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Reliability of Mandibular Canine Index on Gender Determination

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Abstract - Forensic odontology plays a important role in the identification of individuals, particularly in situations where bodies are disfigured or decomposed. This study aimed to assess sexual dimorphism using the mesiodistal width and intercanine distance of mandibular canines in a sample population from Bilaspur, Chhattisgarh. A total of 120 dental cast samples (60 males and 60 females), aged 15–70 years, were examined. Measurements of the right and left mandibular canine widths and intercanine distances were taken using a sliding vernier caliper. Mandibular canine indices (MCI) were calculated, and statistical analysis was performed to assess gender differences. The results revealed that males exhibited significantly greater mesiodistal widths and intercanine distances compared to females. The left mandibular canine demonstrated more sexual dimorphism than the right. Overall, the study confirmed the utility of mandibular canines, particularly their width and intercanine distance, as reliable parameters for sex determination in forensic cases. These findings can aid in personal identification during forensic investigations, especially in mass disaster scenarios..

Key Words: mandibular canine, gender Determination, Forensic, Investigation, Case, Dentistry,

1.INTRODUCTION *(Size 11, Times New roman)*

Forensic Odontology is the area of forensic dentistry that deals with the examination of teeth. The practice of using dental principles to address dental disorders in legal contexts is known as forensic odontology. Teeth have long been used as evidence. As early as AD 49, there are records of people being identified by distinguishing certain dental traits. However, forensic odontology as a field of study did not emerge until Dr. Oscar Amoedo's doctoral thesis, "L' Art Dentaire en Medicine Legale," published in 1897, which discussed the use of dentistry in forensic medicine with a focus on identification.

Archaeological and medicolegal exams include determining the gender of skeletal remains. According to the available bones and their state, different techniques are used. The DNA approach is the only technique that can produce results that are 100 percent correct, although it is frequently not applicable for a variety of reasons. In order to distinguish between male and female remains, anthropological measures of the skeleton must be used, and these measurements must be compared to current standard data. Gender differences are not always noticeable on an individual basis, but when considered as a whole, they typically provide a good indication. When the entire body of an unidentified person is available, identification of living or dead human beings can be made by examining the external or internal sexual characteristics. Because the prostate and non-gravid uterus are the last organs to putrefy in highly decomposed carcasses, it is sometimes feasible to determine the sex of the person when only fragments of the body are present, as in air crashes, railroad accidents, etc. Forensic professionals find it difficult to determine sex from skeletal remains, especially when only the skeletal remains are found. Bones in skeletonized remains can be used to determine a person's sex, with the pelvis and skull being the most significant.

In both living and non-living populations, teeth constitute a distinctive material for forensic, genetic, anthropological, and odontological inquiry. In a constant biological process called tooth eruption, developing teeth push through the mucosa that covers the jaws and into the oral cavity. Estimating sex determination is a significant activity that is frequently carried out in the medicolegal field. The assessment of sex is frequently necessary when dispensing justice to those involved in civil and criminal action. Being the main part of the masticatory system, teeth make a good tissue for genetic and odontologic research. Due to their resistance to putrefaction and consistency in appearance, teeth are crucial evidence in medico-legal proceedings since they aid in identification and sex determination in both the living and the dead. The fundamental benefit of dental evidence is that it may be kept safe even after the person has passed away. The examination of ante mortem and post mortem factors is made possible by the distinctive tooth pattern. When just pieces of the corpse are found, gender can be determined using the dentition. So, a person's dentition is quite important in determining their gender. The strongest and most stable tissues in the body are teeth. Sexual dimorphism is the term for variations in a given object's size, shape, or stature that can distinguish a man from a female. In legal proceedings, the issue of personal identity comes up when identifying other people and dead bodies. The most crucial factors in forensic identification are those that determine sex. Based on sex determination utilising dental traits, the size of the teeth in men and women are compared.

The term "sexual dimorphism" refers to the differentiation of males and females based on morphological traits. The examination of tooth size in distinct populations finds application in anthropological and forensic investigations among all dimorphic features. Males' tooth crowns are consistently seen to be wider than female tooth crowns. Canines have a higher chance of

surviving traumatic events like disasters, conflagrations, and hurricanes. The mandibular canine tooth and intercanine distance measures can be used to determine the sex in circumstances when postcranial bones are fragmentarily damaged or unavailable. Therefore, one of the key interests in cases of large calamities is to determine the gender using odontomentric procedures.

Dental maturity is preferred to tooth emergence into the oral cavity because it is less affected by regional circumstances. It is frequently employed to calculate chronological age. The process of creating a personal identification from human skeletal remains heavily relies on the assessment of sex. Accurate sex significantly reduces the number of potential matches in half, and many methods used to calculate lifespan and age at death depend on sex. There is evidence that racial, cultural, and environmental factors all affect the morphometry of teeth. They are helpful in identifying gender using various odontometric methods. The width is thought to be more significant than the length of the two dimensions. A branch of forensic dentistry known as "sex determination" is crucial, particularly when there is little information available about the deceased. In the event of accidents, explosions of chemical and nuclear bombs, natural disasters, crime investigations, and ethnic studies, determining a person's sex becomes the first priority in the process of identifying a person by a forensic investigator. Sex identification has been done in a variety of ways. Both morphological (of the tooth, cranium, and other soft tissues of the oral and paraoral region) and molecular analyses can be used to determine the sex of an individual. Either the comparative approach or postmortem dental profiling are used to identify teeth. The fundamental benefit of dental evidence is that it may be kept safe even after the person has passed away.

The canines are the best teeth to demonstrate the most sexual dimorphism when just the maxilla, mandible, or only teeth are present. Even after the rest of the body has decomposed, teeth can still be recognised. Since teeth may be easily examined and no two teeth have a comparable morphology, they make a great forensic tool for sex identification. In the event of a significant tragedy, where bodies are frequently destroyed beyond repair, the identification of sex is important. Canines are the least susceptible of all the teeth in the human dentition to plaque, calculus, brushing abrasion, or strong occlusal loading. They are also less severely afflicted by periodontal diseases. Due to their resilience in the mouth cavity, canines are favoured as the best teeth to examine.

The average age of eruption for canines, which are regarded as the "key teeth" for personal identification, is 10.87 years.

With measurements of mesiodistal breadth, intercanine distance, and canine index, the current study is an honest attempt to identify the sexual variations in the morphology of permanent mandibular canines. In the Bilaspur community, an effort is being made to determine whether the mandibular canine index is useful at predicting sex while taking proper dental alignment into account.

In the current investigation, the mesiodistal breadth of the left and right mandibular canines was assessed on patient casts from a comparable cohort of male and female participants while maintaining the same parameters for both groups. In order to determine the significance of the parameters in determining sex, the measurements were next subjected to statistical comparison..

2. Materials And Methods:

The 120 dental cast samples included in the current study came from Bilaspur, Chattisgarh, and included 60 males and 60 females between the ages of 15 and 70. This age range was chosen because by this time, all canines would have reached full development, attrition was anticipated to be low, and the intercanine distance was determined by the age of 12 years. Samples of dental castings were gathered from several Bilaspur dental clinics. The mandibular canine width and intercanine distance of the corresponding jaws in these samples were measured as part of the study's methods.).

Gender	Age Group	Total Sample
Male	15-70	60
Female	15-70	60

Table -1: Data Collection

2.1 Inclusion Criteria

1. Fully erupted teeth
2. Caries free teeth
3. Teeth with normal overjet and overbite.
4. Healthy state of gingiva and periodontium.
5. Normal molar and canine relationship.
6. Absence of spacing in anterior teeth.
7. Age range 15 to 70 years.

2.2 Exclusion Criteria:

Samples with following status of teeth were excluded from the study.

1. Abnormal teeth alignment.
2. Crowded or excessive spacing in the anterior teeth.
3. Subjects with missing anterior teeth.
4. Caries teeth.
5. Abnormal over jet and overbite

6. Samples with bad/ poor oral hygiene
7. Canine teeth with attrition
8. Samples with orthodontric treatment.

3. Following parameters were determined in this study:

1. Mesiodistal width of right mandibular canine
2. Mesiodistal width of left mandibular canine
3. Intercanine distance
4. Right mandibular canine index
5. Left mandibular canine index

The measurement process began after the samples were chosen at random and the study's objectives were explained to them. A sliding calliper with a precision of 0.01 mm was used to measure the dental cast sample, and it had the ability to be fixed in the proper position to prevent any errors from being made when accurately measuring the canines.

Fig -1: Measurement Of Mesio-Distal Width Of The Canine

3.1 Mesio-Distal Crown Width of Canine Fig -1)

A sliding vernier calliper was used to measure the largest mesio-distal width of a canine tooth. The measurement was taken by placing the calliper's two pointed ends between the jaws.

Fig -2: Measurement Of Inter-Canine Distance

3.2 Inter-Canine Distance (Fig -2)

The received readings were analysed to arrive at conclusions. The Muller et al. formula was also used to compute the mandibular canine index (MCI) and standard canine index for all four canines.

3.3 MCI = Mesiodistal Crown Width of Mandibular Canine / Mandibular intercanine Distance

According to the above formula, the MCI for each subject was determined, and the mean MCIs for men and women were then calculated. The standard MCI, which is the sum of the mean male and mean female MCI plus standard deviation divided by two, was determined using the mean male and mean female MCI. If a person's estimated MCI was higher than the standard mandibular canine index, that person will be classified as male, and if it was lower, that person will be classified as female.

3.4 Standard Mci = (Mean Male Mci – Sd) + (Mean Female Mci + Sd)/2

The readings obtained were subjected to statistical analysis and sexual dimorphism in the right and left canines was calculated using the formula given by Garn and lewis 1967.

3.5 Sexual Dimorphism = Xm – 1 *100/ Xf

Data were entered into Microsoft Excel 2010 and statistical analysis was performed on them. Means, standard deviation (S.D.) calculations, and frequency calculations were all included in descriptive statistics (percentage). Student's t-test was used to determine the significance of the variations in tooth measurements between the sexes. For a value of p0.05, each value was deemed statistically significant.

In the current study, a total of 120 samples—60 males and 60 females—covering the age range of 15 to 70 years—were collected as the study group. Dental castings for each person were measured. For both the left and right sides, the mandibular canines' mesio-distal widths were measured. The inter-canine distance, or the distance between the two canines, was also measured. The measurements were made three times by three different people, and the mean of the measurements was taken into account to rule out any measuring error.

Result:

Measurement Of Various Parameters of Mandibular Canine in Males & Females Ar Their Statistical Significance						
Group Statistics						
	Gender	N	Mean	Std. Deviation	T- Value	P-Value
Mesiodistal Width of Canine (Right)	MALE	60	0.59	0.37	-3.64163	0.000202 Significant at P<.05
	FEMALE	60	0.54	0.21		
Mesiodistal Width of Canine (Left)	MALE	60	0.57	0.37	-1.24408	.107967 Not Significant P<.05
	FEMALE	60	0.55	0.27		
Intercanine Distance	MALE	60	2.6	2.17	-2.62919	.004849 Significant at P<.05
	FEMALE	60	2.48	4.8		

Table -2: Result Analysis

Standard Canine Index

Sr. No	Standard CI	Value
1	Right MCI	0.3962
2	Left MCI	0.3925

Table -3: Stander Canine Index

4. Summary of Sexual dimorphism in mandibular canine width.

Parameter	Sexual Dimorphism
RMCW	3.64%
LMCW	2.62%

Table -4: Summary of Sexual dimorphism in mandibular canine width

5. Result of present study depicted in Table 2,3,4

In **Table -1**:- The parameters of mandibular canines of male and female and their statistical significance have been shown.

The result showed that the mean value of the inter-canine distance in male and female was **2.6mm** and in females it was found to be **2.48mm**. When the mean value of inter-canine distance of **120** samples (**60** males and **60** females) were compared, male showed higher values than females and the differences was statistically significant. **(P value 0.0048)**

The width of the mandibular canine was slightly higher for males than females. When the mean values for left and right mandibular canine width were compared between male and females, the females showed lesser value. Furthermore, variations in width of the right and left mandibular canine was more in the males than in females.

The mean values of the width of right canine and left canine as measured using sliding vernier callipers in male was found to be 0.59mm and 0.57mm.

The mean value of the width of right canine as measured using sliding vernier calliper in male and female was found to be 0.59mm and 0.54mm (P<0.107) and this was found to be not significant. The mean value of the width of left canine as measured using sliding vernier callipers in male and females was found to be 0.57mm and 0.55mm (P<0.002) and was found to be significant.

Mandibular canine indices for left mandibular canine was also found to be significantly different in male and female. Mandibular canine for left mandibular canine was not significant.

Sexual dimorphism was calculated and right mandibular canine was found to be more dimorphic than left mandibular canine.

Overall, the values obtained for the inter-canine distance, right canine width, left canine width, right MCI were found to be significantly higher in males than in females (**Table -2**).

6. Discussion:

An assertion based on features that match those of a particular individual can be used to identify an unknown body or living person. Humanitarian and legal requirements both call for accurate identification of the deceased. Forensic professionals have used radiographic techniques, fingerprinting, DNA and serologic comparisons, and more to identify the deceased.

Dental evidence is useful in identifying people in many circumstances where other techniques are ineffective, making forensic odontologists an essential member of the forensic team. Dental identifications have always been crucial in times of natural and man-made disaster, especially the huge casualties typically connected to

aircraft and fire disasters. In the past, visual approaches, the shape of the jaw, the pelvic bone, etc., have been used to determine the gender of a victim as an important stage in identification.

The most mineralized tissue known to be resistant to various destructive agents is the tooth. They are especially helpful in identifying gender using various odontometrical procedures, which is of considerable interest in the event of big disasters where remains are irreparably ruined.

The human dentition is a well-organized morphological system that reacts to genetic alterations in a predictable way. While some genetic variations in the dentition are broad, others are specific and only impact certain teeth. Mandibular canines are among the 32 permanent teeth that are known to exhibit the most sexual dimorphism. The mesio-distal crown size and canine arch width of the mandibular canines consistently show a larger sex difference. Canines are also less likely to be extracted and to suffer from periodontal problems, which lends itself to other benefits when utilising them to determine gender.

Biological variation is a characteristic of life, whether it is between different species or between different individuals of the same species. Pronounced differences in the tooth dimensions between various populations have been observed in various studies conducted in the past. In the present study, the subjects who have been taken into consideration were from Bilaspur population, Chattisgarh. Similar study was conducted by Rao et al.8 on South Indian population, and Al Rifaiy et al.11 in Saudi population. The sample size in the present study was 120 subjects comprising of 60 females and 60 males.
503 school students (252 females and 251 men) were the participants of a study by Al-Rifaiy et al.11, and 766 people (384 females and 382 males) were the subjects of a study by Rao et al.8. In 243 subjects—almost exactly the same number as our sample size—Garn et al.7 examined the degree of sexual dimorphism.

In the present study an age range of 15 to 70 years was considered, which was comparable to the age range of 15 to 18 years by Al-Rifaiy et al.11 and 15 to 21 years in a study conducted by Rao et al.8 Compared to other studies, greater age range was taken into consideration in the present study. This age group was selected as periodontal problems and attrition is minimum in this age group.

In the present study based on the measurements and statistical analysis, the mesio-distal width of left and right mandibular canine were measured and analysed to be mm for left mandibular canine in females and 7.691±0.313 mm in males whereas 6.794±0.360 mm for right mandibular canine in females and 7.657±0.313 mm in males. These values are in accordance to the values obtained from the study conducted by Al-Rifaiy et al,11 who calculated the mesio-distal width of left mandibular canine in females to be 6.8310±0.9345 mm. Thus, the range of mesiodistal width of mandibular canine may be helpful in establishing the sex for unidentified bodies in forensics and also in criminal scenes.

7 . CONCLUSIONS

It is concluded that the mesiodistal widths of mandibular canines are significantly different in males and females, as are the mandibular canine indices. The mandibular intercanine distance was significantly different. The left mandibular canine was found to be more dimorphic than right mandibular canine. The parameters measured in the present study will be of immense help in identification of sex in forensic investigations.

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