

Evaluation and Correlation of Tooth Morphometrics in the Maxillary Arch for Sex Identification

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ABSTRACT

Introduction: In recent years, mankind has tried to calibrate human dentition and was successful to a certain extent. Tooth morphometrics had played an important role in forensic odontology and many medicolegal cases. Newer criteria such as standard canine index, intercanine distance, and intermolar arch width (IMAW) need to be analyzed to help in better understanding and to use them in forensics. Our focus was to correlate these parameters and to use as reliable guide for tooth identification.

Aims and objectives: To evaluate intercanine, IMAW, and canine crown width parameters for gender identification.

Materials and methods: One hundred maxillary dental casts were taken between 50 males and 50 females. All the measurements were taken as per inclusion and exclusion criteria using the Vernier caliper. SPSS Version 22 was used for statistical analysis.

Results and conclusion: Overall mean values in males and females between IMAW were significant. The right canine crown width was greater compared to the left canine which was highly significant. The intercanine arch the width showed highly significant. In all aspects, males-manifested dominant values compared with females.

Keywords: Dental casts, Gender identity, Parameters, Volunteers.

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INTRODUCTION

Identification of remains is of utmost importance in cases of mass fatality during crimes and natural disasters, where mutilated bodies are damaged beyond recognition.¹ Gender confirmation through fragments of skeletal residues is a part of archeological and medicolegal examination.²⁻⁴ The skull is the matrix of the living head. It is the bony core of the fleshy head and the face in life that beholds teeth which are the hardest and chemically the most stable tissue in the body. Teeth are excellent material for genetic, odontological, anthropological, and forensic investigations. The first few instances in the evolution of forensic odontology was the first forensic evidence which was found at an American Revolutionary War by a dentist named Dr Paul Revere in the year 1775.⁵

Human dentition is as unique as a finger print. This is based on the fact that although the morphology of tooth structure is the same in males and females, the size of teeth is determined by culture, environment, racial, and genetic factors that is always different.⁶

A study of the maxillary and the mandibular canine as well as the molar contributes certain advantages in forensic odontology for sex identification. This study discusses about the maxillary arch difference between males and females, i.e., the intercanine arch width, the intermolar width, and the canine crown width which have a vast scope in this field.

AIMS AND OBJECTIVES

- To evaluate intercanine and IMAW.
- To correlate intercanine and intermolar arch parameters to gender.

MATERIALS AND METHODS

Measurements were made on 100 maxillary casts (50 females' and 50 males' casts) in a group of 18–25 years in a dental institution.

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The inclusion criteria are normal overjet, overbite, ideal arch form and alignment, complete permanent dentition, absence of morphological, and developmental anomalies (peg lateral, supernumerary teeth, mesiodens, and retained deciduous teeth). The exclusion criteria are subjects with any malocclusion, caries teeth, subjects with orthodontic treatment, presence of partially erupted teeth, and presence of any deleterious habit.

Impressions of the maxilla were taken using the alginate compound and casts were made with dental stone on each selected student. A digital caliper was used to measure the intercanine width (ICW), the IMAW, and the mesiodistal crown width of the right and the left canine. The ICW was measured from the tip of the one canine to the tip of the another canine. The IMAW was measured from the central fossa of the first right molar to the central fossa of the left first molar. The crown width of canine (CCW) measured by a maximum mesiodistal distance of the canine on each side.

The three measurements of each subject were recorded in a period of 1 month. The measurement obtained was interpreted and subjected to statistical analysis.

RESULTS

The mean and the standard deviation of IMAW are 46.85 and 3.98, respectively; the intercanine distance is 35.07 and 3.0, respectively; the right canine crown width is 7.41 and 0.51, respectively, and the left canine crown width is 7.36 and 0.52 (Table 1), respectively. The inter canine distance showed higher significance in males than females ($p < 0.01$) (Table 2). The intermolar arch width showed lesser significance in females than in males ($p < 0.05$) (Table 3). Average values of IMAW is 46.85, ICW = 35.07, right canine crown width = 7.41, left canine crown width = 7.36 in both males and females (Fig. 1). Males had a higher crown width in both left and right compared with females (Fig. 2). Females had an equal crown width in both left and right canines (Fig. 2). Right canine had higher crown width compared with left in both males and females ($p < 0.01$) which was highly significant (Fig. 3).

Table 1: Descriptive statistics of IMAW, ICD, and CCW

Parameter	Minimum	Maximum	Mean	SD
IMAW (mm)	40.48	74.15	46.85	3.98
Inter canine distance (mm)	28.02	53.77	35.07	3.00
Canine crown width, right	6.37	8.76	7.41	0.51
Canine crown width, left	6.14	8.60	7.36	0.52

Table 2: Statistical data analyzed using an independent t test

Parameter	Gender	Mean	SD	t value	p value
IMAW (mm)	Female	46.02	4.88	2.12	<0.05 S
	Male	47.68	2.60		
Inter canine distance (mm)	Female	34.28	2.16	2.71	<0.01 HS
	Male	35.86	3.50		
Canine crown width, right	Female	7.22	0.48	3.99	<0.01 HS
	Male	7.60	0.48		
Canine crown width, left	Female	7.20	0.50	3.25	<0.01 HS
	Male	7.53	0.50		

p value of <0.05 = significant
p value <0.01 = highly significant

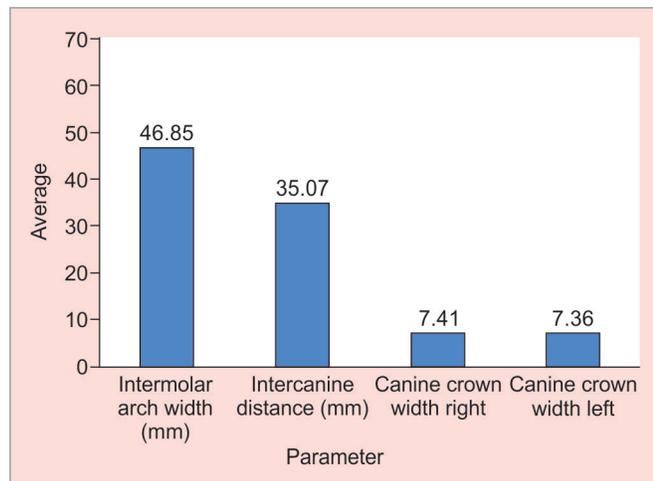


Fig. 1: Average values of IMAW, ICW, right, and left CCW

DISCUSSION

Determination of characteristics of a person in mass disasters becomes the priority in forensic investigations. Although DNA analysis is the most precise technique, sometimes due to lack of facilities and cost factor can be an overwhelming in developing countries such as India which is an obstacle.⁴ With an increase in the number of natural as well as manmade calamities like earthquakes and flood, the need to correctly identify the remains of individuals is ever increasing.¹ In such situations, teeth being the hardest, chemically most stable which are known to resist a variety of ante-mortem and postmortem insults, are an important raw material in forensic investigations.^{2,3}

Considering the fact that there are differences in odontometric features in different populations and even within the same population, it is important to determine specific gender values to make identification possible on the basis of dental measurements. Dentition in males is larger than in females as seen in the field of forensic odontology.⁷ It is noted that the permanent canine and the permanent molar arch width contribute to sex identification through dimorphism.⁸ The study of the maxillary and the mandibular canine and the molar offers certain advantages as they are in the least extracted teeth and less effected by the periodontal disease and also last to be extracted in respect of age (Bossert and Marks, 1956; Krogh, 1968). The intercanine and intermolar widths are usually recorded on the plaster model but can also be recorded using photocopies and digitalized images of

Table 3: Comparative values of standard deviation of parameters IMAW, ICD, and CCW in males and females

Parameter	Gender	Minimum	Maximum	Mean	SD
IMAW (mm)	Female	40.62	74.15	46.02	4.88
	Male	40.48	53.56	47.68	2.60
Inter canine distance (mm)	Female	28.02	38.78	34.28	2.16
	Male	30.95	53.77	35.86	3.50
Canine crown width, right	Female	6.37	8.41	7.22	0.48
	Male	6.76	8.76	7.60	0.48
Canine crown width, left	Female	6.14	8.33	7.20	0.50
	Male	6.57	8.60	7.53	0.50

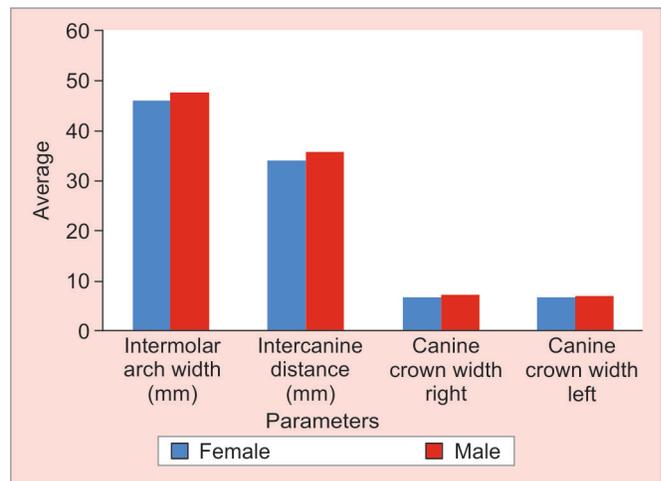


Fig. 2: Comparative values of standard deviation of parameters IMAW, ICD, and CCW in males and females

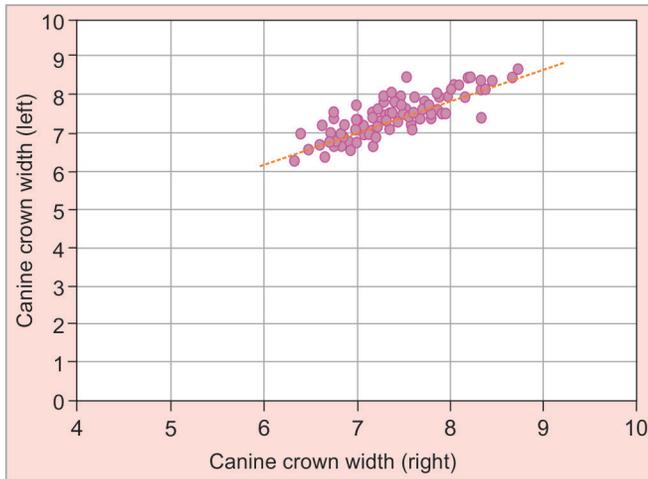


Fig. 3: Right canine crown width versus left canine crown width in the scatter plot diagram

the models.⁹ The canine index can also be used to predict sexual dimorphism.¹⁰

In the present study, subjects with an age of 17–25 years were selected because the eruption of canines and molars including the width of total dental arches is completed. An attempt has been made in the current study to establish the sex of a person between males and females by using mesiodistal width of canine, intercanine arch length, and intermolar arch distances.

A study by Peeyush et al., on the basis of the Pearson correlation of maxillary ICW with interpupillary, outer inter-canthal distance, and interalar distance, showed a statistically significant dimorphism in intracomparison within females and males of age group 18–35 years.² Similarly, the ICW in our study is statistically significant using Pearson's correlation.

According to similar studies conducted on the maxillary first molar and the canine inter-arch width in an age group of 18–25 years were significantly higher in males than females,¹ which was proved to be the same with a dimorphism of 1.34 ($p \leq 0.01$) greater in males in the present study.

Another study conducted on the maxillary canine mesiodistal width found that the mean values for the right and the left maxillary canine mesiodistal width was less for females than for males but were not statistically significant.^{7,8,13,15} However, in a study done by Shankar et al., using the maxillary and the mandibular canine width and intercanine distance, the prediction of sex using only maxillary canine showed poor statistical significance than mandibular canines.¹⁰ The measurements of the maxillary canine can also be compared with interalar distance and it has been shown that the interalar distance gives the strongest predictive relationship with the maxillary canine.¹¹

Various theories have been proposed on teeth dimorphism. According to Moss, due to long period of amelogenesis in males compared to females and the Y chromosome producing slower male maturation, the thickness of enamel is greater in males compared to females.^{4,12}

Male subjects have a greater mesiodistal width than female subjects and the right side dominates in most of the readings indicating that the mesiodistal width is greater on the right side than on the left side.^{13,14}

In our study, the mesiodistal width of canines and intercanine distance between males and females was statistically significant

with a mean difference of 3.99 (t value) in the right canine and 3.25 (t value) in the left canine where males have a greater mesiodistal canine width than females by using an independent t test.

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Technological advances have provided faster measuring means which makes evaluating easier the reliability of intercanine and intermolar widths taken on photocopies and digitalized images taken for orthodontic purposes and T-shaped flat metal plate (canine tip marker). However, photocopies would not constitute the method for proper replacement of plaster models since they depict two-dimensional static images but provide information regarding the patients predentulous state.^{10,11}

CONCLUSION

Our analysis on the intercanine distance and the canine crown width showed a higher significance and a minimal significance in the intermolar distance between males and females of south Indian population. Measurements were made on ideal occlusion without any developmental anomalies and subjects who underwent orthodontic treatment for accurate results in gender discrimination. Our study was done on subjects between 18 years and 25 years; hence, future research could include age variation and also including parameters like the mandibular arch.

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