

Full Length Research Paper

Odontometric Study of Mandibular Canine Teeth Dimorphism In Establishing Sex Identity In South-east Nigeria

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Abstract

Gender determination of skeletal remains is a part of many medico-legal as well as anthropological examinations. Many anatomical structures have been studied but the teeth seem to be the most reliable structure since teeth represent the durable and resilient part of the skeleton. In this study, odontometric evaluation of mandibular canine width and inter-canine distance was carried out on 400 apparently healthy individuals whose ages ranged between 17-30 years at a gender ratio of 1:1 so as to determine the sex of individuals and possibility of dimorphism of the canines being used as a valid tool in the forensic and legal identification of an individual. These measurements were done with digital vernier caliper while the mandibular canine indices were derived by the division of the mandibular canine width by the inter-canine distance. The mean right mandibular canine width was 7.35 ± 0.55 and mean left mandibular canine width of 7.64 ± 0.48 in males while females had 6.84 ± 0.35 and 7.07 ± 0.41 respectively. The percentage analysis of sexual dimorphism showed that the left mandibular canine exhibited a greater degree of sexual dimorphism. The inter-canine distance showed a high degree of sexual dimorphism which was found statistically significant. The calculated MCI was greater in males than in females, but when offered for prediction of sex, out of 200 males, sex was correctly predicted only in 65 males and out of 200 females, only 58 were correctly predicted. Thus MCI of right side values showed 31.5% of males and 29% in females while MCI left side values showed 36% of males and 27.5% in females. Therefore, the mandibular canine width and inter-canine distance have proven beyond doubt high degree of sexual dimorphism hence a useful material in forensic identification while the use of MCI in forensic identification is discarded.

Keywords: Odontometry, Sex determination, Mandibular canine width, Mandibular inter-canine distance, Mandibular canine index.

INTRODUCTION

Odontometrics study of mandibular canine teeth dimorphism is the study of mandibular canine teeth size and its applicability in sex identification. Dental measurements are important in anthropology and in sexual dimorphism (De-Castro *et al.*, (1993).

Sexual dimorphism represents a group of morphologic characteristics that differentiate a male from a female. Among these dimorphic traits, tooth size has

been evaluated in various populations for its applicability in anthropologic and forensic investigations.

The morphological differences of the teeth between males and females have been reported and mandibular canines are found to exhibit the greatest sexual dimorphism among all teeth (Kaishal *et al.*, (2003).

The mandibular canines are not only exposed to less plaque, abrasion from brushing, or heavy occlusal loading than other teeth, they are also less severely affected by periodontal disease and so usually the last teeth to be extracted with respect to age. These findings indicated that mandibular canines can be considered as the "key teeth" for personal identification and can be

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applied to identify the gender from dental remains (Anderson and Thompson, 1973) and (Dahlberg, 1967).

Although this has been reported by several researches but the obvious truth remains that standards of morphological and morphometric sex differences in the skeleton may differ with the population sample involved especially with reference to dimensions and indices and thus cannot be applied universally (Krogman and Iscan, 1986).

This study therefore aims at establishing a proof of mandibular canine width, intercanine distance, mandibular canine index and sexual dimorphism as a forensic tool for South-east population.

MATERIALS AND METHOD

Study Area and Population

This study was conducted in college of Health Science, Nnamdi Azikiwe University, Nnewi, ANambra State, south-east Nigeria. The college has a population of 1800 predominantly students. The college is located in Okofia Village, Otolo Nnewi with males and females contributing 43% and 57% of the population respectively.

Study Design and Sampling Strategy.

The study was conducted using stratified random sampling in which the study population was divided into two groups (males and females) and then a random sample pulled from each group. The age of each subject was obtained by asking (eg. What is your age) which was recorded along with the parameters measured.

Inclusion Criteria

The subjects who are of south-east origin between the range of 17-30 years and with the following status of teeth were included into the study.

Healthy state of gingival, Caries free teeth and overbite, Absence of diastemas in the anterior teeth, Normal molar and canine relationship.

Exclusion Criteria

Individuals who had deformities of the teeth like caries, diastema and bleeding gums were not used.

Instrument/Materials for Data Collection

Digital veneer caliper, Cotton wool, Methylated spirit, Lighter

Methodology

The parameters were measured as follows:

The Mandibular Canine Width: With the subjects in a sitting position, the external jaws of the digital vernier caliper were placed on the subjects' mandibular canine. It was measured as the greatest mesio-distal width between the contact points of the teeth on either side of the lower jaw.

The Inter-Canine Distance: This was measured as a linear distance between the tips of right and left mandibular canine in the lower jaw.

The Mandibular Canine Index (MCI): This was calculated based on formula adapted from Rao who derived Mandibular canine index (MCI) for establishing sex identity.

$$\text{MCI} = \frac{\text{Mandibular canine width of mandibular canine}}{\text{Mandibular canine intercanine distance}}$$

Sexual Dimorphism: Sexual dimorphism in right and left mandibular canines was calculated using formula given by Garn et al. (1967) as follows sexual dimorphism = $\frac{Xm}{Xf-1} \times 100$

Where, xm = Mean value of male canine width

xf = Mean value of female canine width

Ethical approval and Consent

Ethical approval was obtained from the faculty of basic medical sciences ethical committee, Nnamdi Azikiwe University, Nnewi campus and informed consent form from each participant.

RESULT

Table 1, the width of the mandibular canine was slightly higher for males than females. Comparing the mean values for the left and right mandibular canine width between males and females, the females showed lesser values. Also, variation in width of the right and left mandibular canine was more in the males than in females. The mean value of inter canine distance of the 400 subjects (200 males and 200 females) showed that males had higher values than females and the differences was statistically significant ($P < 0.05$).

Table 2, the mean mesiodistal width of left mandibular canine is significantly ($P < 0.05$) higher than the right when compared in all the age groups. The ICD of age groups 17-21 is significantly higher ($P < 0.05$) than age group 22-26 but significantly lower ($P < 0.05$) than age groups 27-30 years and in both cases, the differences are statistically significant ($P < 0.05$). The LMCI is statistically higher than RMCI in all the age groups. There is no difference in the mean of RMCI and LMCI in all the age groups.

Table 1. Showing significant differences in the following parameters. Right Mandibular Canine Width (RMCW), left Mandibular Canine Width (LMCW), Right Mandibular Canine Index (RMCi), Left Mandibular Canine Index (LMCI), and intercanine distance (ICD) between male and female subjects.

Parameters	Sex	Mean \pm Std	Range	Variances	T-calculated	Prob of Sig
RMCW	Males	7.35 \pm 0.55	6.20 – 8.50	0.301	38.544	P<0.05
	Females	6.84 \pm 0.35	5.92 – 7.85	0.128		
LMCW	Males	7.64 \pm 0.48	6.55 – 8.71	0.228	6.620	P<0.05
	Females	7.07 \pm 0.41	6.12 – 8.08	0.168		
RMCi	Males	0.21 \pm 0.01	0.19 – 0.25	0.000	5.335	P<0.05
	Females	0.20 \pm 0.01	0.18 – 0.25	0.000		
LMCI	Males	0.22 \pm 0.01	0.17 – 0.28	0.000	5.689	P<0.05
	Females	0.21 \pm 0.01	0.17 – 0.25	0.000		
ICD	Males	34.47 \pm 2.12	29.44 – 40-56	4.523	13.043	P<0.05
	Females	33.16 \pm 1.62	27.64 – 37-78	2.620		

Table 2. Showing age wise distributing of the mandibular canine parameters in males (n = 200).

Parameters	17-21 yrs	22-26 yrs	Prob of Sig	27-30 yrs	Prob of Sig.
RMCW	7.42 \pm 0.46	7.26 \pm 0.55	P< 0.05	7.71 \pm 0.60	P<0.05
LMCW	7.64 \pm 0.39	7.57 \pm 0.49	P<0.05	8.01 \pm 0.46	P<0.05
ICD	34.79 \pm 2.19	34.06 \pm 7.03	P<0.05	36.18 \pm 1.51	P<0.05
RMCi	0.21 \pm 0.01	0.21 \pm 0.01	P>0.05	0.21 \pm 0.01	P> 0.05
LMCI	0.22 \pm 0.01	0.22 \pm 0.01	P>0.05	0.22 \pm 0.00	P> 0.05

Table 3. Showing age wise distribution of the mandibular canine parameters in females (n=200).

Parameters	17-21 yrs	22-26 yrs	Prob of Sig	27-30 yrs	Prob of Sig
RMCW	6.82 \pm 0.33	6.86 \pm 0.36	P< 0.05	6.76 \pm 0.69	P<0.05
LMCW	7.06 \pm 0.41	7.10 \pm 0.37	P<0.05	6.74 \pm 0.96	P<0.05
ICD	34.79 \pm 2.19	33.02 \pm 1.82	P<0.05	33.98 \pm 0.64	P<0.05
RMCi	33.26 \pm 1.45	0.20 \pm 0.01	P>0.05	0.19 \pm 0.01	P> 0.05
LMCI	0.20 \pm 0.01	0.21 \pm 0.01	P>0.05	0.19 \pm 0.02	P> 0.05

Table 3, the mean mesiodistal width of left mandibular canine is significantly higher (P<0.05) than the right in all the age groups except in the age groups 27-30years. The ICD mean values of age groups 17-21 is significantly higher (P<0.05) than age groups 22-26 but significantly lower (P<0.05) age groups 27-30 years. The mean of LMCI and RMC statistically showed no significant difference in all the age groups.

DISCUSSION

It is a known fact that teeth provide excellent models for the study of relationship between ontogeny and phylogeny (Eimerls and Devore, 1967) and (Lund and Mornstad, 1999) postulated that in the evolutions of primates, canines differ from other teeth with respect to survival and sex dichotomy (Vandana *et al.*, (2008).

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. 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 bite marks were discovered in the remains of forbidden fruits in the Garden of Eden and identified as those of Adam and Eve (Danielson, 1973).

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. In males, the mean right mandibular canine width was 7.45 and the mean left mandibular canine width was 7.64 while in females was 6.84 and 7.07 respectively.

This study agrees with studies done by (Rastogi *et*

al., 2013) on western Pradesh population and (Garn *et al.*, (1967) on Ohio Caucasian population.

The values of mandibular canine width in the present study were found to be contrary with the concluding statement made by (Kaushal *et al.*, 2008). which says that whenever the width of either canine is >7mm, the probability of sex being male is 100% while if it is <7mm, the sex could be either. Rather in the present study, it is observed that whenever the width of mandibular canine is greater than 8.1mm, the probability of sex being male is 100%. This may be accounted for by the racial or regional differences.

However our finding is consistent with studies of (Hashim and Mushid, 1993) on Saudi population which showed that only the canines of the both jaws exhibited significant sexual differences.

Our findings revealed a greater inter canine distance which is consistent with (Reddy *et al.*, (2008), (Abdullah, 1998) and (Al-Rifary *et al.*, (1997) (male: 26.860±1.48, female: 26.287±7.45), (males: 26.9552±2.3129, female: 26.45715±2.7761) and (male: 27.0171±2.3168 and female: 26.415±2.7761) respectively.

The present study reported lower values for sex prediction than that of (Parekh *et al.*, (2011) i.e. 37.5% in males and 29% females using MCI of right side and 36% males and 27.5% females using MCI of left side. The probability of correct prediction of sex using MCI is higher for males in our study. We have noted on overall higher percentage of accuracy for sex prediction for right side MCI as compared to left side MCI but owing to its lower level in predicting sex, it is thus refuted in the forensic identification of sex.

CONCLUSION

Our study conclusively established the existence of a definite statistically significance sexual dimorphisms in mandibular canines with the left mandibular canine being more dimorphic than the right. The mandibular canines width and inter-canines distance are greater in males than in females. The mandibular canine index is also noted to be of limited value and thus refuted in prediction of sex. The mandibular canine width and inter-canines distance have proven beyond doubt high degree of sexual dimorphism, hence a useful material in forensic identification.

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