
Sexual Dimorphism in Permanent Mandibular Canines

Dayananda R^{a*}, Kumar MP^{b*}, Govinda Raju HC^{c#}, Anand P Rayamane^{a*}, Ashish Saraf^{c*}

Introduction: Amongst the various calcified structures in the human body, teeth have gained lot of popularity in estimating the sex of an individual as they are highly resistant to destruction and decomposition. Using permanent mandibular canines many researchers have predicted a high level of accuracy in identifying the sex correctly. The purpose of our study was to gauge the effectiveness of mandibular canines in discerning sex. **Materials and Methods** - The present study was performed on 200 students, between the age group of 18-25 years, randomly sampled with informed consent. Mandibular canine width and inter-canine distance were measured with the help of Vernier callipers after observing aseptic conditions. Mandibular canine index (MCI) was calculated and the observed MCI was compared with the standard MCI value. Then Variance and Z value was calculated for each parameter. **Results:** No significant statistical difference was noted between the right and left mandibular canines among same sex, but when comparison was done between males and females, there was highly statistical significant difference. Then standard MCI for canines was calculated. With these calculations we could predict sex correctly in 71% of the cases (Male: 68% and Female: 74%). **Conclusion:** MCI is a quick and reliable method for sexual identification, when a standard for the population is available. This method can be used as adjunct to other available tools for sex determination.

Keywords: mandibular canines; inter-canine distance; sexual identification

Introduction

The four leading features of biological identity are sex, age, stature, and ancestry background. The forensic anthropologist wishes to authenticate these traits for an individual from their skeletal remains.¹ An important initial step in identification of the dismembered remains of mass disaster victims is the separation of sexes.² Gender determination of skeletal remains is a part of archaeological and many medico-legal examinations.

Sexual dimorphism refers to the differences in size, stature, and appearance between male and female. This can be applied to dental identification also because no two mouths are alike.³ Various features like tooth morphology and crown size are characteristic of male and

female. In addition, tooth size is influenced by a galaxy of factors due to which its morphometric study is a subject of profound interest and gives significant results. Tooth size standards are frequently used in sex determination. Out of the two proportions - width and length, the former is considered to be more important.⁴

Tooth sexual dimorphism is often related to body size. In living people today, body size dimorphism averages 10%.⁵ Human dental dimorphism is on the order of 2-6%. Canines vary from other teeth with respect to survival and sex dichotomy. The differences in all probability are correlated to their function, which is different on an evolutionary basis from other teeth. In many animals, large canines are considered to be visual sexual signs of dominance and rank. In carnivores and in most primates, their chief function is related to threat of aggression and actual aggression.⁶

^aAssistant Professor, ^bAssociate Professor, ^c Professor and Head, ^e Postgraduate, ^{*} Mysore Medical College & Research Institute, Mysore. [#] Basaveshwara Medical College, Chitradurga.

Corresponding Author:

Dr Dayananda R - Mobile No – 09900076248.

Mandibular canines are found to exhibit greatest sexual dimorphism. The mandibular canines have a mean age of eruption of 10.87 years and they are the last teeth to be extracted with respect to age. They are less affected by periodontal diseases and are most likely to survive severe trauma such as air disasters, hurricanes or conflagration. These findings indicate that mandibular canines can be considered as the „key teeth“ for personal identification.⁷

Mandibular canine index was employed in numerous studies on large populations as it is simple, reliable, inexpensive and easy to perform. This is of definite significance, as tooth morphology is known to be influenced by cultural, environmental and racial factors. In recent times various studies have been done by several researchers to explore the validity of mandibular canine tooth size in sex detection, specifically the mandibular canine index (MCI), which is the ratio of the mesio-distal (MD) dimension of the lower canine and the inter-canine arch width.

Materials and Methods:

This study was conducted in the M S Engineering College, Bangalore. The study population involved the students of M S Engineering College, sample size was 200 (100 males and 100 females) between the age group 18-22 years, which was randomly selected. Informed consent was taken from the students.

Inclusion Criteria

Subjects with following status of teeth were included in the study:

- Healthy state of gingiva & periodontium.
- Caries free canine teeth.
- Absence of spacing in the anterior teeth.
- Normal molar and canine relationship.

Following parameters were determined in this study:

Mesio-distal width of right mandibular canine.

Mesio-distal width of left mandibular canine.

Inter canine distance.

Right mandibular canine index.

Left mandibular canine index.

Measurements

All the measurements were taken intra-orally in clean and well-illuminated room, taking all the aseptic precautions.

Measurement of the Mesiodistal Width: The mesial and distal surfaces of the teeth were identified and the distance between the crest of curvature on the mesial surface and crest of curvature on the distal surface was recorded by the divider points. The divider was then held against the Vernier calliper (Fig. 1) and read.

Measurement of the Inter-canine Distance-

The inter-canine distance was measured between the tips of the mandibular canines. The divider points were applied to the tips of the mandibular canines as shown in Fig. 2. The divider was then held against the Vernier calliper and the reading was noted.

The observed mandibular canine width and intercanine width were recorded. The variance and Z value were calculated for each parameter.

The mandibular canine index was calculated using the formula

Mandibular canine index = Mesio-distal crown width of mandibular canine / Inter canine width.

The standard MCI value is used as a cut-off point to differentiate males from females, which is obtained from the measurements taken from the samples by applying the following formula:

Standard mandibular canine index =
(Mean male MCI-SD) + (Mean female MCI+SD) / 2

The observed MCI was then compared with the standard MCI value obtained in this study.

Results: The descriptive statistics and the degree of sexual dimorphism for mesio-distal measurements of mandibular canines and the inter-canine arch width are depicted in Table 1. Mesio-distal Width of Right and Left Mandibular Canine showed very highly significant difference between males and

females, Right and Left Mandibular Canine Index showed highly significant difference however intercanine showed no significant difference.

Table 2 shows the accuracy of estimating sex using Standard mandibular canine index. In our study 68% of males and 74% of females were correctly identified. The table also compares our results with that of studies.

Table 1– Measurement of various parameters of Mandibular Canine Index and their statistical significance.

Parameter	Sex	Mean	SD**	Variance	z Value	Significance
Mesio-distal Width of Right Mandibular Canine	Male	0.74	0.042	0.0017	11.75	Very Highly significant
	Female	0.65	0.049	0.0024		
Mesio-distal Width of Left Mandibular Canine	Male	0.74	0.044	0.0019	21.86	Very Highly significant
	Female	0.67	0.053	0.0028		
Intercanine distance	Male	2.576	0.22	0.0466	0.17	Not Significant
	Female	2.5622	0.27	0.0751		
Right Mandibular Canine Index	Male	0.2864	0.029	0.0008	7.45	Highly Significant
	Female	0.2569	0.027	0.0007		
Left Mandibular Canine Index	Male	0.2888	0.028	0.0008	5.89	Highly Significant
	Female	0.2645	0.027	0.0007		

Table 2 - Sex Classification Accuracy using Standard Canine Index in Mandibular Canine

	Mandibular Canine Index Percentage correctly predicted	
	Our study	Rao et al ¹³
Males	68	84.3%
Females	74	85.7 %
Total	71	85 %

Discussion

Human sexual dimorphism is said to be an outcome of a survival strategy, a balancing of the need for high degree of biological variation within the species with the need for a narrow range of variation in the female, who is physically structured for the support of an infant prenatally and postnatally.⁸ Thus, the

differences are a reflection of the on-going processes of evolution. The genetic basis for variation has been explained by a polygenic model of inheritance. This is the basis of the sexual dimorphism in the morphological and metric attributes of males and females.

It is a known fact that teeth provide excellent models for the study of relationship between

ontogeny and phylogeny. The canines are functionally not masticatory but are related to threat of aggression and actual aggression. A transfer of this aggressive function occurred from the teeth to the fingers in man and until this transfer was completed, survival was dependent on canines especially in males. Canines differ from other teeth with respect to survival and sex dichotomy. Thus in the present day humans, sexual dimorphism in mandibular canines is not merely a coincidence but can be expected to be based on functional activity.

Lund and Mornstad⁹ studied 58 dental casts of Swedish subjects and found the canines to be most dimorphic of all the teeth. Lysell and Myrberg¹⁰ in an extensive study of more than 1000 subjects concluded that the mandibular canine demonstrated the greatest sexual dimorphism (5.7%) amongst all teeth. Hashim and Murshid¹⁵ conducted a study on pre-treatment orthodontic casts of 720 Saudi male and female subjects in the age group of 13-20 years and found that the mandibular canines were only teeth to exhibit sexual dimorphism. Hence the present study was conducted on mandibular canines to find out sexual dimorphism.

In the present study, the right mandibular canine was found to be more dimorphic than left mandibular canine. However Kaushal et al³ and Nair et al¹². This difference can be attributed to several factors namely, racial, environmental and nutritional factors.

The mean mesio-distal width of right and left mandibular canine as found in the present study is similar to that found by Kaushal *et al.*³ The difference of mean mesio-distal width of mandibular canine of male and female was found to be statistically more significant for left mandibular canine than right mandibular canine. This indicates that mesio-distal width of left mandibular canine is a better parameter to identify male and female mandibular canines.

The mandibular intercanine distance was not statistically significant. So the intercanine distance is an equivocal parameter to identify sex from mandibular canines.

In the present study, right and left mandibular canine indices were found to be significantly different in males and females. The accuracy of measurement was 71%. There are many studies done using permanent mandibular canine in estimating sexual dimorphism and have obtained reliable accuracy.

Amongst all these studies, the study carried out by Rao et al¹³ on a diverse sample that originated from the state of Karnataka in Southern India stands out because they proposed the 'Mandibular Canine Index (MCI)'. They concluded that 84.3% males and 85.7% females could be discriminated correctly with respect to sex. The method has been tested on other Indian samples in Southern India by Yadav et al¹⁴ and they have achieved 72% accuracy in sex estimation. Similar study was conducted by Reddy et al¹⁵ from the state of Uttar Pradesh in Northern India and they have achieved 82% accuracy in sex estimation.

Lower levels of accuracy (51%) in sex estimation was obtained by Muller et al¹⁶ when MCI was applied to the students enrolled in the University of Nice-Sophia Antipolis.²¹ 210 girls and 214 boys were randomly sampled in that study. Lower levels (63%) were achieved by Acharya et al¹⁷ too.

From the above it is clear that such a method of sex determination has its limitations due to variations of this parameter with geographic distribution.

Conclusion

It is concluded that the mesio-distal widths of mandibular canines are significantly different in males and females, as are the mandibular canine indices. The mandibular intercanine distance was not significantly different. The right mandibular canine was found to be more dimorphic than left mandibular canine. The

accuracy of sex determination using MCI is 71% in our study.

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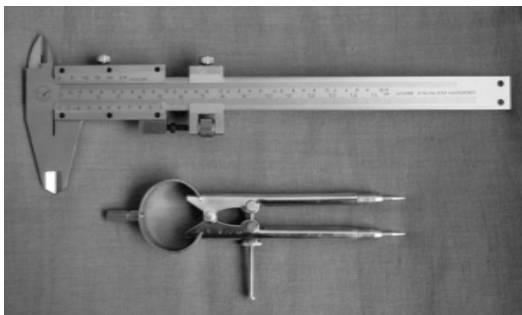


Fig. 1 – Vernier Caliper and Divider



Fig. 2 – Measurement of Intercanine distance