

CANINE INDEX: A TOOL FOR SEX DETERMINATION IN FORENSIC ODONTOLOGY

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ABSTRACT:

Aim: To establish the effectiveness of mandibular canine index in predicting sex in vidharbian population.

Materials and Methods: 100 subjects belonging to vidharbian population (50 males; 50 females) in the age group of 20-40 yrs were included. Impressions were made with alginate and study models prepared with dental stone. Maximum mesiodistal diameter of mandibular canines and the linear distance between tips of mandibular canines were measured using a Vernier caliper. Observed mandibular canine index and standard mandibular Canine Index was calculated as the ratio between the maximum mesiodistal width of mandibular canine and canine arch width.

Results: In our study right mandibular canine index was significant with p-value of 0.031. Right canine exhibited greater sexual dimorphism i.e. 3.56% as compared with left mandibular canine i.e. 2.67%.

Conclusion: This study concludes that the mandibular canine index shows sexual dimorphism in vidharbian population. Hence it is considered as a quick, easy and reproducible method for determining the sex of an individual.

Keywords: Forensic, permanent mandibular canine index, Canine, mesio-distal dimension, sexual dimorphism.

INTRODUCTION:

Teeth are the stable tissue of the human body and possess least turnover of natural structure. They are the central component of the masticatory apparatus of the skull and are good sources of material for civil & medico-legal identification.^[1] The question of personal identity arises in courts of law for identification of criminals as well as in the identification of other persons and dead bodies.^[2] Sex determination is one of the important parameters in forensic

identification. Sexual dimorphism refers to systemic difference in the form (either in shape and size) between individuals of different sexes in the same species.^[3] Sex determination using dental features is based upon the comparison of tooth dimensions in males and females.

Mandibular canines are found to exhibit greatest sexual dimorphism. The mandibular canines have a mean age of eruption of 10.87 years and are less

affected than other teeth by periodontal diseases. These are the last teeth to be extracted with respect to age. Canines are also better likely to survive severe trauma such as air disasters, hurricanes or conflagration.^[4] These findings indicate that mandibular canines can be considered as the 'key teeth' for personal identification.^[5]

The present study is a sincere attempt to delineate the sexual variation in the morphology of permanent mandibular canines, involving the measurement of mesiodistal width, intercanine distance and canine index. It is an effort to establish the effectiveness of mandibular canine index in predicting sex, taking correct dental alignment into consideration in vidarbhan population.

Mesiodistal width of left and right mandibular canines were measured in the present study on the casts of the patients in a comparable cohort of male & female subjects keeping the same parameters for both groups. The measurements were then subjected to statistical comparisons and values of significance were calculated to know the importance of parameters in determination of sex.

MATERIALS AND METHODS:

The study was conducted on patients reporting to the Department of Oral Medicine and Radiology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur. 100 subjects between age group of 20-40 years were selected for the study.

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

Exclusion criteria

Subjects 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. Subjects with bad/poor oral hygiene.
7. Canine teeth with attrition.
8. Subjects with orthodontic treatment.
9. Any trauma to canine teeth.

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.

MEASUREMENT PROCEDURE

Alginate impressions were made of 50 males and 50 females. Maxillary and mandibular cast were prepared. All measurement were carried out by a single examiner to eliminate intra observer error. The mesial and distal surfaces of the teeth were identified on the cast and the distance between the crest of curvature on the mesial surface and crest of curvature on the distal surface were recorded by the Vernier calliper. The intercanine distance was measured between tips of right & left mandibular canines using Vernier calliper and the readings were noted. Mandibular Canine Index – It was calculated by dividing the mesiodistal width of the canine by the intercanine distance.

Sexual dimorphism was calculated according to the formula given by Garn et al (1967) as follows:

Sexual Dimorphism in mesiodistal width = $[\{X_m/X_f\} - 1] \times 100$; where X_m is mean mesiodistal width in males and X_f is mean mesiodistal width in females.^[6]

Standard canine index = $\frac{(\text{mean male CI} - \text{SD}) + (\text{mean female CI} + \text{SD})}{2}$

Data obtained were quantified and analysed statistically using SPSS (Statistical Package for the Social Sciences, Version 11.5) to determine the

significance of differences between the sex.

RESULT:

Results of present study are depicted in Table-1, 2, 3, 4.

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

The results showed that the mean value of the intercanine distance in males was 27.67 mm and in females, it was found to be 26.94 mm. When the mean value of intercanine distance of 100 subjects (50 males & 50 females) were compared, male showed higher value than females and the difference was statistically significant. (P value 0.036).

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

The mean value of the width of right canine and left canine as measured using Vernier callipers in males was found to be 7.788 mm and 7.538 mm ($P < 0.001$) and this was found to be highly significant. The mean value of the width of right canine and left canine in females was found to be 7.344 mm and 7.142 mm respectively ($P < 0.001$) and was highly significant.

The mandibular canine index (MCI) was calculated using a standardized formula. In males, the MCI on the right side was found to be 0.275962 mm whereas on the left side it was found to be 0.265673 mm. In females, the MCI on the right side was found to be 0.266458 mm whereas on the left side it was found to be 0.258750 mm. The values of the calculated MCI were found to be significantly higher in males compared to females on both right and left sides.

Mandibular canine indices for right mandibular canine were also found to be significantly different in male and female. Mandibular canine indices 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 intercanine distance, right canine width, left canine width, right MCI, were found to be significantly higher in males than females [Table 1].

Table-3 shows percentage of sex correctly predicted using right and left side MCIs. By using the right MCIs, sex prediction was noted to be 53.84% in 50 males and in 54.16% in 50 females with overall accuracy of 54%. Similarly by using MCIs left side the correct sex prediction was noted to be 36.53% in 50 males and 70.83% in 50 females with overall accuracy of 53%.

DISCUSSION:

Teeth help in forensic investigation to estimate age, determine sex and race of a person even in decomposed and burnt bodies. Studies of sexual dimorphism provide information about the evolution of a population and for that matter, an individual too.^[7] In this study an attempt has been made to establish the sex of a person by using mesiodistal width of canine teeth and the respective intercanine distances and mandibular canine indices in the vidharbian population.

In the present study the inter-canine distance both in males and females is found highly significant (p value <0.01). It is further observed that mean intercanine distance in males is 27.67 mm and the value in females is 26.94 mm, thus values in males being higher than those of females. Observations in males and females has been observed by Kaushal et al^[8]. (male: 25.873 ± 1.253 , female: 25.070 ± 1.197), Abdullah^[11]. (male: 26.9552 ± 2.3129 , female: 26.4575 ± 2.7790), and Al- Rifaiy et al.^[12]. (males: 27.0171 ± 2.3168 and females: 26.4615 ± 2.7761 mm). Reddy et al^[9]. (male: 26.860 ± 1.48 , female: 26.287 ± 1.45), Kaushal et al. ^[10]. (male: 25.87 ± 1.25 , female: 25.07 ± 1.19). The results of present study are higher than previous studies in case of males as well as females.

In the present study there exists a statistically significant sexual dimorphism in the morphometry of the mandibular canines as far as mandibular canine widths are concerned. We have

noted the mean value of right canine width in males and females to be 7.788 mm and 7.344 mm respectively and that of left canine width in males and females 7.538 mm and 7.142 mm respectively. These values are found to be highly significant ($p < 0.01$). It is also observed that mean values of canine widths to be higher in males compared to females. Our findings in males and females are supported by Kaushal et al. [8] who have reported mean right canine width in males 7.229 ± 0.280 mm and in females 6.690 ± 0.256 mm, and left canine width in males 7.299 ± 0.292 mm and in females 6.693 ± 0.323 mm in their study on 60 subjects (males: 30 and females: 30) of 17 – 21 years age group. In the present study comparison of right canine width with left canine width in males have showed no difference and a similar observation is noted in females when right canine width is compared with left canine width. Thus, it can be clearly stated that the canine width of either side both in males and females depicts no significant differences. Our findings are well supported by Kaushal et al. [8], Reddy MV et al. [9], Kaushal S et al. [10], Abdullah MA [11], Al-Rifaiy MQ et al. [12], Boaz K et al. [13].

Kaushal et al. [10] in their study on 30 males and 30 females of the North Indian population in the age group of 17 - 21 years on right and left mandibular canine have observed that the probability of sex determination using right MCI for males and females is 70% and 80% respectively and that with left MCI for males and females has been

66.67% and 83.33% respectively. This is in contrast to our findings where in we have noted still lower values for sex prediction i.e. in males 53.84% and 54.16% in females using MCI of right side with overall accuracy of 54% and 36.53% males and 70.83% females using MCI of left side with an overall accuracy of 53%. The findings of this study were nearby similar to the study conducted by Parekh et al. [11], that shows lower values for sex prediction i.e. 50.5% in males and 49% in females using MCI of right side and 52.4% males and 50.8% females using MCI of left side. Further, the probability of correct prediction of sex using MCI is higher for males in our study. We have noted an overall higher percentage of accuracy for sex prediction from right side MCI as compared to left side MCI. The overall gender predictability using mandibular canine index was 54%. Similar to studies conducted by Muller et al. on the French population which showed a lower gender predictability value (59.57%). [15]

CONCLUSION:

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 right mandibular canine was found to be more dimorphic than left 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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TABLES:

Table-1: Measurements of various parameters of permanent mandibular canine in males and females and their statistical significance

Group Statistics							
	Gender	N	Mean	Std.* Deviation	Std.* Error Mean	z value	P value
Mesiodistal Width of canine(Right)	Male	50	7.788	0.5178	0.0718	4.466	<0.001 Highly Sig
	Female	50	7.344	0.4744	0.0685		
Mesiodistal Width of canine(Left)	Male	50	7.538	0.5318	0.0737	4.092	<0.001 Highly Sig
	Female	50	7.142	0.4272	0.0617		
intercanine distance	Male	50	27.67	1.593	0.221	2.128	0.036 Sig
	Female	50	26.94	1.861	0.269		
Mandibular canine index(Right)	Male	50	0.2759 62	0.0216	0.0029990	2.183	0.031 Sig
	Female	50	0.2664 58	0.0219	0.0031579		
Mandibular canine index(Left)	Male	50	0.2656 73	0.0178	0.0024679	1.778	0.078 Non Sig
	Female	50	0.2587 50	0.02118	0.0030455		

* Std = Standard Deviation.

Table 2- Standard canine indices

Sr no	Standard CI*	Value
1.	Right MCI **	0.271
2.	Left MCI **	0.2631

*CI-canine index . **MCI - mandibular canine index

Table 3 - Gender predictability using Maxillary Canine Index.

Sex	MCI* Right side		MCI* Left side	
	No	%	No	%
Male	50	53.84%	50	36.5%
Female	50	54.16%	50	70.83%
Total	54%		53%	

Table 4- Summary of sexual dimorphism in mandibular canine width

Parameter	Sexual Dimorphism(%)
RMCW*	3.56%
LMCW**	2.67%

*RMCW-Right mandibular canine width. **LMCW-Left mandibular canine width.

FIGURES:



Fig-1. Measurement of canine width using Vernier Calliper



Fig 2. Measurement of intercanine width using Vernier Calliper