absent or DNA is degraded. Teeth are among the most enduring components of the human body due to their hardness and resistance to environmental insults.<sup>8</sup> In particular, canine

teeth hold special importance in forensic contexts because of their strong roots, low susceptibility to caries, and resistance to trauma and periodontal disease. They are also among the last teeth to be lost with aging, further supporting their reliability for personal identification.<sup>2</sup>

The pronounced sexual dimorphism observed in mandibular canines is believed to stem from genetic factors, particularly the influence of the Y chromosome, as well as the evolutionary significance of these teeth. Their robustness and persistence make them ideal candidates for odontometric analysis in gender estimation during forensic investigations.<sup>9</sup>

Given that dental morphology can vary across populations due to genetic, environmental, and evolutionary factors - even within the same ethnic group over time it becomes essential to develop population-specific odontometric standards. These localized references are crucial for enhancing the accuracy of personal identification based on dental metrics.<sup>10</sup> The present research aimed to evaluate the influence of sex on the morphology of permanent mandibular canines in individuals from the Jamnagar region.

According to established dental literature, the typical mesiodistal width of mandibular canines is approximately 7.0 mm.<sup>11</sup> In the present study, the mean mesiodistal dimension of the right mandibular canine in males was  $6.47 \pm 0.33$  mm, whereas in females, it was  $6.1 \pm 0.34$  mm. Although the absolute difference between the groups was relatively small, statistical analysis revealed a highly significant difference between the sexes.

Similar findings were reported by Muller et al. in 2001, who analysed a randomized cohort of 210 female and 214 male students from the University of Nice-Sophia Antipolis. Their results also indicated a statistically significant difference in dental dimensions between males and females.<sup>12</sup> In line with these results, the present study confirmed a similar significant variation based on sex.

Further support comes from studies conducted by Sonia G et al. on the Srinagar population, Patel RA et al. in Gandhinagar, and Zoya K et al. who studied a mixed population group. All of these investigations consistently found that males exhibited greater



mesiodistal widths of mandibular canines than females, with differences reaching statistical significance.<sup>13, 14, 15</sup>

However, in contrast to mesiodistal width, the mean intercanine distance between males and females in the current study did not reach statistical significance. This observation is consistent with earlier findings by Rohini Singh et al. who also noted a lack of significant variation in intercanine width between sexes.<sup>3</sup>

In the current investigation, measurements of the mesiodistal width of mandibular canines and the intercanine distance were carried out among 100 individuals from the Jamnagar population. The findings revealed a statistically significant difference in mesiodistal dimensions of mandibular canine between males and females, highlighting its usefulness as a reliable marker for sex determination. However, since odontometric values can vary across different geographic and ethnic groups, further studies involving larger and more diverse populations are recommended to reinforce and generalize these results. Additionally, the precision of sex identification is notably enhanced when dental measurements are evaluated in conjunction with skeletal characteristics.

#### Tables

[Table I]

Parameter	Males	Females
Mesio-distal Width of Left Mandibular canine in mm (Mean±S.D.)	<b>6.53±0.33</b>	<b>6.02±0.36</b>
Mesio-distal Width of Right Mandibular canine in mm (Mean±S.D.)	<b>6.47±0.33</b>	<b>6.1±0.34</b>
Intercanine distance in mm (Mean±S.D.)	<b>26.0±2.3</b>	<b>25.5±1.44</b>

**Table I: Mean values of dental parameters between males and females, including the mesio-distal width**

**of the left mandibular canine, the mesio-distal width of the right mandibular canine, and the intercanine distance.**

[Table II]

**Table II: Comparison of left mandibular canine**

Study Group	Left Mandibular Canine width in mm (Mean±S.D.)	't' value	P value
Group I	<b>6.53±0.33</b>	<b>3.27</b>	<b>0.004</b> <b>(p&lt;0.05)</b> <b>Statistically significant</b>
Group II	<b>6.02±0.36</b>		

**width between males and females**

**on applying unpaired t test**

[Table III]

Study Group	Right Mandibular Canine width in mm (Mean±S.D.)	't' value	P value
Group I	<b>6.47±0.33</b>	<b>2.46</b>	<b>0.024</b> <b>(p&lt;0.05)</b> <b>Statistically significant</b>
Group II	<b>6.1±0.34</b>		

**Table III: Comparison of right mandibular**



### canine width between males and females on applying unpaired t test

[Table IV]

Study Group	Inter Canine Distance in mm (Mean±S.D.)	't' value	P value
Group I	26.0±2.3	1.26	0.221  (p>0.05) Not significant
Group II	25.5±1.44		

**Table IV: Comparison of Inter Canine Distance between males and females on applying unpaired t test**

### References

- Patil SS, Aher SD, Nehete AB, Gulve ND, Tambe MS, Shukla RM. Evaluation of intercanine arch width, intermolar arch width and the canine fossa width in the determination of gender of an individual between 18 and 35 years – An in vitro analytical retrospective study. *J Acad Dent Educ.* 2023;9:18-23.
- Khan MA, Verma M, Hassan SB, et al. Comparative study of sex estimation by mesiodistal width of mandibular canine and mesiodistal width of maxillary canine in North Indian population. *Medico Legal Update.* 2024;24(2).
- Singh R, Garg K, Singh S. Sex determination by evaluating inter-canine distance and mesiodistal width of mandibular canine. *Int Healthc Res J.* 2017;1:284-91. doi:10.26440/IHRJ/01\_09/132.
- Kumawat RM, Dindgire SL, Gadhari M, Khobragade PG, Kadoo PS, Yadav P. Mandibular canine: A tool for sex identification in forensic odontology. *J Forensic Dent Sci.* 2017;9(2):109. doi:10.4103/jfo.jfds\_41\_16.
- Monali C, Pritam P, Tapan M, Kajal D. Gender determination: A view of forensic odontologist. *Indian J Forensic Med Pathol.* 2011;4:148-51.
- Acharya AB, Mainali S. Limitations of the mandibular canine index in sex assessment. *J Forensic Leg Med.* 2009;16(2):67-9.
- Acharya AB, Angadi PV, Prabhu S, Nagnur S. Validity of the mandibular canine index (MCI) in sex prediction: Reassessment in an Indian sample. *Forensic Sci Int.* 2011;204(1-3):207.
- Otuaga PO, Chris-Ozoko LE, Sakpoba OS, Oyem JC. A comparative study of the canine tooth as a tool in gender determination in Nigerian population. *Galician Med J.* 2019;26(2).
- Reddy V, Saxena S, Bansal P. Mandibular canine index as a sex determinant: A study on the population of Western Uttar Pradesh. *J Oral Maxillofac Pathol.* 2008;12: doi:10.4103/0973-029X.44577.
- Işcan MY, Kedici PS. Sexual variation in buccolingual dimensions in Turkish dentition. *Forensic Sci Int.* 2003;137:160-4.
- Wheeler SJ. *Dental anatomy, physiology and occlusion.* 9th ed. Missouri: Elsevier; 2010.
- Muller M, Lupi-Pegurier L, Quatrehomme G, Bolla M. Odontometrical method useful in determining gender and dental alignment. *Forensic Sci Int.* 2001;121:194-7.
- Gupta S, Latoo SH, Dar MS. Mandibular canine index in gender determination: A viewpoint of a forensic odontologist. *IAIM.* 2020;7(8):9-13.
- Patel RA, Chaudhary AR, Dudhia BB, Macwan ZS, Patel PS, Jani YV. Mandibular canine index: A study for gender determination in Gandhinagar population. *J Forensic Dent Sci.* 2017;9:135-43.
- Zoya K, Renu T. Sex determination using canine dimorphism: Forensic relevance. *J Forensic Sci Crim Inves.* 2018;11(1):555802. doi:10.19080/JFSCI.2018.11.555802.