

# Gender determination using mandibular intercanine distance and mesiodistal width of right mandibular molar

Reshma Poothakulath Krishnan, Srivatchava S, Ashna Yuvaraj, Deepak Pandiar

Department of Oral Pathology and Microbiology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

## Abstract

**Background:** Forensic odontology plays an important role in mass disasters, house fires, criminal deaths, identification of missing persons, and child abuse cases. Teeth are the most stable part of the human body and are resistant to thermal, mechanical, and chemical insults. The aim of this study was to evaluate the effectiveness of mandibular intercanine distance and mesiodistal width of mandibular first molar in gender determination.

**Materials and Methods:** The study comprised 100 participants (50 males and 50 females) in the age group of 18–23 years. The mandibular impressions were made, and casts were prepared using dental stone. The intercanine distance and mesiodistal width of the right mandibular first molar were measured using digital vernier callipers. The data obtained was statistically analysed using SPSS software version 23.

**Results:** The mean mandibular intercanine distance was found to be  $27.2 \pm 2.3$  in males and  $25.94 \pm 1.76$  in females ( $P = 0.03$ ). There was no statistical difference in the mesiodistal width of the mandibular molar between males and females ( $P = 0.166$ ). However, the mean mesiodistal width of males was higher when compared to females.

**Conclusion:** Males have a greater intercanine width and mesiodistal dimension when compared to females. This result will be helpful in forensic medicine, anthropology, orthodontic treatments, and clinical dentistry.

**Keywords:** Forensic anthropology, forensic medicine, mandible, molar, tooth

**Address for correspondence:** Dr. Reshma Poothakulath Krishnan, Department of Oral Pathology and Microbiology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India.  
E-mail: reshmakpai@gmail.com

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## INTRODUCTION

Forensic odontology, a branch of forensic science, plays an important role in mass disasters, bioterrorism, criminal deaths, and child abuse cases.<sup>[1,2]</sup> Establishing the gender of an individual by using teeth and related structures has gained importance in recent times, mainly in mutilated cases beyond recognition and in situations where only a few body parts are recovered.<sup>[3]</sup> In several

circumstances, teeth could be the only source of personal identification.

Teeth are the most stable and hardest part of the human body. They are resistant to thermal, mechanical, chemical, and microbial insults, and it has been reported that the tooth can withstand temperatures as high as  $1600^{\circ}\text{C}$ .<sup>[4]</sup> Mandibular canines are least exposed to mechanical irritation, abrasion,

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and periodontal disease and are the last tooth to be extracted.<sup>[5]</sup> They have a mean eruptive age of 10.87 years and are called the cornerstone of the dental arch.<sup>[5]</sup> Evolutionary clues have been provided by metric tooth measurements and traits that various teeth of human dentition, such as the mandibular canines and mandibular molars, exhibit sexual dimorphism. Males usually have larger crowns than females; however, this degree of sexual dimorphism differs in various populations.<sup>[6]</sup> Variations in tooth size may be influenced by genetic makeup, epigenetic influences, and environmental factors. According to Black *et al.*,<sup>[7]</sup> odontometric measurements can be used in gender determination and age estimation in forensic science. These details also play a pivotal role in establishing the identity of an individual in anthropology. The aim of this study was to evaluate the effectiveness of mandibular intercanine distance and mesiodistal width of right mandibular first molar in gender determination.

## MATERIALS AND METHODS

The present study was conducted in a private dental college in Tamil Nadu, India. Ethical clearance was obtained from the institutional ethical committee. The participants were informed about the study protocol, and voluntary written informed consent was obtained. The study comprised 100 participants (50 males and 50 females) in the age group of 18–25 years. Subjects with the presence of a complete set of permanent teeth (presence or absence of third molars was not considered), without any developmental defects, periodontal disease, fractures, pathologies, caries, or restorations were included in the study. The mandibular impressions were made, and casts were prepared using dental stone. The intercanine distance and mesiodistal width of the right mandibular first molar were measured using digital vernier callipers. The intercanine distance is the distance between the tips of the right and left mandibular canines [Figure 1]. The mesiodistal width of the right first molar was measured by keeping the vernier callipers parallel to the occlusal surface of the mandible. The data obtained was statistically analysed using SPSS software version 23.

## RESULTS

Independent *t*-test was performed for the statistical analysis. It was noted that the intercanine distance was greater in males than in females. The mean mandibular intercanine distance was found to be  $27.2 \pm 2.3$  in males and  $25.94 \pm 1.76$  in females ( $P = 0.03$ ). There was no statistical difference in the mesiodistal width of the mandibular molar between males and females ( $P = 0.166$ ). However, the mean mesiodistal width of males was



**Figure 1:** Measurement of the mandibular intercanine distance

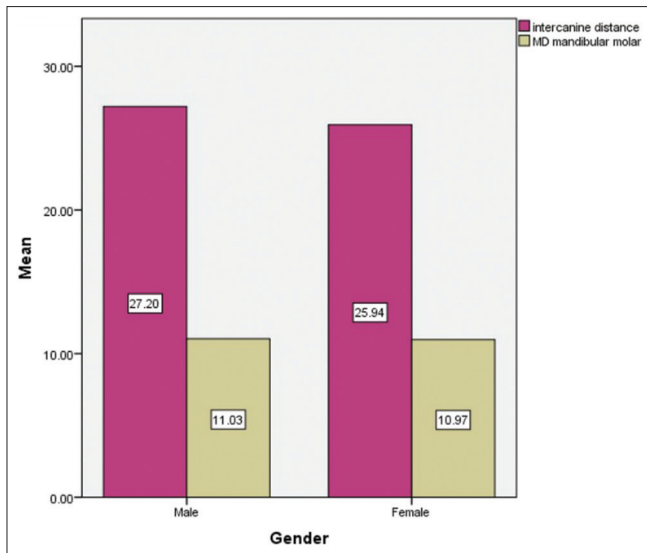
higher when compared to females (males =  $11.03 \pm 0.23$ , females =  $10.97 \pm 0.15$ ) [Figure 2].

## DISCUSSION

Forensic odontology plays an important role in personal identification.<sup>[8,9]</sup> Dental examination is useful in forensic sciences for genetic, anthropological, and crime investigations. Odontologic evaluation using various dimensions of teeth, such as bucco-lingual measurement, mesiodistal measurement, and inter-tooth distance, has been reported by various authors.<sup>[10,11]</sup> Furthermore, the evaluation of metric measurements is considered to be more reliable in forensics than the non-odontometric analysis.<sup>[10]</sup>

In the present study, the mandibular intercanine distance was statistically higher in males than in females. These results suggest a sexual dimorphism in mandibular intercanine distance in the Tamilian population. Similar results were reported by Singh S *et al.* and Adamek A *et al.*<sup>[11,12]</sup> Singh S *et al.*<sup>[11]</sup> performed a study in Faridabad children and concluded that the mandibular intercanine index was  $33.8 \pm 0.54$  in males and  $32.1 \pm 1.57$  in females. Puri *et al.*<sup>[13]</sup> reported a difference of 0.62 mm between men and women. Furthermore, Keng *et al.*<sup>[14]</sup> reported that males have a wider intercanine distance when compared to females. This difference between males and females could be due to the larger alveolar process, bony ridges, average musculature strength, and crests in men.<sup>[15]</sup> The larger arch measurements in males could also be one of the reasons for the increased intercanine distance in males.

The difference in the odontometric values and variation in the magnitude of dimorphism varies between specific populations and within the same population and is



**Figure 2:** The bar graph represents the association between gender and mandibular intercanine distance and mesiodistal width of the right mandibular first molar

related to evolution, socialization, variation in food resources, and cultural factors.<sup>[15]</sup> The magnitude of sexual dimorphism values also depends upon various genetic and environmental factors.<sup>[16]</sup> It is well known that the tooth moves within the bone confines and reaches a functionally stabilised position. Hence, the increase in muscular strength and larger bone size could further increase the intercanine distance in men.

Odontogenic measurements such as tooth size evaluation are important in forensic sciences, aesthetic restorations, and dental anthropology. The size of the tooth differs between males and females; generally, males are considered to have a larger tooth size than females.<sup>[6]</sup> Acharya *et al.*<sup>[17]</sup> reported that tooth measurements such as mesiodistal and buccolingual width have an accuracy rate of 62%–83%. In our study, the mean mesio-distal width of the mandibular molar was greater in males than in females; however, the results were not statistically significant. Hussain T *et al.*<sup>[18]</sup> reported the mean mesiodistal width as 10.16–10.93 mm in females and 10.31–11.11 mm in males. Tikku *et al.*<sup>[19]</sup> from India concluded that the size of teeth is larger in males when compared to females. Odontogenic analysis has confirmed that sexual dimorphism is seen in the overall crown size: the average value in males exceeds than that of females.<sup>[6]</sup>

Various genetic, environmental, racial, and epigenetic changes may contribute to this variation in size between males and females. The role of sex-linked genes, an increase in the jaw size in males, and differences in the enamel, dentin, and pulp are the reasons for increased tooth dimensions in males.<sup>[20]</sup> It is been reported that females have

higher enamel and males have more dentin in the teeth.<sup>[20]</sup> This is attributed to the X and Y chromosomes. The Y chromosome in males is known to increase the mitotic potential of tooth germ and control the size of teeth by increasing the thickness of dentin.<sup>[21,22]</sup> The increase in the dentinal zone in males leads to increased odontometric measurements in males. However, the X chromosome controls the thickness of enamel.<sup>[22]</sup> Genetic coding for enamel is related to the Amelogenin protein; 90% of this protein is located on the X chromosome and 10% on the Y chromosome.<sup>[23]</sup> Hence, males might undergo a lengthier enamel formation or have a longer period of amelogenesis than females. Longer amelogenesis indicates increased enamel formation and larger crown size. Furthermore, the Y chromosome affects the rate of body development and produces slower maturation.<sup>[24]</sup> Regional differences also affect the size of the tooth. Other factors that can influence this are nutrition, climate, and cultural changes in various populations.

Forensic odontology is an emerging field in forensics that relies on inexpensive and easy methods of identification from dental remains and fragmented jaws. From the present study, it can be concluded that males have a greater intercanine width and mesiodistal dimension when compared to females. The odontometric methods used in this study are simple, inexpensive, and can be used for a large sample population. This result will be helpful in forensic medicine, anthropology, orthodontic treatments, and clinical dentistry. Further studies in different geographical populations and in larger populations are required to generalise the results.

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### Conflicts of interest

There are no conflicts of interest.

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