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An Odontometric's Key To Sex Determination: Study Analysis Of Permanent Canine Teeth In Indian Population

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Abstract

Sex determination of a person becomes the first priority of a forensic investigations in the process of identification. Permanent canine provide excellent evidence in gender determination as they are least extracted and can withstand extreme environmental conditions. Permanent canine shows highest sexual dimorphism compared to other teeth, making them ideal for forensic investigations. Aim of the study is to determine whether variations in the mesio-distal dimensions of permanent canines had any role in sex determination. The study group included 100 dental students (50 male & 50 female) aged 18-22 years. Mesio-distal width of permanent maxillary and mandibular canine and intercanine width was measured using digital vernier caliper. The result obtained in the study clearly indicate a maximum sexual dimorphism in mandibular canine compared to maxillary canine.

Keywords: Sexual dimorphism, Odontometric, Mean canine index

Introduction

One's identity is what one has earned all through his or her lifetime. What if it is lost in cases of sudden unexpected death? In events like air, road or rail mishaps, bomb or chemical explosions, earthquake or any other disastrous conditions, the body are usually destroyed beyond identification. In such cases, when only the skeletal remains are found, the first priority of the forensic investigator is to establish the identity of remain.[1] Human teeth are the hardest and chemically the most stable tissues in the body, and can resist extreme environmental conditions such as high temperature and humidity, prolonged immersion, desiccation, extensive trauma, as well as advanced stage of decomposition.[2] Sex determination of a person become first priority of a forensic investigation in the process of identification. Sexual dimorphism refers to differences in size and form between males and females that can be applied to dental identification.[3] Permanent canines are considered to be the key teeth for sexual dimorphism as they consistently show greatest sexual dimorphism.[4] Canines are least frequently extracted teeth being less affected by periodontal disease. Canine are also more likely to survive severe traumatic conditions. It is their resilience to fire and bacterial decomposition that make them important for identification in forensic sciences.[5] Present study establishes the impact of sex factor on morphometry of permanent canines. The results indicate that the dimorphism in canine cane be of immense medico-legal use in identification. The aim of this study was to establish permanent canine width and inter-canine dimensions in Indian population and to compare these measurements between males and females for forensic purposes.

Material and Methods

The study was conducted on 110 (55 male & 55 female) undergraduate dental students of Awadh Dental College and Hospital, Jamshedpur, Jharkahand. The age range was 18-22 years. Written consent were obtained from the subjects.

Inclusion Criteria

- Non carious teeth
- 18-22 year age
- Healthy gingiva and periodontium
- Normal overjet & overbite
- Absence of spacing between teeth

Exclusion Criteria

- Carious tooth
- Malaligned tooth
- Partially erupted tooth
- Rotated tooth
- Spacing between teeth
- Periodontitis or gingivitis

Following measurements were taken intraorally in clean and well illuminated room, keeping all the aseptic precautions, with digital vernier caliper:

1. Mandibular canine width was taken as greatest mesio-distal width between contact points on teeth on either side of lower jaw
2. Maxillar canine width was taken as greatest mesio-distal width between contact points on teeth on either side of upper jaw
3. Intercanine width was measured as linear distance between tip of left and right canine in both maxillary and mandibular arch.

Each parameter was measured two times separately and average value was taken. The observed canine width and inter canine width were recorded on an excel spread sheet and subjected to statistical analysis.

Figure 1: Mesiodistal Width Of Mandibular Canine

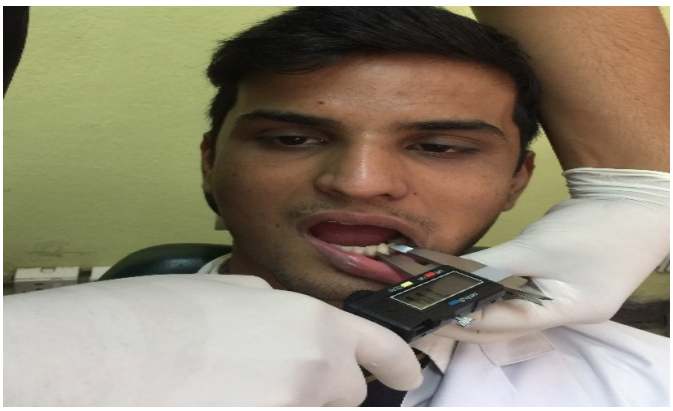


Figure 2: Mandibular Intercanine Width

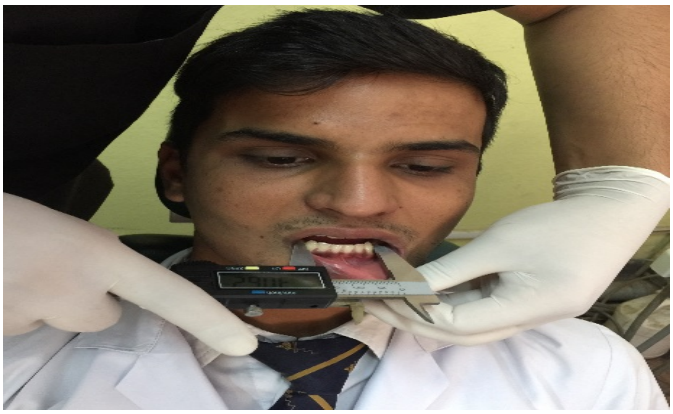
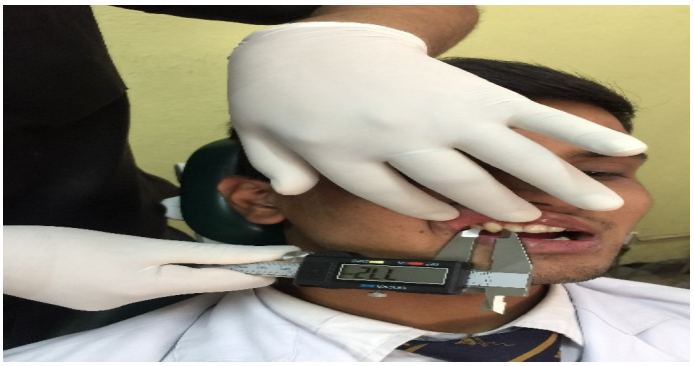


Figure 3: Mesiodistal Width Of Maxillary Canine



The canine index was calculated for maxillary and mandibular jaw based on formula given below

$$\text{Canine index:} \quad \frac{\text{Mesio-distal width of canine}}{\text{Intercanine width}}$$

Sexual dimorphism in right and left canine was calculated by using formula given by Garn and Lens (1967)[4]

Sexual dimorphism: (Xm/Xf) -1 x 100

Where Xm is mean value for male and Xf is mean value for female

Statistical Analysis

The data were analyzed using SPSS version 17 software presented as descriptive statistics. A correlation of left and right mandibular and maxillary canine width with gender variation was analyzed by "t test".

Result

From the results of the present study, it is evident that mesiodistal width of mandibular and maxillary canines were statistically insignificant ($P > 0.05$). The mean values of mandibular and maxillary canine widths in males and females on right and left sides were compared using t-test and were found to be statistically significant ($P < 0.0001$). (Table 1 & 2)

Table 1: Mean mandibular canine width with standard deviation

Sex	No. of sample	Mean RMCW (in mm)	SD of RMCW	Mean LMCW (in mm)	SD of LMCW
Male	55	7.060	0.36	7.140	0.31
Female	55	6.640	0.38	6.614	0.30

Table 2: Mean Maxillary canine width with standard deviation

Sex	No. of sample	Mean RMCW (in mm)	SD of RMCW	Mean LMCW (in mm)	SD of LMCW
Male	55	8.092	0.36	8.024	0.36
Female	55	7.734	0.36	7.758	0.39

The present study also indicates the probability of sex determination to an extent as high as 90%. When the width of mandibular canine was greater than 7 mm, the sex was male, similarly when the width of maxillary canine was greater than 8 mm, the sex was male. Left mandibular canine showed a greater sexual dimorphism (7.952%) when compared to right mandibular canine (6.325%). In case of maxillary arch, right maxillary canine showed greater sexual dimorphism (4.628%) than left maxillary canine (3.428%) (Table 7 & 8). The intercanine width of maxillary arch in male was 36.666mm and in female was 35.148mm whereas in mandibular arch it was 26.921mm in male and 25.497mm in female. (Table 3 & 4) Study also indicated that mandibular canine showed greater sexual dimorphism than maxillary canine.

Table 3: Mandibular canine arch width (in mm)

Sex	No. of sample	Mean inter-canine distance (in mm)	SD
Male	55	26.921	0.99
Female	55	25.497	1.30

Table 4: Maxillary canine arch width (in mm)

Sex	No. of sample	Mean inter-canine distance (in mm)	SD
Male	55	36.666	1.34
Female	55	35.148	1.29

Table 5: Mandibular canine index

Sex	No. of sample	Mandibular canine index (in mm)
Male	55	Right:0.25 Left: 0.25
Female	55	Right: 0.25 Left: 0.25

Table 6: Maxillary canine index

Sex	No. of sample	Maxillary canine index (in mm)
Male	55	Right:0.25 Left: 0.21
Female	55	Right: 0.21 Left: 0.21

Table 7: Sexual dimorphism (Mandible)			
Measurement	Side	Sexual dimorphism	"p" value
Mesiodistal canine width	Right Left	6.325% 7.952%	0.00000004 0.00
Mandibular canine arch width		5.584%	0.00

Table 8: Sexual dimorphism (Maxilla)			
Measurement	Side	Sexual dimorphism	"p" value
Mesiodistal canine width	Right Left	4.628% 3.428%	0.00000090 0.000299
Maxillary canine arch width		4.318%	0.00000004

Discussion

Accurate gender determination is one of the most important step in post-mortem reconstructive identification of skeletal remains since it excludes approximately half of the population. This allows investigators and law enforcers to undertake a more focused search of the missing persons' files, and a potentially swift recovery of ante-mortem records. Biological analysis of hard tissues is shown to be almost 100% accurate in sex identification.[6,7] However in cases where investigative agencies to advice against invasive procedures that result in destruction of evidentiary material, the use of anthroposcopic or odontometric parameters are required.

Sexual dimorphism in tooth measurements has been evaluated for decades, with published reports on male and female odontometric differences available from various countries and diverse population groups.[8]

Odontometric features that show sexual dimorphism can be used in sex determination in cases where sex could not be determined using craniofacial features.[9] Ditch and Rose were the first researcher to prove that teeth diameters can be successfully used in determining sex in poorly preserved and fragmentary skeletal remains in archaeology.[10]

Crowns of permanent teeth are formed at an early stage and their dimensions remain unchanged during further growth and development, except in cases when specific changes and disorders in terms of functionality, pathology and nutrition can have effect on the normal dimensions of a tooth.[9] Chromosomes responsible for the sexual difference are in direct connection to growth and development of teeth.[11]

The research performed by Stroud et al showed that males have larger mesiodistal diameters of single teeth, which is due to a thicker dentin layer. [11]The dimensions of canine teeth were studied by several methods which include Moire's topography and Fourier's analysis and measurement of linear dimensions, such as mesiodistal width, buccolingual width and incisocervical height.[4] The use of Moire's topography and Fourier's analysis were limited to small samples whereas measurements of linear dimensions of canine teeth was employed in a large population because it is simple, reliable, inexpensive and easy to perform.[12,13]

In the present study 110 students (55 male and 55 female) with age ranging from 18-22 years were selected because eruption of canines and growth in width of both the jaws, including the width of the dental arches, are completed before the adolescent growth changes. The inter-canine distance do not increase after 12 years of age.[14] The present study showed mesiodistal diameter of both maxillary and mandibular canine and intercanine width in maxilla and mandible was significantly higher in male compared to female.

Study conducted by Hashim HA and Murshid ZA on 720 teeth in pretreatment orthodontic cast in Saudi Arabian population aged 13-20 years showed canine were the only teeth that exhibit sexual dimorphism.[15] Al-Rifaiy et al, conducted a study on 503 school children of Saudi Arabia showed that mean values of left and right maxillary and

mandibular canine mesiodistal width was less in female compared to male.[16]

According to Kaushal et al who conducted a study on 60 subjects from North Indian population, mandibular left canine sexual dimorphism was 8.8% and mandibular right canine sexual dimorphism was 7.9%. They also concluded that if the width of mandibular canine is more than 7mm, the probability of the person under consideration being male is 100%.[17] Nair et al in their study on South Indian population found that mandibular canine sexual dimorphism on left side was 7.7% and on right side was 6.2%.[18] Both observation are in accordance with present study which show sexual dimorphism in mandibular right canine as 6.325% and on left canine as 7.952%. Lysell and Myrberg conducted a detailed study on 1000 subjects. The study revealed that mandibular canine exhibit greatest sexual dimorphism (5.7%)[19]

Gupta S et al in their study on maxillary canine in 180 subjects (90 male and 90 female), observed that mesiodistal width of maxillary canine for both right (male: 8.13mm, female: 7.80mm) and left (male: 8.07mm, female: 7.79mm) was significantly higher among male subject than female subject, which is in accordance with present study which shows mesiodistal width of maxillary canine in male (right: 8.092mm, left: 8.024mm) was greater than mesiodistal width of maxillary canine in female (right: 7.734mm, left: 7.758mm). They also revealed that maxillary intercanine width was greater in male (41mm) than female (36.05mm) which is also in accordance with present study (male: 36.666mm, female: 35.148mm).[20] According to study conducted by Parekh et al, mesiodistal width of maxillary canine in male (right: 6.923mm, left: 7.098mm) was greater than female (right: 6.35mm, left: 6.617mm).[21]

Olav et al conducted a study on 64 female and 80 male casts of Norwegian decent which showed mean mandibular intercanine width in male was 19.06mm and in female was 18.24mm.[22] According to Yogitha et al, who did study on 25 male and 25 female cast, mean mandibular intercanine width was 27.98mm in male and 26.86mm in female.[23] Abdullah et al did a study on 251 male and 252 female Saudi Arabian students which showed mandibular intercanine width in male was 27.01mm and in female was 26.46mm.[16] All the findings in previous studies were in accordance with present study which showed mandibular intercanine width in male was 26.921mm and in female was 25.497mm and mean maxillary intercanine width in male was 36.666mm and in female was 35.148mm.

Reverse dimorphism (where female showed larger teeth than males) was found in studies conducted by Acharya and Mainali on mandibular 2nd premolar[24] and by Yuen et al on mandibular incisors in a longitudinal study on Chinese population.[25]

The present study establishes a statistically significant sexual dimorphism in mandibular and maxillary canines. Determination of gender by mesiodistal measurement of canine is a relatively easy, quick, non-invasive and inexpensive method, and can aid in identifying persons from fragmented jaws and dental remains.

Conclusion

The distinguishable characteristic features present in canine tooth forma a valuable informative tool for forensic investigators. The role and responsibilities of trained forensic odontologist are defined and sought after in developed countries, however the utilization of their expertise in india is very limited. In such circumstances, the method of sex determination by canine teeth eases many difficulties for the investigating forensic experts, as it is simple to perform, less time consuming, economical and are relatively accurate. From the present study it can be concluded that mesiodistal width of both maxillary and

mandibular canine and both maxillary and mandibular intercanine width are greater in male than female. A more detailed and vast study including larger population is required, so that a database can be established of dental morphometric measurements with a view to determine variations among large populations that may be beneficial for anthropological, genetic, legal, and forensic applications.

References

1. Grover M, Bai, Ram T, Puri PM, Ghodke KR. An odontologist's key to sex determination: study analysis of mandibular canine teeth in South Indian population. J Forensic Res 2013;3(3):157-160.
2. Kapila R et al. Sexual Dimorphism in Human Mandibular Canines: A Radiomorphometric Study in South Indian Population. J Dent Res, Dent Clin, Dent Prospects 2011; 5(5): 51-54.
3. Kiesu JA. The study of variation in adult tooth size. Cambridge University Press. Human Adult Odontometrics 1990; 125-134.
4. Garn SM, Lewis AB, Kerewsky RS. The relationship between sexual dimorphism in tooth size and body size as studied with families. Archs Oral Biol 1967;12:299-301.
5. Boaz K, Gupta C. Dimorphism in human maxillary and mandibular canine in establishment of gender. J Forensic Dent Sci 2009;1:42-44.
6. Sivagami AV, Rao AR, Varshney UA. A simple and cost effective method for preparing DNA from the hard tooth tissue and its use in polymerase chain reaction amplification of Amelogenin gene segment for sex determination in an Indian population. Forensic Sci Int 2000;110:107-15.
7. Morikawa T, Yamamotu Y, Miyaishi S. Anew method for sex determination based on detection of SRY, STS and Amelogenin gene region with simultaneous amplification of their homologous sequences by a multiplex PCR. Acta Med Okayama 2011; 65:113-22.
8. Zorba E, Moraiti SK, Manolis Sk. Sexual dimorphism in permanent teeth of modern Greeks. Forensic Sci Int 2011;210:74-81.
9. Krogh HW. Permanent tooth mortality, a clinical study of causes of loss. J Am Dent Assoc 1958; 57:670-675.
10. Patterson KB, Kogan SL. Dental identification in Woodbridge disaster. J Canad Dent Assoc 1985; 37: 301-06.
11. Rao NG, Rao NN, Pai ML, Kotian MS. Mandibular canine index- a clue for estabilishing sex identity. Forensic Sci Int 1989;42:249-254.
12. Ditch LE, Rose JC. A multivariate dental sexing technique. Am J Phys Anthropol 1972;37:61-64.
13. Stroud JL, Buschang PH, Goaz PW. Sexual dimorphism in mesiodistal dentin and enamel thiscckness. Dentomaxillofac Radiol 1994;23:169-171.
14. Anderson DL, Thompson GW. Interrelationships and sex differences of dental and skeletal measurements. J Dent Res 1973;52:431-438.
15. Hashim MA, Murshid ZA. Mesiodistal tooth width in a Saudi Population sample comparing right and left side. Egypt Dent J 1993;39:347-50.
16. 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.
17. Kaushal S, Patnaik VVG, Agnihotri G. Mandibular canines in sex determination. J Anat Soc India 2003;52:119-24.
18. Nair P, Rao BB, Annigeri RG. A study of tooth size, symmetry and sexual dimorphism. J Forensic Med Toxcol 1996;16:10-13.

19. Lysell L, Myrberg N. Mesiodistal tooth size in deciduous and permanent dentition. Eur J Orthod 1982;61:113-22.
20. Gupta S, Chandra A, Gupta OM, Verma Y, Srivastava S. Establishment of sexual dimorphism in North Indian population by odontometric study of permanent maxillary canine. J Forensic Res 2014;5(2):1-4.
21. Parekh DH, Patel SV, Zalawadia AZ, Patel SM. Odontometric study of maxillary canine teeth to establish sexual dimorphism in Gujarat population. Int J Biol Med Res. 1995;3:1935-1937.
22. Olav B et al. Changes in occlusion between 23 and 34 years of age. Angle Orthod 1998;68(1):75-80.
23. Yogitha R, Aruna N, Ramadevi, Balasubramanyam. Canine morphometry in human sex determination. J Anat Soc India 2005;54(1).
24. Acharya A, Mainali S. Univariate sex dimorphism in the Nepalese dentition and the use of discriminant function in gender assessment. Forensic Sci Int 2007;173:47-56.
25. Yuen KK, So LL, Tang EL. Mesiodistal crown diameters of primary and permanent teeth in Southern Chinese. A longitudinal study. Eur J Orthod 1997;19:721-31.
26. Ayoub F et al. Mandibular canine dimorphism in establishing sex identity in the Lebanese population. Int J Dentistry 2014;1-4.
27. Davoudmanesh Z et al. Sexual dimorphism in permanent canine teeth and formulas for sex determination. Biomed Res 2017;28(6):2773-2777.
28. Acharya AB, Angadi PV, Prabhu S, Nagnur S. Validity of the mandibular canine index (MCI) in sex predilection: Reassessment in an Indian sample. Forensic Sci Int 2011;204:1-4.
29. Saunders SR, Chan AHW, Kahlon B, Kluge HF, Fitzgerald CM. Sexual dimorphism of the dental tissues in human permanent mandibular canine and premolars. Am J Phys Anthropol 2007;133:735-740.
30. Fernandes TM et al. Comparison of mesiodistal widths in Caucasian, African and Japanese individual with Brazilian ancestry and normal occlusion. Dental Press J Orthod 2013;18:130-35.