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Original Research Article

Mandibular Canine Index : A Tool For Sexual Dimorphism.

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Mesiodistal widths,
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Abstract

Background: Gender estimation is an important aspect of personal identification and, has an immense forensic relevance. The mandibular canines have a mean age of eruption of 10.87 years and are least affected than other teeth by periodontal diseases. Mandibular canines to exhibit the greatest sexual dimorphism among all teeth. **Materials and methods:** Total 91 subjects including 2nd year MBBS students were studied out, of which 49 were male and 42 were female. **Results:** All the male and female students were 18 - 21 yrs. Mesiodistal widths of right and left mandibular and maxillary canines were measured intraorally with the help of digital vernier caliper accurate to 0.1 mm along with Inter-canine distance or width. **Conclusion:** The mesiodistal width of mandibular canines significantly greater in males than females and Standard canine Index for right and left mandible can be used as a tool for sex prediction.

1. Introduction

Gender estimation is an important aspect of personal identification and, has an immense forensic relevance.¹ Teeth are the hardest and chemically most stable tissues in the body which exhibit the least turnover of natural structure. They can be selectively preserved and fossilized, thereby providing the best evidence for evolutionary change. Their resilience in the case of fire and bacterial decomposition makes them important for identification in forensic science.²

In the human dentition off all the teeth, the canines are the least frequently extracted teeth because of the decreased incidence of caries and periodontal disease. Furthermore, canines are reported to withstand extreme conditions and

have been recovered from human remains even in air disasters and hurricanes.² The mandibular canines have a mean age of eruption of 10.87 years and are least affected than other teeth by periodontal diseases. These are the last teeth to be extracted with respect to age. These findings indicate that mandibular canines can be considered as the 'key teeth' for personal identification also the tooth size standards based on odontometric investigations can be used in age and sex determination.³ Mandibular canines to exhibit the greatest sexual dimorphism among all teeth.² Whenever it is possible to predict the sex, identification is simplified as it leads to consideration of one sex of missing persons.

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of one sex need to be considered. In this sense identification of sex takes precedence over age.⁴ In the present study an attempt has been made to establish the sex of a person by using mesio-distal width of canine teeth and the respective inter-canine distances in the central Indian College going youth.

2. Materials and methods:

The study was initiated after the protocol had been approved by the Institutional Ethics Committee, and written informed consents were obtained from all the subjects. In the present study, total 91 subjects were included. Subjects with healthy mandibular canines and periodontium were included in the study. Subjects with dental or occlusal abnormalities (rotation, crowding, occlusal disharmony, etc.), physiologic or pathologic wear and tear (e.g., attrition, abrasion, abfraction, erosion) and deleterious oral habits (like bruxism) were excluded from the study. The maximum mesiodistal widths of right and left mandibular and maxillary canines were

first measured intraorally with the help of digital vernier caliper accurate to 0.1 mm. Inter-canine distance or width it was measured as the horizontal distance between the cusp tips of right-side canine to the cusp tip of left side canine. It was again measured with the help of Vernier caliper accurate to 0.1 mm. Statistical analysis was done by using MS Excel & SPSS 16.0 version. Sexual dimorphism in right and left mandibular canines was calculated using the formula given below by Garn and Lewis.²

$$\text{Sexual dimorphism} = \frac{X_m}{X_f - 1} \times 100$$

Where, X_m = Mean value of male canine width,
 X_f = Mean value of female canine width.²

3. Results:

Total 91 subjects including 2nd year MBBS students were studied out, of which 49 were male and 42 were female. All the male and female students were 18 - 21 yrs.

Table no. 1: Sex wise distribution of mesio-distal crown canine width:

Side	Sex	Mandibular Canine			Maxillary Canine		
		Range	Mean	+/- SD	Range	Mean	+/- SD
Right	Male	5.78- 8.18	6.800	0.5127	5.49-8.56	7.297	0.5824
	Female	5.23-7.51	6.379	0.4635	5.97-8.15	7.153	0.618
Left	Male	5.58- 7.92	6.840	0.590	6.07-8.6	7.371	0.4926
	Female	5.37-7.94	6.353	0.5262	5.82-8.79	7.274	0.635

From the **Table No. 1**, it was observed that the mean value of the mesio-distal crown width of right and left mandibular canines and mesio-distal crown width of right and left maxillary canines in males were more than that of female. This value was statistically significant ($p < 0.001$).

The statistical analysis of the data for sexual dimorphism with mean mesiodistal width of for right and left mandibular and maxillary canine showed, that there were a statistically significant difference of mean mesiodistal width of mandibular and maxillary canine for males and females ($P=0.00008$).

Table No. 2: Sex wise distribution of intercanine distance:

	Sex	Intercanine Distance		
		Range	Mean	+/- SD
Mandi bular	Male	20.29 – 32.6	25.06	2.235
	Female	22.26-36.4	26.78	3.332
Maxill ary	Male	30.93- 43.7	35.49	2.516
	Female	26.99-42.11	33.46	2.775

Table No. 2 shows that intercanine distance of male and female in both mandibular and maxillary teeth.

The right mandibular canine index in males ranged from 0.217 to 0.324 with a mean of 0.273 ± 0.0217 , while it was ranged from 0.176 to 0.306 with a mean of 0.240 ± 0.0263 in females. This was statistically significant ($P < 0.001$). The left mandibular canine index value in males ranged from 0.202 to 0.356 with a mean of 0.275 ± 0.0279 , and in females it was 0.183 to 0.306 with a mean of 0.239 ± 0.0266 . This was also statistically significant ($p < 0.001$). The right maxillary canine index in males ranged from 0.146 to 0.243 with a mean of 0.206 ± 0.0194 , while it was ranged from 0.155 to 0.247 with a mean of 0.214 ± 0.0192 in females. This was statistically significant ($P < 0.001$). The left maxillary canine index value in males ranged from 0.143 to 0.237 with a mean of 0.208 ± 0.0175 , and in females it was 0.173 to 0.245 with a mean of 0.218 ± 0.0175 . This was also statistically significant ($p < 0.001$). Canine index (**Table 3**) given as follows-

$$\text{Canine index} = \frac{\text{Mesio - distal crown width of canine}}{\text{Intercanine Distance}}$$

Table No. 3: Canine index:

Side	Sex	Mandibular Canine			Maxillary Canine		
		Range	Mean	+ - SD	Range	Mean	+ - SD
Right	Male	0.217-0.324	0.273	0.0217	0.146-0.243	0.206	0.0194
	Female	0.176-0.306	0.240	0.0263	0.155-0.247	0.214	0.0192
Left	Male	0.202-0.356	0.275	0.0279	0.143-0.237	0.208	0.0175
	Female	0.183-0.306	0.239	0.0266	0.173-0.245	0.218	0.0175

Standard Canine Index (table 4) is given as follows-

$$(\text{Mean Male CI} - \text{SD}) + (\text{Mean Female CI} + \text{SD})$$

$$\text{Standard Canine Index} = \frac{\quad}{2}$$

Table no. 4: Standard Canine Index

		Value	
Mandibular	Right	$(0.252 + 0.266)/2$	0.259
	left	$(0.248+0.265)/2$	0.257
Maxillary	Right	$(0.186+0.233)/2$	0.209
	left	$(0.190+0.235)/2$	0.212

The standard canine index for the right and left mandibular canines were 0.259 and 0.257, respectively and for that of right and left maxillary canines were 0.209 and 0.212, respectively.

Table No. 5: Sex Prediction by Mandibular Canine Index

Mandibular Canine Index (Mn CI)	Sex	Case	%
Right Mn CI	Male	40 /49	81.63
	Female	34 /42	82.95
	Total	74 /91	81.31
Left Mn CI	Male	37 /49	75.51
	Female	33 /42	78.57
	Total	70 /91	76.92

Sex predictability using the standard canine index with right mandibular canine index shows that 81.63 % and 82.95 % for male and female respectively. While with left mandibular canine index shows that 75.51 % and 78.57 % for male and female respectively.

Table No. 6: Sex Prediction by Maxillary Canine Index

Maxillary Canine Index (Mx CI)	Sex	Case	%
Right Mx CI	Male	24 /49	48.97
	Female	15 /42	35.71
	Total	39 /91	42.85
Left Mx CI	Male	22/49	44.89
	Female	16 /42	38.09
	Total	38 /91	41.75

Sex predictability using the standard canine index with right and left maxillary canine index below the acceptable level (below 50%) for both male and female.

4. Discussion:

Teeth help to estimate age, determination of sex and race of a person even in decomposed and burnt bodies. Studies on sexual dimorphism provide information about the evolution of a population and for that matter, an individual too.⁵

Canine is one of the most strongest and stable teeth among all other teeth, due to its shape, structure and the length of the root. Also, its position in the mandible and maxilla, and the presence of a single cusp makes it less prone to damage, or cavity formation. Thus, makes the canine teeth even more forensically relevant and being resistant to decay can be used as a forensic tool for the purpose of identification of individuals.¹

In present study, prediction of sex accurately using the right mandibular canine index was 81.63 % and 82.95 % for male and female respectively with an overall accuracy of 81.31%. This value was comparable and correlated with the study conducted by Kaushal et al on a North Indian population with an accuracy of 75%.³

Using the left mandibular canine index, the accuracy of prediction of sex was 75.51 % and 78.57 % for male and female respectively, with an overall accuracy of 76.92% which correlate with the study conducted on a North Indian population by Kaushal et al. with an accuracy of 75%.³ Similar sex prediction has been reported by Rao NG et al⁶ and Yadav S et al⁷ for South Indians (82.2%–85.9%), by Mughal IA et al⁸ for Punjabi–Pakistani population (76%) and for Egyptians by Hashim HA et al.⁹ But studies conducted by Muller et al. on the French population showed a lower sex predictability value (59.57%).¹⁰

Mandibular canine index are useful parameters in differentiating the sexes. In the present study both these parameters as measured in males

and females were compared and the difference was found to be statistically significant.³

In the present study, mean mesiodistal width of right mandibular canine in males was 6.8 +/- 0.512 mm whereas in females it was found to be 6.379 +/- 0.463 mm. and mean mesiodistal width of left mandibular canine in males was 6.84 +/- 0.59 mm whereas in females it was found to be 6.35 +/- 0.526 mm. The test of significance applied to the difference showed that there was a statistically significant difference in the mesiodistal width of males and females signifying that the mesiodistal width of canines can be used for determination of sex in individuals. ($P < 0.05$) as shown in Table 1. This was in accordance with the previous studies by Garn *et al.*¹¹, Nair *et al.*,¹² Fernandes TM *et al.*¹³, Santoro M *et al.*¹⁴ and Pamecha S *et al.*¹⁵

Using these two sexual dimorphic characteristics of mandibular canine such as mesiodistal width and intercanine distance, and their range of accuracy suggests that mandibular canine odontometrics should be used as a supplementary method along with the other methods to increase the accuracy of sex identification in unknown body remains.¹⁶

5. Summary and conclusion:

Present study was conducted on 91 subjects including 2nd year MBBS students of which 49 were male and 42 were female. All the male and female students were 18 - 21 yrs.

From the present study we can conclude that.

1. The mesiodistal width of mandibular canines was significantly greater in males than that of females.
2. Standard canine Index for right and left mandible can be used as a tool for sex prediction.
3. Prediction of sex accurately by using the right mandibular canine index was 81.63 % and 82.95 % for male and female respectively with an overall accuracy of 81.31%.
4. Prediction of sex accurately by using the left mandibular canine index was 75.51 % and 78.57 % for male and female respectively, with an overall accuracy of 76.92%.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

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