

Canine tooth dimorphism: An adjunct for establishing sex identity

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Abstract


Background: Teeth are an excellent material for genetic, odontological and forensic investigations and research purpose. From all the teeth, the mandibular canines are found to exhibit sexual dimorphism. However, very few studies have been published on maxillary canine's measurements. **Aims:** 1. To find out utility of maxillary and mandibular canine width as a tool for sex determination in Central Indian population. 2. To find out the average size of canines in males and females of Central Indian population. 3. To compare the findings with National and International studies **Materials and Methods:** The present study was conducted in 100 cases in the age group of 17-21 years. Mesiodistal width of right and left mandibular and maxillary canines were measured on the casts with digital calliper and subjected to statistical analysis. **Statistical Analysis:** Statistical analysis was done to assess sex difference using Students 't' test (paired). **Results and Conclusions:** It was seen that a definite statistically significant sexual dimorphism exists when mandibular and maxillary canine measurements were compared. Thus, it can be suggested that canine width measurements can be used as an adjunct for sex identification purpose in Central Indian Population.

Key words: Canine dimorphism, forensic odontology, sex determination

Introduction

Teeth are a first-rate material for genetic and forensic investigations. Teeth show signs of the least amount of changes in morphology and they are easily accessible for examination. It is the hardest and chemically the most stable structure in the body. They are selectively preserved and fossilized, thereby providing by far the best proof for evolutionary alteration. Their resilience in the case of fire and bacterial decomposition makes them important for identification in forensic science.^[1] Sex determination with aid of skeletal remains pose a great dilemma to forensic experts

particularly when part of the body are remained. To solve this difficulty, tooth size standards based on odontometric data can be used in age and sex determination.^[2] "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 (dentitions) are alike.^[3] Studies on tooth morphology have in the past been conducted using either intraoral measurements or measurements on casts. Barrett *et al.* (1963)^[4] have observed that intraoral measurements are less reliable. But Kaushal *et al.* (2003)^[5] found no significant difference between the two methods. Hence, we have selected dental casts of the patients for this study. Garn *et al.* (1967)^[6] and Nair *et al.* (1999)^[7] have found the mandibular canines to exhibit the greatest sexual dimorphism among all teeth. Dahlberg considered mandibular canines as the 'key teeth' for personal identification.^[8] In India, various studies has been reported on South India,^[5] North India,^[9] Western Uttar Pradesh^[10] population for sex determination using mandibular canine width dimorphism. Only two studies were reported where maxillary canines were studied.

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The present study was undertaken

- 1] To find out utility of maxillary and mandibular canine width as a tool for sex determination in Central Indian population.
- 2] To find out the average size of canines in males and females of Central Indian population.
- 3] To compare the findings with National and International studies.

Materials and Methods

A retrospective, hospital-based study was conducted in Central Indian population. The casts were selected from VSPM Dental College and Research Centre, Post Graduate Department in Orthodontics. The age group of selected casts were 17-21 yrs, as attrition is minimal in this age group. Casts were selected with all permanent canines erupted and with exclusion criteria of unerupted or partially erupted teeth and any prosthetic replacement. Type of malocclusion present was not taken into consideration. Total 100 casts were selected out of which 50 were males and 50 were females. The mesiodistal diameter of maxillary and mandibular canines was measured using a digital vernier calliper. The measurements were recorded on excel spreadsheet and subjected to statistical analysis to assess sex difference using Students 't' test (paired).

Results

The results are depicted in Tables 1-4.

Discussion

Hashim and Murshid (1993),^[11] conducted a study on Saudi males and females in the age group of 13-20 years to determine the teeth in human dentition with the highest likelihood of dimorphism and found that only the canines in both the jaws exhibited a significant sexual difference

Table 1: All the mean values are in millimetres

Sex	Tooth	Mean	SD	't' value	'P' value	Significance
Male	Right mx	8.04	0.583	1.93	0.05	S
Female	Right mx	7.73	1.506			
Male	Left mx	8.32	0.583	2.023	0.04	S
Female	Left mx	8.01	1.485			
Male	Left mn	7.76	0.516	2.28	0.02	S
Female	Left mn	7.44	0.523			
Male	Right mn	8.01	0.512	2.52	0.01	S
Female	Right mn	7.74	0.480			

Table 3: Comparison with wheeler

Mandibular canines	Male Rt.	Male Lt.	Female Rt.	Female Lt.
Mean	8.01	7.76	7.74	7.44
Mandibular Rt. Lt. mean	7.88		7.59	
Combined male female mean	7.73			
According to wheeler	7.0			

while the other teeth did not. In a continuation of the same study, they also determined that there was no statistically significant difference between the left and right sides suggesting that measurements of teeth on one side could be truly representative when the corresponding measurements on other side was unobtainable.

Following this study, number of studies were reported in literature studying mandibular canine width and mandibular canine index. However, our study was limited to just canine widths of maxilla and mandible and comparison with other studies.

A study by Kaushal *et al.*,^[5] found a statistically significant dimorphism in mandibular canines in 60 subjects in North Indian population where the mandibular left canine was seen to exhibit greater sexual dimorphism. According to Kaushal *et al.*,^[5] if the width of the canine is greater than 7 mm, the probability of the sex of the person under consideration being male was 100%.

Schild *et al.*,^[12] observed sexual difference in tooth size among American black, European and Mongoloid populations. The degree of sexual dimorphism of mandibular canine width was more in Ohio Caucasians and Australian aborigines than in Pima Indians and Tristanite population.^[6]

The present study also states that the sexual dimorphism is present in mandibular canines. Only two studies were reported where maxillary canines were studied (Mohd Abdulla,^[13] Gorea and Sharma). Latest study reported by Sharma and Gorea on North Indian population (Patiala) supported our findings that statistically significant

Table 2: Comparisons with wheeler

Maxillary canines	Male Rt.	Male Lt.	Female Rt.	Female Lt.
Mean	8.04	8.32	7.73	8.01
Maxillary Rt, Lt. mean	8.18		7.87	
Combined male female mean	8.02			
According to wheeler	7.5			

Table 4: Comparison with other studies

Author	Year	Population	M/F	Mx Rt	Mx Lt.	Mn Lt.	Mn Rt
Mohd. Abdulla ^[13]	1997	Saudi	M	7.53	7.53	6.907	6.931
			F	7.55	7.36	6.831	6.80
Kaushal ^[5]	2004	North Indian	M			7.32	7.198
			F			6.69	6.67
Karan Boaz ^[17]	2009	South Indian	M			7.05	6.98
			F			7.00	6.9
Gorea, Sharma ^[9]	2010	North Indian	M	7.61	7.67	6.78	6.71
			F	7.31	7.39	6.39	6.41
Present study		Central Indian	M	8.04	8.32	7.76	8.01
			F	7.73	8.01	7.44	7.74

sexual dimorphism is present in case of maxillary canines.

However, Mohd. Abdulla reported the difference in Saudi population but with a low degree of sexual dimorphism (not statistically significant). Similarly low degree of sexual dimorphism was reported by Al Rifaiy *et al.*,^[14] in Saudi Arabian population and by a study of human fossil excavated at Ra's Al- Hamra, Eastern Arabian Coast, which showed a general low degree of sexual dimorphism of mandibular canine teeth.^[15]

Acharya and Mainalli^[16] found reverse dimorphism in the mesiodistal dimension of mandibular second premolar in Nepalese population. The finding could be attributed to evolution resulting in a reduction in sexual dimorphism, causing an overlap of tooth dimension in modern males and females. Similar finding was observed by Karen Boaz and Chaavi Gupta^[17] in a dimorphic study of maxillary and mandibular canines in 100 subjects in South Indian population and revealed the lack of significant dimorphism in canines and also the finding of reverse dimorphism where the females exhibited larger canines than males.

We derived the mean measurement of right and left maxillary canines for males and females and mean of these measurements were taken to arrive at a single value for maxillary canine. Similarly one single value was measured for mandibular canine. These values were compared with the values given by Wheeler's.^[18] Both the maxillary and mandibular canine measurements in the present study were found to be more than the Wheeler's. This finding is very important as it indicates that normative data based on one population cannot be used for other population.

Comparing the mean canine measurement of our findings with other studies, the values of our study on Central Indian population are more than the other studies [Table 4]. One more interesting finding observed was that there is more variation in size of maxillary right and left canines of females which is reflected by more standard deviation [Table 5]. The maxillary canines in males show more consistent mesiodistal width [Difference in SD=0] as compared to female maxillary canines. In the literature, mandibular canines are found to be more reliable in sex determinations. In our study, measurements of maxillary canines are found to be more consistent and reliable for sex determination. The mandibular canines show more

variations in mesiodistal width of right and left sides as compared to maxillary canines.

Conclusions

The emerging field of forensic odontology in India relies a lot on inexpensive and easy means of identification of persons from fragmented jaws and dental remains. Application of Moire's topography^[19] and Fourier's analysis^[20] requires sophisticated equipments and the use of complex mathematical equations, respectively, hence the present study measured by only linear dimensions because of the simplicity, reliability and in expensivity. The mandibular canine index may also be used as an adjunct to enhance accuracy.

From the present study we can conclude that

- 1) The mesiodistal width of canines of both the jaws is significantly greater in males than females. This finding can be used as a tool for sex determination in Central Indian population.
- 2) The mean maxillary canine width in males and females is 8.02 mm. The mean mandibular canine width in males and females is 7.73 mm.
- 3) The mean (male and female), maxillary and mandibular canine width is found to be more in Central India Population as compared to North Indian and South Indian population.
- 4) The mean (male and female), maxillary and mandibular canine width is found to be more in Central India Population as compared to values given by Wheelers and the Saudi population.

As tooth morphology is known to be influenced by cultural, environmental and racial factors, more studies on different populations will be of much use to make data base available on dental morphometric measurements with a view to determine variation among large population that may be beneficial for anthropological, genetic, legal and forensic applications.

References

1. William's PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, *et al.* Gray's Anatomy. In: The Teeth, 38th Ed; London: Churchill Livingstone; 2000. pp. 1699-1700.
2. Black GV. Description of human teeth. 4th Ed; Philadelphia S.S.White Mfg.co. 1902.
3. Kiesu JA. Human adult odontometrics. In: The study of variation in adult tooth size. Cambridge: University Press; 1990.
4. Barrett MJ, Brown T, Macdonald MR. Tooth size in Australian aborigines. Aust Dent J 1963;8:150-5.
5. Kaushal S, Patnaik VV, Agnihotri G. Mandibular canine in sex determination. J Anat Soc India 2003;52:119-24.
6. Gam SN, Swindler DR, Kerewsky RS. Genetic control of sexual dimorphism in tooth size. J Dent Res 1967; 46:963.
7. Nair P, Rao BB, Annigeri RG. A study of tooth size, symmetry and

Table 5: Differences in standard deviation

		S.D Rt.	SD Lt.	Difference
Male	Maxillary	0.583	0.583	0
	Mandibular	0.516	0.512.	0.004
Female	Maxillary	1.506	1.485	0.021
	Mandibular	0.480	0.523	0.043

SD = Standard deviation, Mx = Maxillary, Mn = Mandibular, S = Statistically significant, Rt = Right, Lt = Left, M = Male, F = Female

- sexual dimorphism. *Journal of Forensic Medicine and Toxicology*. 1999;16:10-3.
8. Dahlberg AA. Dental traits as identification tools. *Dent Brog* 1963; 3:155-60.
 9. Gorea RK, Sharma M. Odontometric study of canines of Indian population for sex determination. *Jr Indo Pacific Acad Forensic Odontol* 2010;1:34-37
 10. Reddy VM, Saxena S, Bansal P. Mandibular canine index as a sex determinant: A study on the population of western Uttar Pradesh. *J Oral Maxillofac Pathol* 2008;12:56-9.
 11. Hashim HA, Murshid ZA. Mesiodistal tooth width- a comparison between Saudi males and females. *Egypt Dent J* 1993; 39:343-6.
 12. Schield ED, Altschuller A, Choi EY, Michaud M. Odontometric variation among American black, European and Mongoloid population. *J Craniofac Genet Biol* 1990;10:7.
 13. Mohammed QA, Abdullah MA, Ashraf I, Khan N. Dimorphism of mandibular and maxillary canine teeth in establishing identity. *Saudi Dent J* 1997;9:17-20.
 14. Al-Rifaiy MQ, Abdullah MA, Ashraf I, Khan N. Dimorphism of mandibular and maxillary canine teeth in establishing sex identity. *Saudi Dent J* 1997;9:17-20.
 15. Macchiarelli R. Pre-historic “fish eater” along the eastern Arabian Coast: Dental variation, morphology and oral health in Ra’s Al-Hamra Community (Qurum, Sultanate of Oman, 5th-4th Millenia B.C.). *Am J Phys Anthropol* 1989;78:575.
 16. Acharya A, Mainali S. Univariate sex dimorphism in the Nepalese dentition and the use of discriminant functions in gender assessment. *Forensic Sci Int* 2007;173:47-56.
 17. Boaz K, Gupta C. Dimorphism in maxillary and mandibular canines in establishment of gender. *J Forensic Dent Sci* 2009;1:42-4.
 18. Ash NM, Nelson SJ. *Wheeler’s Dental Anatomy, Physiology and Occlusion* 8th Ed, Philadelphia: W.B.Saunders’s Company; 2009. p. 201-2.
 19. Kuwana T. On sex difference of maxillary canines observed in the Moire tribes. *Nihon Univ Dent J* 1983;57:88.
 20. Minzuno O. Sex determination from maxillary canine by Fourier analysis. *Nihon Univ Dent J* 1990;2:139.

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