ORIGINAL RESEARCH PAPER

Inter-canine width as a tool for sexual dimorphism and stature estimation

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ABSTRACT

*Introduction: Identification by means of dental tissue is an easy and helpful tool in forensic Odontology. Dental architecture grows in proportion to the human body and shows some positive correlation. Being hard and resistant to adverse conditions makes it very valuable in scientific studies. Since canine has a longer root in the jaw, it makes it a notifiable structure that can be used in research. Hence, among the dental tissues, canine tooth is chosen most often in studies. **Materials and methods**: study was conducted in Department of Forensic Medicine & Toxicology, Himalayan Institute of Medical Sciences, Dehradun, Uttarakhand, involving 200 subjects (100 males & 100 females) 19 to 24 years of age. Intercanine width of their maxilla and mandible were measured by manual vernier caliper to determine sex and height; data was analyzed by SPSS software. **Result**: Mean Maxillary and Mandibular Intercanine width of males was found to be more as compared to females and were statistically highly significant. Sexual dimorphism was more by using Mandibular Intercanine width as compared to Maxillary Intercanine width. Percentage accuracy of sex determination was found to be more in Maxillary Intercanine width. Simple linear regression equations were obtained for predicting height from Intercanine width. Correlation between Height and Intercanine width of Maxilla and Mandible was statistically significant in males than females. **Conclusion**: Sexual dimorphism and stature estimation is possible by measuring Intercanine width. However, better prediction with more accurate height and sex determination requires a combined study of dental tissue along with bones.*

Keywords: Forensic Odontology; dental tissue; canine; identification.

INTRODUCTION

Human beings have important characteristics that differ from each other due to uniqueness, and one such feature is the morphology of dentition. It is one of the most durable parts like bone in the body that resist damage under time factors and weather conditions. These unique and strong characteristics of dentition is used for the purpose of research in medico-legal field. An excellent proof of its indestructible property is the presence of teeth in the lower jaw of Tabun man which is approximately about 35,000 years old.[1]

In Human jaw, canine's morphology and structure is such that it is less affected by disease, plaque, abrasion from brushing and is also the least extracted tooth.[2-4] Canine can survive even in a hurricane disaster.[5] In situations, such as flood, earthquakes, cyclones, tsunami etc where body is

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decomposed and identification becomes difficult then, the odontometric parameters helps in identification of the individual. The most reliable, easy, and less time-consuming method in investigation is the measurement of teeth. It was reported that sexual dimorphism[6,7] and stature estimation from permanent canines and their arch width could be possible. However, using dentition for estimation of stature needs more exploration and with this background, the current study was conducted to establish a relationship between stature, sexual dimorphism and Intercanine width.

The aims of this study is to find out sexual dimorphism based on Intercanine width and to find out relationship between Intercanine width and stature

MATERIALS AND METHODS

A descriptive cross sectional study was conducted in the Department of Forensic Medicine and Toxicology, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Uttarakhand, involving 200 subjects (100 males and 100 females) of age ranging from 19 to 24 years. A written informed consent was duly obtained from all of them, informing about the study, purpose and techniques to be used for the measurements. Only those subjects having normal dental alignment with complete eruption of permanent teeth were included. Subjects having missing teeth, fractured teeth, dental caries, endocrine or any other abnormalities were excluded from the study.

Inter-canine width is defined as the horizontal distance between the two canines. It was measured using a manual Verniercaliper; the subject was asked to open his/her mouth

were placed at the medial borders of right and left canine of both the jaw, then an average value was noted. In order to maintain proper hygiene, aftertaking these measurements, the tips of Verniercaliper were cleaned before using it on another subject.

For measuring the stature, a stadiometer was used; the subject was asked to stand barefoot in an upright posture with his/her head positioned in Frankfurt plane and with his/her heel, buttocks, scapulae and occiput touching the measuring rod, then by using a movable rod, the reading was taken. To reduce the errors while observing, all the readings were taken twice. The collected data was then analysed using SPSS.

RESULTS

The mean Intercanine width of males was more than females in both Mandible as well as Maxilla; they were found to be statistically highly significant. Since, T value between males and females was more in Maxillary Intercanine width than Mandibular Intercanine width, hence sexual dimorphism is more in Mandibular Intercanine width. Also, sex can be differentiated on the basis of Inter-canine width of the subjects as P value is less than 0.05, which is statistically highly significant (**Table 1**).

Percentage accuracy to predict the sex on the basis of Inter-canine width is 62 % in males and 70% in females if using maxilla, 68 % in males and 55 % in females if using mandible.

Correlation between the stature and Maxillary Intercanine width is more positive and stronger as compared to Mandibular Intercanine width in total subjects as well as

**Table 1** Independent t test: for sex differentiation from Inter-canine width

Parameter	sex	Mean ± SD	T value	P value	Level of Significance	% of sexual dimorphism
Maxillary Inter-canine width	M	3.4512 ± .23568	5.027	.000	Highly significance	5.43 %
	F	3.2980 ± .19336				
Mandibular Inter-canine width	M	2.7042 ± .22900	4.466	.000	Highly significance	6.16 %
	F	2.5712 ± .19036				

and then the two tips of external jaw of manual verniercaliper were placed at the distal borders of right and left canine respectively for measuring the maximum Intercanine width (max. Id) and for measuring the minimum Intercanine width (min. Id), the tips of the external jaw of manual Verniercaliper

male and female subjects individually. They were found to be statistically highly significant in total subjects and male subjects as p value is less than 0.05 but not statistically significant in female subjects as p value is more than 0.05 (**Table 2**).

Table 2 Regression analysis for predicting stature (Y) of subjects (dependable variable) considering Inter-canine width as an independent variable

Parameter	Mean	Std. Deviation	Correlation value	P value	R Square	Regression equation
Mean Height of **Total** Subjects (n= 200)	167.06	9.48231	.368	.00	.135	Y = 115.525 + 15.270 (maxillary Intercanine width in Total Subjects)
Mean Maxillary Inter-canine width of Total Subjects (n =200)	3.37	.22833				
Mean Height of **Total** Subjects (n= 200)	167.06	9.48231	.332	.00	.110	Y = 129.355 + 14.293 (mandibular Intercanine width in Total Subjects)
Mean Mandibular Inter-canine width of Total Subjects (n =200)	2.64	.22037				
Mean Height of **Male** Subjects (n=100)	174.42	5.90969	.239	.008	.057	Y = 153.706 + 6.003 (maxillary Intercanine width Of male Subjects)
Mean Maxillary Inter-canine width of Male Subjects (n =100)	3.45	.23568				
Mean Height of **Male** Subjects (n=100)	174.42	5.90969	.217	.015	.047	Y = 159.258 + 5.609 (mandibular Intercanine width in male Subjects)
Mean Mandibular Inter-canine width of male Subjects (n − 100)	2.70	.22900				
Mean Height of **Female** Subjects (n=100)	159.69	6.00936	.109	.141	.012	Y = 148.563 + 3.373 (maxillary Intercanine width in Female Subjects)
Mean Maxillary Inter-canine width of Female Subjects (n =100)	3.30	.19336				
Mean Height of **Female** Subjects (n=100)	159.69	6.00936	.097	.168	.009	Y = 115.525 + 15.270 (mandibular Intercanine width in Female Subjects)
Mean Mandibular Inter-canine width of Female Subjects (n =100)	2.57	.19036				

(a)

(b)

(c)　　　　　　　　　　　　　　　　**(d)**
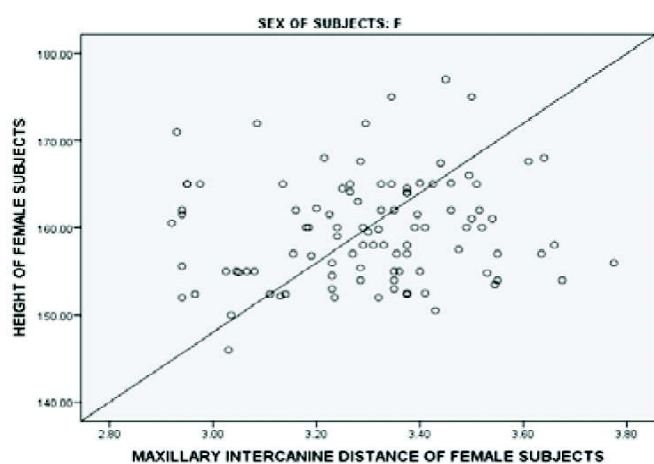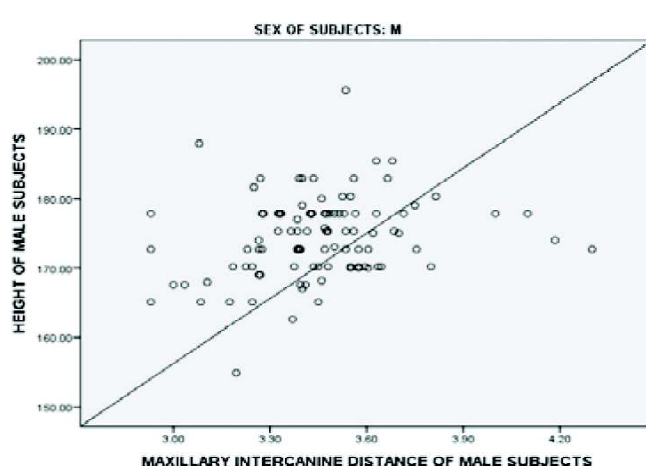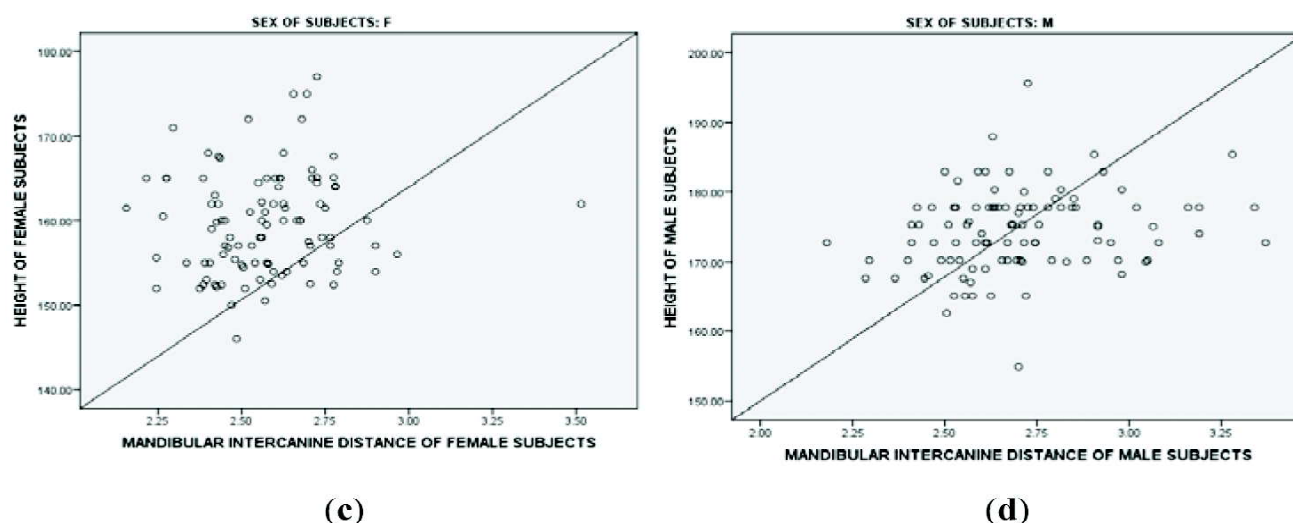
Figure 1 Scatter diagram showing correlation between Intercanine width and stature (**a** to **d**)

DISCUSSION

The present study was conducted for sexual dimorphism using Mandibular and Maxillary Intercanine width, thereafter prediction of stature was done by considering Intercanine width as an independent variable. The mean Mandibular Intercanine width was more in males as compared to females; statistically significant difference was found as p value was less than .05. These findings are consistent with most of the studies[8-17] but inconsistent with study conducted by Dayananda[18] where mean value was more in males but statistically insignificant difference was observed. In the present study, mean Maxillary Intercanine width was more in males as compared to females and statistically significant difference was found between males and females which is consistent with Prakash Chandra Jhaetal[18] and Rao G V[19] but inconsistent with Hamid and Mastooreh[20] where statistically insignificant difference was found. Sexual dimorphism using Mandibular Intercanine width in the present study was found to be 6.61 % whereas a slightly higher percentage was found by Fulwaria Mukesh[21] (13.74 %). The correlation coefficient between Stature and Maxillary intercanine width of the present study was found to be weakly positive (0.368) and a statistically significant relationship was obtained which is consistent with Harshala S Patil's[22] (r = 0.493 and p value < 0.05).

CONCLUSION

Sexual dimorphism is successfully possible if Intercanine width of Maxilla and Mandible are measured in the jaw. Also, percentage of sexual dimorphism using Mandibular Intercanine width is more than Maxillary Intercanine width. The percentage accuracy to predict the sex, considering Intercanine width is more in females if using Maxilla and more in males if using Mandible. Since, we obtained a positive, weakly strong correlation and not a very high percentage of sex prediction. Hence, there is a need for more research relating to Intercanine width involving a larger population of different age groups. In order to obtain a more reliable, better and more accurate prediction of stature and sexual dimorphism it suggested to conduct a combined study of dental tissues and bones in contrast to dental issues alone.

Conflicts of interest: None.

Contribution of Authors: All authors declare that: (1) The article is original with author(s) and does not infringe any copyright or violate any other right of any third party. (2) The article has not been published (whole or part) elsewhere, and is not being considered for publication elsewhere in any form, except as provided herein. (3) All author(s) have contributed sufficiently in the article to take public responsibility for it and (4) All author(s) have reviewed the final version of the above manuscript and approved it for publication. The contributions were made as: Dr. Rattan Singh: Concept, study design, data collection, data arrangement, statistical analysis, manuscript writing; Neha Bhasin: Collect the data, review the manuscript; Dr. Jyoti Barwa: Interpret the table and graphs, Draft writing, review the manuscript; Dr. Sanjoy Das: Concept, Study Design, Draft writing, Review Manuscript.

Ethical clearance: Taken.

REFERENCES

1. Whittaker DK. Introduction to forensic odontology. Quintessence Int. 1994;25:723-30.

2. Williams PL, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE et al. The teeth in gray's anatomy. 38th ed. New York. Churchill Livingstone; 2000. p. 1699-721.

3. Bosset WA, Marks HH. Prevalence and characteristics of periodontal disease in 12,800 persons under periodic dental observation. J Am Dent Assoc 1956;52:442-9.

4. Krogh HW. Permanent tooth mortality: A clinical study of causes of loss. J Am Dent Assoc 1968;57:570-5.

5. Patterson KB, Kogan SL. Dental identification in woodbridge disaster. J Canad Dent Assoc 1985;37:301-6.

6. Omar A, Azab S. Applicability of determination of gender from odontometric measurements of canine teeth in a sample of adult Egyptian population. Cairo Dent J 2009; 25:167-80.

7. Sekhon H, Singh R, Barwa J. Determination of sex from mandibular canine index in Delhi population; Medicolegal Update 2017 July- December;17(2):156-9.

8. Muller M, Lupi PL, Quatrehomme G, Bolla M. Odontometric method useful in determining gender and dental alignment. Forensic Science International 2001;121:194-7.

9. Kaushal S, Patnaik VV, Sood V, Agnihotri G. Sex determination in North Indians using mandibular canine index. JIAFM 2004;26(2):45-9.

10. Abdullah MA, Mohammed AQ, Ashraf I, Khan N. Saudi Dental Journal 1997;9(1):1-5.

11. Yogitha R, Aruna N, Balasubramanyam R. Canine morphometry in human sex determination. Journal of the Anatomical Society of India 2005;54(1):217.

12. Bondevik O. Changes in occlusion between 23 and 34 years of age. Angle Orthod 1998;68(1):75-80.

13. Anderson DL, Thompson GW. Interrelationships and sex differences of dental and skeletal measurements. J Dent Res 1973;52(3):431-8.

14. Sherfudhin H, Abdullah MA, Khan N. A cross-sectional study of canine dimorphism in establishing sex identity: comparison of two statistical methods. Journal of Oral Rehabilitation 1996;23:627-31.

15. Aggarwal B, Vasudeva K, Kaushal S, Chhabra U, Singla S .Gender based comparison of intercanine distance of mandibular permanent canine in different populations. JPAFMAT 2008;8(2):6-9.

16. Ayoub F, Shamseddine L, Rifai M, Cassia A, Diab R, Zaarour I, et al. Mandibular canine dimorphism in establishing sex identity in the Lebanese population. International Journal of Dentistry 2014;1:1-4.

17. Rao GV, Kiran G. Sex determination by means of inter-canine and inter-molar width- a Study in Telangana population. Asian Pac J Health Sci 2016;3(4):171-5.

18. Jha PC, Sanghamesh NC, Alok A, Singh S, Bharti BB, Raj R. Dimorphism of canine: a diagnostic value in gender identification - a clinical study. Int J Sci Stud 2015;3(8):81-4.

19. Dayananda R, Kumar MP, Govinda Raju HC, Rayamane AP, Saraf A. Sexual dimorphism in permanent mandibular canines. JKAMLS 2014 Jan - Jun;23(1):1-8.

20. Asli H M, Mastooreh KG. Evaluation of the relationship between upper intercanine and inner canthal distances in selected patients. Biosci Biotech Res Comm 2017;10(2):143-7.

21. Fulwaria M, Bijaraniya K. Determination of sexual dimorphism in Bikaner city population in Rajasthan by odontometric study of permanent mandibular canine. Sch J App Med Sci 2017 Oct;5(10E):4187-90.

22. Patil HS, Alane UY. Estimation of stature in local beed (Maharashtra) population: an odontometric approach. Journal of Dental and Medical Sciences 2017 Sep;19(9):80-4.