

SEXUAL DIMORPHISM USING CANINE WIDTH AND INTER-CANINE WIDTH AMONG NORTH INDIAN POPULATION

Forensic Medicine

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ABSTRACT

Introduction: Identification is an important characteristic of forensic medicine. Personal identification needed specially in natural mass disasters like tsunamis, earth quakes, floods, landslides etc., and in human made disasters like chemical bomb blast, nuclear bomb blast, mass murder terrorist attacks, and in case where body is highly decomposed, mutilated body and fragmentary human remains. Teeth are extremely durable, hardest and chemically most stable structure of the body. Since teeth being highly resistance to decay and decomposition, their measurement can be used as reliable research tool for sex estimation. Mesiodistal parameter of mandibular canine and mandibular inter canine distance are simple, easy and unexpensive method that can be used in sex estimation of an individual. **Aim:** The aim of the study was to estimate the sexual dimorphism from mandibular canine width and mandibular inter canine distance. **Materials and Methods:** The sample comprised of dental impression from 120 individuals (60 males and 60 females), all young adults between 20 and 35 years of age. Impressions of the teeth were made using irreversible hydrocolloid (alginate) material and casts poured in dental stone. Mesiodistal (MD) dimensions of mandibular canine of both right and left side and mandibular inter canine distance is measure by caliper. **Results:** Data were summarized as Mean and SD. Groups (in Gender Male vs female) were compared by unpaired or independent Student's t test. Mean mandibular canine width as well as mean mandibular intercanine distance are higher in male than female and are statistically significant in young north Indian population. Left mandibular canine width (6%) was more sexually dimorphic than right mandibular canine width (5.1%). Mandibular intercanine distance shows 7.8% of sexual dimorphism. **Conclusion:** mandibular canine width and mandibular intercanine distance can be used for estimating sexual dimorphism.

KEYWORDS

Sexual dimorphism, Canine, Sex estimation, Mesiodistal width, Intercanine distance.

INTRODUCTION

Identification is an important characteristic of forensic medicine¹. Personal identification needed specially in natural mass disasters like tsunamis, earth quakes, floods, landslides etc., and in human made disasters like chemical bomb blast, nuclear bomb blast, mass murder terrorist attacks, and in case where body is highly decomposed, mutilated body and fragmentary human remains¹². To create a biological profile, various methods of identification are used in forensic medicine for unknown person¹⁴. Those various methods are anthropometry, stature estimation, dactylography, sex estimation, age estimation, DNA analysis, differentiation by blood groups and odontology⁵. Estimation of sex is the first approach towards identification of an individual⁶. Various methods are practiced for sex determination like odontometry⁷, osteometry⁸ and cheiloscopy^{9,10,11}, and DNA analysis¹² have been used for gender determination. Analysis of DNA gives definitive proof of sex determination, but such methods are expensive, exhaustive, relatively prolonged involves difficult DNA extraction technique and requires qualified trained staff^{13,14}. Among the osteometric analysis of various bone, pelvic bone is most reliable bone for sex determination with accuracy more than 95%^{15,16,17}. Mandibular and craniofacial bones are also reliable for sex determination with high accuracy^{18,19}. Skeleton has susceptibility to break down after deposition and thus creating difficulties in their evaluation, particularly in mass disaster or catastrophic events, where these bones rarely appear complete²⁰. Teeth are extremely durable, hardest and chemically most stable structure of the body²¹. Since teeth being highly resistance to decay and decomposition, their measurement can be used as reliable research tool for sex estimation²², hence tooth play dominant role when others determinant of bony skeleton are fragmented, destroyed^{23,24,25} or unavailable²⁶.

Recent research shows that mandibular canines exhibit the greatest sexual dimorphism amongst all teeth²⁶. Mesiodistal parameter of mandibular canine and mandibular inter canine distance are simple, easy and unexpensive method that can be used in sex estimation of an individual²⁷.

The aim of our study was to evaluate the mandibular canine width and mandibular inter canine distance as tool for sex determination among

north Indian population.

MATERIAL AND METHODS

Material required

1. Alginate
2. Dental stone
3. Maxillary Impression Trays
4. Mandibular Impression Trays
5. Rubber Bowl
6. Spatula

The alginate dental impression forms an imprint (i.e., a 'negative' mould) of those teeth and gums, which can then be used to make a cast or 'positive' model of the patient's dentition (fig.no.1).

Sample size

Sample selection:

sample size was calculated by formula

$$N = Z_{\alpha}^2 p(1-p) / E^2$$

Where Z_{α} is critical value of z-score at α level of significance (at = 5%, $Z_{\alpha} = 1.96$), p is proportion and E is permissible error. 9.8 % of sexual dimorphism observed by mandibular canine width (9.9% by left canine width and 9.7% by right canine width parameter. Average = 9.8 %²⁷. $p = 9.8\%$, i.e., .098, $1-p = .902$, $E = 5.4\%$ i.e., .054. So, $n = (1.96)^2 \times 0.098 \times 0.902 / (.054)^2 = 116.44 \approx 120$.

Study was conducted on 120 volunteer subject (60 male and 60 female) of both the sex having age group between 20 to 35 years. Informed consent was taken from all participants.

Inclusion Criteria:

1. Age between 20 to 35 years.
2. Fully erupted with complete set of teeth.
3. No history of orthodontic treatment or any type of prosthesis
4. Non-carious, non-hypoplastic, non-traumatic, non attrited and periodontally healthy teeth.

Exclusion Criteria:

1. Age below 20 years and above 35 years.
2. Misaligned, spacing teeth, diastema or crowded teeth
3. Carious teeth, restored teeth, fractured teeth, hypoplastic teeth, teeth with prosthesis, attrited teeth, mobile teeth.

Methodology and tooth measurements

Institutional ethical clearance was taken for this study with reference number IEC/IIMS&R/2023/74 (Institutional Ethics Committee, IIMS&R Integral University, Lucknow). Impressions of the teeth were taken using irreversible hydrocolloid (alginate) material and poured by dental stone (Fig No.1). Mesiodistal (MD) dimensions of mandibular canine of both right and left side, were measured on the casts using a digital caliper calibrated to 0.01 mm.

The MD dimension was defined as the greatest distance between contact points on the approximate surfaces of the tooth crown and was measured with the caliper beaks placed occlusally and aligned with the long axis of the tooth (Fig. No.2). If teeth were rotated or misaligned, measurements were taken between points on the approximate surfaces of the crown where it was considered that contact with adjacent teeth would normally occur. Mandibular intercanine distance: defined as the linear distance between the tips of the two mandibular canines; (Fig no.3).



Fig. no.1- Image of dental cast



Fig 2: Measuring of mesiodistal dimension of teeth by the digital caliper



Fig 3: Measuring inter canine distance by digital caliper

RESULTS

Data obtained were quantified and analysed statistically using SPSS (Statistical Package for the Social Sciences). All description shown in table 1 to 4. Data were summarized as Mean and SD. Groups (in Gender Male vs female) were compared by unpaired or independent Student's t test. In this study both right and left mesiodistal mandibular canine width (table 1, chart 1) was higher in male (for right mesiodistal canine width $6.042167 \pm .518561$ and for left mesiodistal canine width $6.084 \pm .604484$) than female (for right mesiodistal canine width $5.743667 \pm .456609$ and for left mesiodistal canine width $5.737833 \pm .600158$) and was statistically significant ((p value = .001103 < 0.05).

The mean mandibular intercanine distance (table 3, chart 3) was higher in male than female (26.2745 ± 2.6314 in male while in female it was 24.35583 ± 1.898114) was highly significant with p value < .001. Left mandibular canine shows higher sexual dimorphism (table 2, chart 2) than right mandibular canine. Mandibular intercanine distance (table 4) shows 7.8% sexual dimorphism.

Table 1. Measurement of mean and standard deviation of mandibular canine width among male and female

Sex	Right mesiodistal mandibular canine width (in mm)			Left mesiodistal mandibular canine width (in mm)		
	Mean	Standard deviation	p value	Mean	Standard deviation	P value
Male	6.042167	.518561	0.001103	6.084	.604484	0.002083
Female	5.743667	.456609		5.737833	.600158	

Table 2. Calculation of % Sexual dimorphism from right and left mandibular canine

Right mandibular canine	5.1 %
Left mandibular canine	6.0 %

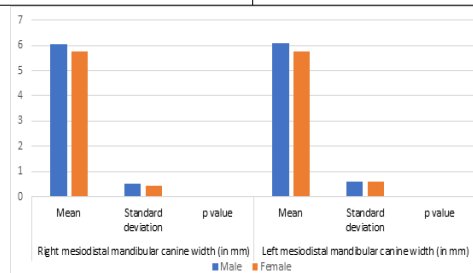


Chart 1. Measurement of mean, standard deviation and p value of mandibular canine width among male and female

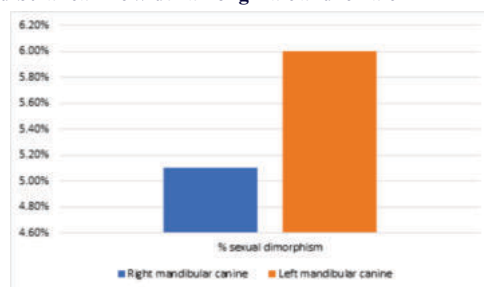


Chart 2 showing % Sexual dimorphism from right and left mandibular canine

Table 3. Measurement of mean mandibular inter canine distance among male and female

Sex	Mean Inter canine distance (IC) (in mm)	Standard deviation	P value
Male	26.2745	2.63014	<.001
Female	24.35583	1.898114	

Table 4. Calculation of % Sexual dimorphism from mandibular intercanine distance.

Mandibular intercanine distance	7.8%
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DISCUSSION

Mandibular canine contemplates as key teeth for identification of an individual since it is least affected by oral disease or dental caries, decay resistance, better to sustain severe trauma such as fire, air disaster and are last teeth to be erupted with respect to age²⁸. Lysell et al studied on more than 1000 individuals and demonstrate that mandibular canine exhibit maximum sexual dimorphism among all teeth²⁹. Lund and Mornstad found canines most dimorphic among all teeth in their study on 58 dental cast subjects of Swedish population³⁰. Study of Hashim and Murshid on 720 male and female cast of Saudi population in age group of 13 years to 20 years found that only mandibular teeth showed sexual dimorphism among all teeth³¹. Similar results obtained by Lew and Keng in their study on ethnic Chinese population with normal occlusions³². Hence the present study was performed on mandibular canines to demonstrate sexual dimorphism among north Indian population with in age group 20 to 35 years. Our study demonstrates maximum sexual dimorphism by left mandibular canine teeth (6%) followed by right mandibular canine teeth (5.1%) which is

similar to study done by Nair et al who found higher sexual dimorphism by left mandibular canine than right mandibular canine (6.2%)³³, study done by Kaushal et al³⁴ on 60 north Indian subject who found left mandibular canine (9.796% in cast and 8.891% intraoral) to be more dimorphic than right mandibular canine (7.954% in cast and 7.594% intraoral) and study done by Kapila et al³⁵ where greater sexual dimorphism (9.7%) was exhibited in the left mandibular canine than in the right mandibular canine (7.4%). Similar results also found in the study of Knak Priya et al³⁶. Our study contradicts with the study of Srivastava³⁷ who reported that right mandibular canine (2.804%) is more dimorphic than left mandibular canine (2.326%). Similar contradict also found in study of Zoya Kalim and Renu Tyagi³⁸ who reported mesodistal width of right mandibular canine (8.87%) show greater sexual dimorphism than mesodistal width of left mandibular canine (8.09%). Grover Maneel et al³⁹ found higher sexual dimorphism in right mandibular canine (10.11%) than left mandibular canine (4.44%) which contradictory to our study.

In our study mandibular intercanine distance is higher in male than female which is similar with the study of Anderson and Thompson⁴⁰ in Canadian population, Muller et al⁴¹ in French population, Kaushal et al³⁴, study of Yogita and Aruna⁴², study of Bindu et al⁴³, study of Vandana et al⁴⁴ and study of Shrivastava et al³⁷ in Indian population. In our study mean mandibular intercanine distance in male was 26.2745mm which is close with study of Anderson and Thomson⁴⁰, Muller et al⁴¹, Bindu et al⁴³ and Vandana et al⁴⁴ while in female mean mandibular canine distance was 24.35583mm which was close to study of Kaushal et al³⁴. In the present study high sexual dimorphism exhibited by mandibular intercanine distance (7.8%) and was statistically significant whereas sexual dimorphism shown in study of Zoya Kalim and Renu Tyagi³⁸ was 4.72%.

CONCLUSION:

Present study reveals that mesiodistal width of mandibular canine of both right and left side higher in male than female and is statistically significant. Mesodistal width of left mandibular canine exhibit higher sexual dimorphism than right mandibular canine width. Mean mandibular intercanine distance is higher in male than female and statistically highly significant. High sexual dimorphism exhibited by mandibular intercanine distance. So, from study it can be concluded that mandibular canine width and mandibular intercanine width is quick, easy and reliable method of demonstration of sexual dimorphism.

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