

Sexual Dimorphism in Mandibular Canine Width and Intercanine Distance of University of Port-Harcourt Student, Nigeria

P.C. Ibeachu, B.C. Didia and C.N. Orish

Department of Human Anatomy, Faculty of Basic Medical Sciences, University of Port Harcourt, Choba, Rivers State, Nigeria

Abstract: One of the major roles of forensics in human identification is establishment of sex of the individual. In this study, a thorough anthropometric evaluation of mandibular canine width and intercanine distance was carried out on 300 apparently healthy individuals whose ages ranged between 18-30 years at a gender ratio of 1:1 so as to determine the sex of an individual and to investigate the 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 the aid of a digital vernier caliper while the mandibular indexes were derived by the division of the mandibular canine width by the intercanine distance. The values were subjected to analysis and there was great evidence of sexual dimorphism. The males have significantly greater mandibular canine width when compared to females. In males, the mean Right mandibular canine width was 7.79 ± 0.05 and the mean Left mandibular canine width was 7.88 ± 0.05 , while in females was 6.76 ± 0.05 and 6.75 ± 0.05 , respectively. The percentage analysis of sexual dimorphism showed that the left mandibular canine exhibited a greater degree of sexual dimorphism. The intercanine distance showed a high degree of sexual dimorphism which was found statistically significant. The mandibular intercanine distance was 34.20 ± 0.19 in males and 32.64 ± 0.22 in females.

Keywords: Anthropometry, identification, mandibular canine width, mandibular intercanine distance, sex determination

INTRODUCTION

Teeth are the hardest and chemically the most stable tissues found in the body, are known to resist postmortem, mechanical, chemical, physical and thermal types of destruction (Teschler-Nicola and Prossinger, 1998). Apart from the hard chemical nature and the effective resistance of teeth to destruction, teeth are also readily accessible and also do not need special dissection (Bindu *et al.*, 2008), therefore, teeth are invaluable elements for identification in living and non-living populations for anthropological, genetic, odontologic, evolutionary and forensic investigations (Williams *et al.*, 2000).

Mandibular canines are found to exhibit the greatest sexual dimorphism amongst all teeth. The mandibular canines have a mean age of eruption of 10.87 years (Kaushal *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 indicate that

mandibular canines can be considered as the “key teeth” for personal identification (Anderson and Thompson, 1973; Dahlberg, 1963).

Although this has been reported by several researchers 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). Also tooth morphology is known to be influenced by cultural, environmental and racial factors (Halim, 2001). Garn *et al.* (1967) studied the magnitude of sexual dimorphism by measuring the mesiodistal width of the canine teeth of an Ohio Cuacasian population and concluded that the magnitude of canine tooth sexual dimorphism varied among different ethnic groups.

However, to the best of our knowledge there has not been any literature documentation of mandibular canine width and intercanine distance for Nigerian population. This study therefore aimed at establishing a proof of mandibular canine width and intercanine distance sexual dimorphism as a forensic tool for this population.

MATERIALS AND METHODS

The subjects for this study are students of University of Port-Harcourt, in Port-Harcourt, Rivers State, Nigeria. Subjects for this study are made up of 300 apparently healthy individuals. One hundred and fifty of the subjects were males while the remaining 150 were females. The ages of the subjects ranged between 18-30 years. The subjects were informed of the nature of the study and a written record of their consent documented. The ages of each subject was determined by interrogation. Individuals who had deformities of the teeth like caries, diastema and bleeding gums were excluded from this study. The parameters measured are as follows:

- **The mandibular canine width:** With the subject in a sitting position, the external jaws of the digital vernier caliper were placed on the subject's mandibular canine. It was taken as the greatest mesio-distal width between the contact points of the teeth on either side of the lower jaw (Fig. 1).



Fig. 1: Teeth of the lower jaw



Fig. 2: Linear distance between the right and left mandibular canine

- **The inter-canine distance:** Was measured as the linear distance between the tips of right and left mandibular canine in the lower jaw (Fig. 2).
- **The Mandibular Canine Index (MCI):** Was calculated based formula adapted from Rao *et al.* (1989) 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 in right and left mandibular canines was calculated using formula given by Garn *et al.* (1967) as follows:

$$\text{Sexual dimorphism} = (X_m / X_f - 1) \times 100$$

where,

X_m = Mean value of male canine width

X_f = Mean value of female canine width

RESULTS

The values gotten from both Right Mandibular Canine (RMCW), Left Mandibular Canine Width (LMCW), intercanine distance and the calculated indexes were summarized in the tables below. Table 1 showed that mandibular canine exhibit sexual dimorphism. The mean mandibular canine width and intercanine distance were higher in males than in females.

DISCUSSION

The distinguishable characteristic nature of canine tooth as a valuable forensic tool could be traced back to its evolutionary history. The canine was the only recognized tooth as a fossil material in evolution of human species. Eimerl and Devore (1967) postulated that in evolution of primates there was a transfer of aggressive function from canines in apes to the fingers in man and that until this transfer was complete, survival was dependent on the canines, especially those

Table 1: Significant differences in parameter between male and female subjects

Parameter	Sex	Mean±S.D.	Range	Variance	Z-calculated	p-value	Sig. level
Intercanine distance	Male	34.20±0.19	30.06-43.33	5.36			
	Female	32.64±0.22	25.53-46.12	6.95	15.70	0.000	Significant
RMCW	Male	7.790±0.50	6.380-9.090	0.37			
	Female	6.760±0.05	5.190-8.040	0.39	14.43	0.000	Significant
LMCW	Male	7.88±0.050	6.510-9.100	0.37			
	Female	6.75±0.050	5.190-7.990	0.41	5.450	0.000	Significant
RMCI	Male	0.228±0.12	0.184-0.268	2.16			
	Female	0.208±0.14	0.157-0.269	2.90	8.970	0.000	Significant
LMCI	Male	0.230±0.20	0.182-0.268	5.84			
	Female	0.207±0.14	0.155-0.258	3.11	11.44	0.000	Significant

RMCW: Right Mandibular Canine Width; LMCW: Left Mandibular Canine Width; RMCI: Right Mandibular Canine Index; LMCI: Left Mandibular Canine Index

Table 2: Summary of sexual dimorphism in mandibular canine width

Parameter	Sexual dimorphism (%)
RMCW	15.24
LMCW	16.74

of the males. Canines differ from other teeth with respect to survival and sex dichotomy (Vandana *et al.*, 2008).

The result of this study provides a conclusive proof of the great potentiality of mandibular canine and intercanine distance as dimorphic tool in forensic studies. The mandibular canine and intercanine distance were significantly higher in males than in females. In males, the mean Right mandibular canine width was 7.79 and the mean Left mandibular canine width was 7.88, while in females was 6.76 and 6.75, respectively (Table 1). This is in agreement with studies done by Vandana *et al.* (2008) on Western Pradesh population and Garn *et al.* (1967) on Ohio Caucasian population. The values of our mandibular canine width were found to be in accordance with the concluding statement made by Kaushal *et al.* (2003) which says that whenever the width of either canine is >7 mm the probability of sex being male is 100%. While if it is <7 mm, the sex could be either. Our finding is consistent with the studies of Hashim and Murshid (1993) on Saudi population which showed that only the canines of both jaws exhibited a significant sexual difference. Al-Rifaiy *et al.* (1997) also reported a larger mandibular canine width in male,

although not statistically significant and a highly significant intercanine distance. The percentage sexual dimorphism was calculated based on Garn and Lewis method and it was found that the left mandibular canine exhibited a greater percentage of sexual dimorphism of 16.74% while the right mandibular canine was 15.23% (Table 2). This is consistent with the study Kaushal *et al.* (2003) who reported 9.058 and 8.891%, respectively but contractdicts with Srivastava (2006) who had reported that right mandibular canine exhibit greater percentage dimorphism of 2.804% as compared to left of (2.326).

In our study, intercanine distance exhibited greater degree of sexual dimorphism than that found in other populations. These differences in dental arrangements are a clear proof of the fact that magnitude of canine tooth sexual dimorphism varied among different ethnic groups (Garn *et al.*, 1967).

Comparison of intercanine distance between the different populations was done as variation in tooth size is influenced by genetic and environmental factors such as race, sex, heredity, environment, secular changes and bilateral asymmetry (Bindu *et al.*, 2008). Our findings revealed a greater intercanine distance which is consistent with Bindu *et al.* (2008) and Kumar *et al.* (1989). In all the populations mentioned in (Table 3), the intercanine distance of the mandibular canines was

Table 3: Comparison of inter canine distance in different ages and populations

Age	Population	Author	Inter canine distance (mm)	
			Male	Female
3-20 Years	Canadian	Anderson and Thompson (1973)	26.080	25.330
	French	Muller <i>et al.</i> (2001)	26.280	25.030
17-21 Years	Indian	Kaushal <i>et al.</i> (2003)	25.830	25.070
	Indian	Yogitha and Aruna (2005)	27.980	26.860
24-34 Years	Norwegian	Olav (1998)	19.060	18.240
15-18 Years	Saudi Arabian	Abdullah and Khan (1996)	27.010	26.460
14-17 Years	Saudi Arabian	Sherfudin <i>et al.</i> (1996)	26.360	26.110
17-21 Years	Indian	Bindu <i>et al.</i> (2008)	26.001	25.001
17-30 Years	Punjab	Maneesha and Gorea (2010)	34.700	33.090
30-50 Years	India	Maneesha and Gorea (2010)	34.520	-
17-25 Years	Western Uttar Pradesh	Vandana <i>et al.</i> (2008)	26.860	26.287
17-21 Years	Bareilly, Uttar Pradesh	Srivastava (2006)	25.760	25.280
18-30 Years	Present study	Ibeachu	34.200	32.640

Table 4: Age wise distribution of the mandibular canine parameters in females (n = 150) showing the mean and standard error

Age	18-22	23-27	28 and above
LMCW (mm)	6.770±0.06	6.69±0.090	6.850±0.33
RMCW (mm)	6.770±0.06	6.66±0.110	6.940±0.26
Intercanine distance (mm)	32.88±0.25	31.92±0.40	34.62±1.79
LMCW index	20.62±0.16	21.00±0.30	19.85±0.99
RMCW index	20.73±0.17	20.88±0.26	20.09±0.70

Table 5: Age wise distribution of the mandibular canine parameters in males (n = 150) showing the mean and standard error

Age	18-22	23-27	28 and above
LMCW (mm)	7.870±0.07	7.900±0.07	7.780±0.26
RMCW (mm)	7.830±0.07	7.720±0.07	7.960±0.28
Intercanine distance (mm)	34.16±0.26	34.12±0.30	35.34±0.62
LMCW index	22.76±0.33	23.20±0.18	22.00±0.58
RMCW index	22.94±0.17	22.65±0.18	22.53±0.68

found to be is more in the males than the females and the difference was statistically significant. It can thus be concluded that the sexual dimorphism in mandibular canines is evident in its intercanine distance. Further analysis of intercanine distance within the groups indicated a varying increase in mean value of both sexes except in group 23-27 which revealed insignificant decrease (Table 4 and 5). These findings however contradict with Proffit *et al.* (1986) which says intercanine distance does not increase after 12 years of age.

However, going by the findings of this study and those of other populations, the mandibular canine width and intercanine distance have indeed proven beyond doubt high degree of sexual dimorphism, hence a useful material in forensic identification.

ACKNOWLEDGMENT

The authors are sincerely grateful to Dr. S. Aprioku Department of Pharmacology College of Health Science University of Port-Harcourt, Nigeria for his generosity in the statistical data analysis. Our profound gratitude also goes to the University of Port-Harcourt students for their wonderful cooperation throughout the study.

REFERENCES

- Abdullah, S.H. and N.M.A. Khan, 1996. A cross-sectional study of canine dimorphism in establishing sex identity: Comparison of two statistical methods. *J. Oral Rehabil.*, 23: 627-631.
- Al-Rifaiy, M.Q., M.A. Abdullah, I. Ashraf, M.D. Nazeer Khan, 1997. Dimorphism of mandibular and maxillary canine teeth in establishing sex identity. *Saudi Dental J.*, 9(1).
- Anderson, D.L. and G.W. Thompson, 1973. Interrelationships and sex differences of dental and skeletal measurements. *J. Dent. Res.*, 52: 43-48.
- Bindu, A., K. Vasudeva, K. Subash, C. Usha, Sanjay, 2008. Gender Based Comparison of Intercanine Distance of Mandibular Permanent Canine in Different Populations Editorial. *JPAFMAT*, Vol. 2.
- Dahlberg, A.A., 1967. Dental traits as identification tools. *Dent Brog.*, 1963(3): 155-160.
- Eimerl, S. and I. Devore, 1967. *Physical Anthropology and Primatology*. Time-Life International, Cambridge University Press, UK, 9(1): 258-260.
- Garn, S.M., A.B. Lewis, D.R. Swindler and R.S. Kerewsky, 1967. Genetic control of sexual dimorphism in tooth size. *J. Dent. Res.*, 46: 963-972.
- Halim, A., 2001. *Regional and Clinical Anatomy for Dental Students: General Principles of Anthropology*. 1st Edn., Modern Publishers, New Delhi, pp: 362.
- Hashim, H.A. and Z.A. Murshid, 1993. Mesiodistal tooth width: A study of tooth size, comparison between Saudi males and females: Egypt symmetry and sexual dimorphism. *Dent. J.*, 39: 343-346.
- Kaushal, S., V.V. Patnaik, G. Agnihotri, 2003. Mandibular canines and permanent dentitions in sex determination. *J. Anat. Soc. India*, 52: 119-124.
- Krogman, W.M. and M.Y. Iscan, 1986. Determination of Sex and Parturition. In: *The Human Skeleton in Forensic Medicine*. Charles C Thomas Publishers, Springfield, pp: 208-259.
- Kumar, N., G. Rao, N.N. Rao, L.M. Pai and M.S. Kotian, 1989. Mandibular canine index-A clue for establishing sex identity. *Forensic Sci. Int.*, 42(1): 249-254.
- Maneesha, S. and R.K. Gorea, 2010. Importance of mandibular and maxillary canines in sex determination. *J. Pun. Acad. Forensic Med. Toxicol.*, 10(1).
- Muller, M., L. Lupi-Pegurier, G. Quatrehomme and M. Bolla, 2001. Odontometric method useful in determining gender and dental alignment. *Forensic Sci. Int.*, 121: 194-197.
- Olav, B., 1998. Changes in occlusion between 23 and 34 years of age. *Angle Orthod.*, 68(1): 75-80.
- Proffit, M.R., H.W. Field Jr, J.L. Ackerman, P.M. Thompson and S.A.C. Tullock, 1986. *Contemporary Orthodontics*. CV MosbyCo, St. Louis, pp: 84.
- Rao, G.N., N.N. Rao, M.L. Pai and M.S. Kotian, 1989. Mandibular canine index-a clue for establishing sex identity. *Forensic Sci. Int.*, 42: 249-254.
- Sherfudhin, H., M.A. Abdullah and N. Khan, 1996. A cross-sectional study of canine dimorphism in establishing sex identity: Comparison of two statistical methods. *J. Oral Rehabilitation*, 23: 627-631.
- Srivastava, 2006. Original research paper correlation of odontometric measures in sex determination. *J Indian Acad. Forensic Med.*, 32(1): 56.
- Teschler-Nicola, M. and H. Prossinger, 1998. Sex Determination using Tooth Dimensions. In: Alt, K.W. Roßing and M.F.W. Teschler-Nicola (Eds.), *Dental Anthropology, Fundamentals. Limits and Prospects*, Springer-Verlag, Wien, pp: 479-501.
- Vandana, M.R., S. Sushmita and B. Puja, 2008. Mandibular canine index as a sex determinant: A study on the population of western Uttar Pradesh. *J. Oral Maxillofac. Pathol.*, 12: 56-59.
- Williams, P.L., L.H. Bannister, M.M. Berry, S.P. Collin, M. Dyson, *et al.*, 2000. *The Teeth in Gray's Anatomy*. 38th Edn., Churchill Livingstone, New York, pp: 1699-1721.
- Yogitha, R. and N. Aruna, 2005. Remadevi balasubramanyam. *J. Anat. Soc. India*, Abstract, 217: 54(1).