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A key role of inter canine distance in sex determination

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Abstract

Mandibular tooth are excellent evidence in identification of a person, specially after mass casualties, estimation of age and sex of anthropomatic analysis of body and establishing identification in case of bite marks. Mandibular canines are found to be exhibit the greatest sexual dimorphism among other teeth. 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 and the present study to determine the sex by inter canine distance & width mandibular canine and compare to different parameters in a cast and orally in male and females.

Keywords: Canine width, Inter canine distance, Mandibular canine, sex determination

Introduction

Mammals are heterodont and needed teeth to do several different jobs and so mammal teeth evolved in to different forms. Teeth are an excellent material in alive and dead populations for anthropological, genetic, odontologic and forensic investigations. Teeth are most stable component of body they can survive from fire and bacterial destruction. It makes them valuable in forensic identification (Williams et al, 2000)[1].

Tooth anatomically and morphologically different in males and females. Tooth size standards based on odontometric investigations can be used in age and sex determination (Black, 1902)[2].

The mean of sexually dimorphism simply difference in size, stature and appearance between individuals. Among whole human dentition mandibular canines exhibit the greatest sexual dimorphism. "Sexual Dimorphism" refers to those differences in size, stature and appearance between male and female that can be applied to dental identification because no two mouths are alike. (Keisu, 1990)[3]. Garn et al (1967)[4] and Nair et al (1999)[5] have found the mandibular canines to exhibit the greatest sexual dimorphism amongst all teeth. There unique characteristics are less exposed to plaque and calculus, abrasion as well as less heavy loading of occlusal force, apart from these they are less affected by periodontal disease so last teeth to be extracted. These findings indicate that mandibular canines can be considered as the 'key teeth' for personal identification. (Dahberg, 1963)[6].

The purpose of our study was to establish the key role of mandibular canines

morphometric in "sex factors". The results show that the mandibular canines sexual dimorphism can be use for medico legal purpose in gender identification. This is of definite significance, as tooth morphology is known to be influenced by cultural, environmental and racial factors. (Halim, 2001)[7].

Materials and methods

Selection criteria- Eighty subjects, forty males and forty females in the age group of 17-30 years were selected for the study. This age group was selected, as attrition is minimal in this age group. (Vacher and Gupta, 1966)[8]. The study was conducted in Dept. of Dentistry, S.P.M.C. Medical College, Bikaner, Rajasthan.

Inclusion Criteria: Subjects with following status of teeth were included in study-

1. Healthy status of gingiva and periodontium
2. Caries free teeth
3. Normal Overject and Overbite
4. Absence of spacing in the anterior teeth
5. Class-1 Molar and canine relationship

The significant exclusion criteria employed for selection of the study sample were the presence of partially erupted/ectopically erupted teeth, patients with dental/occlusion abnormalities (such as rotation, crowding, occlusion disharmony etc.), teeth showing physiologic or pathologic wear and tear (wasting diseases) and patients with deleterious oral habits.

Alginate impression of mandibular arch were made for all the subjects and these were poured immediately in type IV dental stone to minimize dimensional shrinkage. Study models were used for analysis and the measurements were taken for all subjects using a Vernier's caliper. The parameters considered were canine width, inter canine distance, and mandibular canine index.

The following measurements were taken in all casts and intra orally: (1) The greatest mesio-distal dimension of mandibular canine on either side of jaw, (2) The inter canine distance will measured as the linear distance between the cusp tip of right and left mandibular canine.

The observed mandibular canine width and inter canine distance were subjected to statistical analysis to assess sex difference using unpaired t –test.

The mandibular canine index (MCI) was calculated using the following formula given below:

MCI = Mesio distal crown width of mandibular canine/Mandibular canine width or inter canine distance

The finding obtained will be subjected to statistical analysis to derive conclusion and sexual dimorphism in right and left mandibular canines which is calculated by applying the following formula given by Gran & Lens (1967)

$$\text{Sexual dimorphism} = \frac{Xm}{X_f} \times 100$$

Xm = mean value of males

Xf =mean value of females

The standard mandibular canine index (MCI_s) value is used as a cutoff point to differentiate males from females which is obtained from the measurements taken from the samples by using the following formulas:

MCI_s = (Mean male MCI + SD)+(Mean female MCI +SD)/2

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

Observations and results

Statistical Significance of Parameters:

The following parameters were determined intraorally as well as on study casts in males and females.

L Intercanine Distance.

L Rights Mandibular Canine Width.

L Left Mandibular Canine Width.

L Right Mandibular Canine Index.
L Left Mandibular Canine Index.
The results have been depicted in tables I, II and III.

(a) From table I, it is evident that these parameters as measured for males and females when compared are found to be statistically significant. This is irrespective of whether measurements are taken intraorally or on casts.

Table 1: Showing Statistical Significance of Difference Parameters Males V/s Females.

Parameters	Group	Sex	Mean (mm)	±S.D.	Coefficient Of Variation	't' Stat	'p' value	Significance
Inter Canine Distance	Casts	Males	24.628	1.060	4.53	3.056	<0.001	Highly
		Females	24.003	1.050	4.56			Significant
	Intraoral	Males	25.753	1.233	4.83	2.526	<0.006	Highly Significant
		Females	25.020	1.187	4.72			
Right Canine Width	Casts	Males	8.653	0.293	3.156	7.869	<5.08 x 10^{11}	Highly
		Females	7.670	0.242	3.44			Significant
	Intraoral	Males	8.323	0.280	3.87	7.772	<7.38 x 10"	Highly Significant
		Females	7.650	0.256	3.83			
Left Canine Width	Casts	Males	7.325	0.259	3.53	8.368	<5.08 x10"	Highly
		Females	6.690	0.323	4.82			Significant
	Intraoral	Males	7.289	0.293	4.00	7.632	<1.32 v $10^{-,D}$	Highly Significant
		Females	6.623	0.324	4.83			
Right Mandibular Canine Index	Casts	Males	0.278	0.011	3.96	4.328	<3.01 x 10^{5}	Highly
		Females	0.267	0.010	3.74			Significant
	Intraoral	Males	0.280	0.010	3.57	9.719	<7.69 x 10-"	Highly Significant
		Females	0.267	0.01	3.74			
Left Mandibular Canine Index	Casts	Males	0.283	0.013	4.59	3.833	<1.57 x 10^{4}	Highly
		Females	0.268	0.016	5.97			Significant
	Intraoral	Males	0.282	0.013	4.61	4.088	<6.76 x 10^{s}	Highly Significant
		Females	0.267	0.19	5.27			

Table 2: Mean, Standard deviation and level of significance of Inter Canine Distance.

Sex	Group	Mean	S.D	t- value	P- value	Significance
Males	Cast	24.628	1.060	3.056	<0.001	Highly Significant
Females		24.003	1.050			
Males	Intraoral	25.753	1.233	2.526	<0.006	Highly Significant
Females		25.020	1.187			

Table 3: Mean, Standard deviation and level of significance of Right Mandibular Canine Width.

Sex	Group	Mean	S.D	t- value	P- value	Significance
Males	Cast	8.653	0.293	7.869	<5.08 x 10 [11]	Highly Significant
Females		7.670	0.242			
Males	Intraoral	8.323	0.280	7.772	<7.38 x 10"	Highly Significant
Females		7.650	0.256			

Table 4: Mean, Standard deviation and level of significance of Left Mandibular Canine Width.

Sex	Group	Mean	S.D	t- value	P- value	Significance
Males	Cast	7.325	0.259	8.368	<5.08 x10"	Highly Significant
Females		6.690	0.323			
Males	Intraoral	7.289	0.293	7.632	<1.32 v 10-.D	Highly Significant
Females		6.623	0.324			

Table 5: Mean, Standard deviation and level of significance of Right Mandibular Canine Index.

Sex	Group	Mean	S.D	t- value	P- value	Significance
Males	Cast	0.278	0.011	4.328	<3.01 x 10 [5]	Highly Significant
Females		0.267	0.010			
Males	Intraoral	0.280	0.010	9.719	<7.69 x 10-"	Highly Significant
Females		0.267	0.01			

Table 6: Mean, Standard deviation and level of significance of Left Mandibular Canine Index.

Sex	Group	Mean	S.D	t- value	P- value	Significance
Males	Cast	0.283	0.013	3.833	<1.57 x 10 [4]	Highly Significant
Females		0.268	0.016			
Males	Intraoral	0.282	0.013	4.088	<6.76 x 10 [s]	Highly Significant
Females		0.267	0.19			

(b) Further in males or females i.e. for the same sex (tables II,III,IV,V& VI) when these parameters as measured intraorally or on casts, are compared, they are found to be statistically insignificant.

From these findings, it can be inferred that there exists a definite statistically significant sexual dimorphism in the mandibular canines. This influence of the 'sex factor' on morphometry in North Indian population is demonstrable irrespective of whether measurements are taken intraorally or on cast.

Discussion

The present study establishes the existence of a definite statistically significant sexual dimorphism in mandibular canines. It is consistent with *Hashim and Murshid (1993)*[9] *who* conducted a study onSaudi males and females in the age group of 13-20 years and found that only the canines in both jaws exhibited a significant sexual difference while the other teeth did not. Similar findings were given by *Lew and Keng (1991)*[10]in their study on ethnic Chinese population with normal occlusions. *Kumaret al (1989)*[11]have demonstrated that intercanine distance and 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.

Garn & Lewis (1967)[12]and *Lysell & Myrberg (1986)*[13]concluded that the mandibular canine with6.4% and 5.7%, respectively demonstrates thegreatest sexual dimorphism amongst all teeth. *Nair et al (1999)*[5]in thier study on South Indian subjectsconcluded that the left mandibular canine with 7.7%followed by the right mandibular canine with 6.2%shows the maximum sexual dimorphism. In thepresent study also, the left mandibular canine wasfound to exhibit greater sexual dimorphism (10.23%in casts, 9.724% intraorally).

The present study also indicates the probability of sex determination to an extent as high as 100% (when the width of either canine is greater than 7 mm, the sex is male). This finding in North Indian population is of definite significance as the determination of sex makes identification easier and it is of immense forensic importance. In fact, it has been suggested that the first reported crime in the history of mankind was solved when bitemarks were discovered in the remains of forbidden fruits in the garden of Eden and identified as those of Adam and Eve (*Danielsen, 1973*)[14].

It is a known fact that teeth provide excellent models for the study of relationship between ontogeny and phylogeny. *Eimerl and De Vore (1965)*[15] postulated that in the evolution of primates, 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 complete, survival was dependent on canines especially in males. 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.

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