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Estimation of sex by applying mandibular canine index in North Indian population

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Abstract

Introduction: Identification of an individual is one of the important medical and legal aspects of forensic medicine. Personal identification become a necessity in mass disaster like flood, earthquake, landslides, tsunamis, terrorist attack, bomb blast, air plane crash, road side accident, railways accident, mass murder or in case of advanced decomposed body or mutilated body. Being most indestructible, teeth reveal least change of natural structure, they can be used for sex determination. Mandibular canine shows maximum sexual dimorphism among all teeth Mandibular canine index (MCI) is simple and practical method of sex determination based

on ratio between mesiodistal measurement of mandibular canine tooth and lower intercanine distance.

Aim: The aim of the study was to estimate the sex from mandibular canine index.

Materials and Methods: The sample comprised of dental impression from 100 individuals (50 males and 50 females), all young adults between 20 and 30 years of age. Impressions of the teeth were made using irreversible hydrocolloid (alginate) material and casts poured in dental stone. Mesiodistal dimensions of mandibular canine of both right and left side 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 MCI is greater in male than female in young north Indian population. Standard MCI value may consider as cut off value for determining gender i.e., value above standard MCI will be male and below it will be female. Overall sex prediction in our study using MCI is higher in female (67%) than male (59%). Our study showed that left mandibular canine (4.7%) has higher sexual dimorphism than right mandibular canine (4.5%).

Conclusion: mandibular canine index can be used for sex estimation in North Indian population.

Keywords: Sexual dimorphism, Sex estimation, Mesiodistal width, Intercanine distance, Mandibular canine index, Measurement, Accuracy.

Abbreviations: MCI: Mandibular canine index, SD: Standard deviation, mm: millimetre, IC: Intercanine distance.

Introduction

Identification of an individual is one of the important medical and legal aspect of forensic medicine[1].Personal identification become a necessity in mass disaster like flood, earthquake, landslides, tsunamis, terrorist attack, bomb blast, air plane crash, road side accident,railways accident, mass murder or in case of advanced decomposed body or mutilated body[2].Questions for identification of criminals, other person and dead bodies always arises in court of law[3].Dactylography and DNA fingerprinting are most reliable, preferred, fast and secure techniquefor identification. However, these techniques are not always available in certain situation like crime scene, so there is increase demand for alternate and reliable method for personal identification[4]. Determination of age, sex, ethnicity and stature are 'big four' of personal identification[5].Sexdetermination can be done from bones or skeleton remains. Accuracy of sex determination from whole skeleton is 90-100 %[6,7]. Being most indestructible, teeth reveal least change of natural structure[8].That's why teeth can be used for identification from fragmentary skeleton remains[9]. Teeth are hardest, chemically most stable tissue of body made of enamel and dentine and having high concentration of calcium, magnesium and phosphorus, resist putrefaction and other post-mortem changes, mechanical, physical and chemical changes[9,10,11,12].Sexual dimorphism refers to group of morphological traits between male and female such as stature, appearance and size that can be applied to dental identification[9].Since teeth are unique, readily available and no two teeth have similar morphology they can be used as forensic tool. It has been established in various research studies that mandibular canine has greatest sexual dimorphism among all teeth[13].Mandibular canine has mean age of eruption 10.87 years and less affected than other teeth by periodontal diseases[14]. They are also exposed to less calculus, plaque, attrition or heavy occlusal loading than other teeth. These characteristics enable mandibular canine as key teeth for identification[15,16]. Mandibular canine index (MCI) is simple and practical method of

sex determination based on ratio between mesiodistal measurements of mandibular canine tooth and lower intercanine distance[17].In this study we attempted to find correlation between sex and mandibular canine index among young north Indian population.

Materials and Methods

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 atαlevel of significance (at α= 5%, Z_α=1.96), p is proportion and E is permissible error. It was observed that 78.8 % of the subject were correctly estimated for sex[18]. p=78.8%, i.e., .788, 1-p=.212, E=8% i.e., .08.

So, $n= (1.96)^2\times0.788\times0.212/ (.08)^2=100.27 \approx 100$.

Study was conducted on 100volunteer subject (50 male and 50 female) of both the sex have age group between age group 20 to 30 years. Informed consent was taken from all subjects

Inclusion and exclusion criteria:

Inclusion criteria

- Presence of the mandibular canines
- Teeth having healthy periodontium
- Absence of carious lesions
- Absence of fillings in the interproximal aspects of the mandibular canines
- Normal occlusion with normal overbite & over jet

Exclusion criteria

- Attrition
- Cariousteeth
- Erosion
- Developmental anomalies
- Spacing/ Crowding
- Ectopically erupted
- Partially erupted
- Any periodontal disease

Material required

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

Methodology

Institutional ethical clearance was taken for this study with reference number IEC/IIMS&R/2023/73 (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 1).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. Mesiodistal dimension of mandibular canine of both right and left side of jaw was measured by verniercalliper (Fig 2). The intercanine distance is measured by calliper as linear distance between tips of both side mandibular canine (Fig 3).Sexual dimorphism calculated by following formula[18].

Sexual Dimorphism in percentage (%) = $[(Xm/Xf)-1] \times 100$, where Xm is the mean value for males and Xf is the mean value for females.

Mandibular canine index is calculated by following formula[17].

Mandibular Canine index (MCI) =

$$\frac{\text{Mesiodistal crown width of mandibular canine}}{\text{Mandibular canine arch width}}$$

The mean values for both male MCI and female MCI were obtained. After that, the standard MCI value was calculated by using given below formula:

Standard mandibular canine index (MCI)

= (mean male MCI − standard deviation [SD]) + (mean female MCI + SD)/2.

In this study gender determination was based on observed canine index and standard canine index. We used standard canine index value as cut off value to differentiate the gender. All observed MCI value above the standard MCI values were consider as male and all observed MCI value below or up to standard MCI value were consider as female.

Fig 1: Dental Cast

Fig 2: Measurement of mesiodistal width of mandibular canine

Fig. 3: Measurement of mandibular intercanine distance

Results

Data obtained were quantified and analysed statistically using SPSS (Statistical Package for the Social Sciences). All description shown in table 1 to 7.Data were summarized as Mean and SD. Groups (in Gender Male vs female) were compared by unpaired or independent Student's t test.

Both right and left mesiodistal mandibular canine width (table 1) is higher in male (for right mesiodistal canine width 6.032±.5267 and for left mesiodistal canine width 6.0386±.6376) than female (for right mesiodistal canine width 5.7692±.4810 and for left mesiodistal canine width 5.767±.6075) and is statistically significant ((p value <0.05). Right mandibular canine index shows 4.5% sexual dimorphism (table 2)) which is moreless than sexual dimorphism shown by left mandibular canine index (4.7%).In our study mean mandibular intercanine distance is slightly higher for female than male(table 3).

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

Sex	Right mesiodistal canine width (in mm)			Left mesiodistal canine width(in mm)		
	Mean	Standard deviation	*p* value	Mean	Standard deviation	*p* value
Male	6.032	.526773	0.01063	6.0386	.637694	.031871
Female	5.7692	.481014		5.7674	.607571	

Table 2: Calculation of % Sexual dimorphism

Right mandibular canine	4.5 %
Left mandibular canine	4.7%

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

Sex	Mean Inter canine distance (IC) (in mm)	Standard deviation
Male	24.0616	1.996
Female	24.816	2.355

Observed right mandibular canine index is higher in male (.2513±.02413)than female(.2323±.02378) and is statistically highly significant (p value <0.001) whereas observed left mandibular canine index is also higher in male(.2513±.02576) than female(.2335±.02693) is statistically significant (p value <0.05) (table 4).Standard MCI value (table 5) of right side is calculated as .2415 while of left side is .2430. This standard MCI value is consider as cut off for predicting sex. For right mandibular canine, standard MCI value above than .2415 will be male and value below than .2415 will be female. For left mandibular canine, standard MCI value above than .2430 will be male and value below than .2430 will be female. Using right MCI, sex is correctly predicted higher in female (70%) than male (56%) while using left MCI the correctly predicted sex is also higher in female (64%) than in male (62%) (table 6, chart 1). Overall sex prediction (table 7, chart 2) in our study using MCI is higher in female (67%) than male (59%).

Table 4: Observed mandibular canine index among male and female

Sex	Right mandibular canine index (MCI)			Left mandibular canine index (MCI)		
	Mean	Standard deviation	p Value	Mean	Standard deviation	P Value
Male	.251308	.024137	.000148	.251376	.025765	.00103
Female	.232384	.02378		.233512	.026935	

Table 5: Calculation of standard mandibular canine index among male and female

Standard mandibular canine index (MCI)	
Right	Left
.241532	.243058

Table 6: Prediction of sex using Mandibular Canine Index

Sex	Prediction of sex using right MCI	Prediction of sex using left MCI
Male	28/50=56%	31/50=62%
Female	35/50=70%	32/50=64%

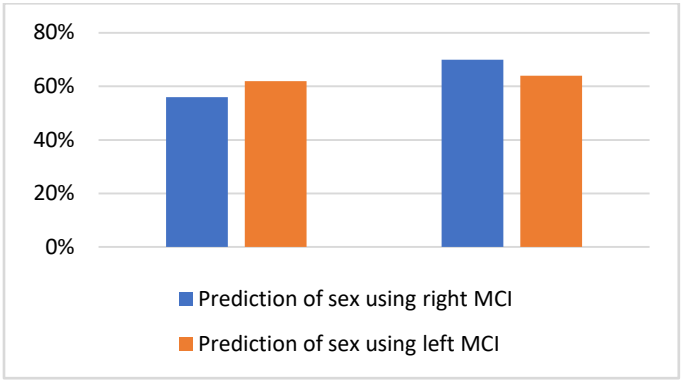

Chart 1: Prediction of sex using Mandibular Canine Index

Table 7: Overall accuracy of sex prediction using mandibular canine index

Sex	Mandibular canine index (MCI)	% Of sex prediction	Overall, correctly predicted sex (%)
Male	Right MCI	56%	59%
	Left MCI	62%	
Female	Right MCI	70%	67%
	Left MCI	64%	

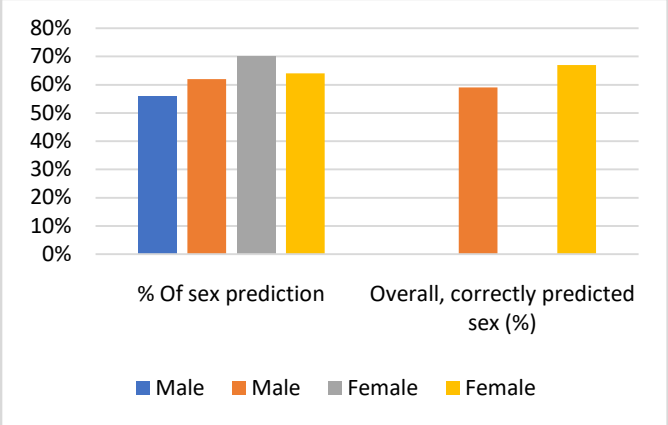

Chart 2: Percentage of sex prediction and overall accuracy of sex prediction using mandibular canine index

Discussion

Sex identification of an individual from skeletal remains is very reliable but its reliability is only when whole skeleton is available[19]. Sex estimation in decompose, skeleton remains or in mutilated bodies is important step of identification in forensic medicine[17]. In these situations, teeth can be used as an important forensic tool as they are decay resistant and can readily accessible[20].Mandibular canines are key teeth for estimation of sex since they are the last teeth to be erupted with respect to age, and less affected to dental caries or dental disease than other teeth and are comparatively better to sustain severe trauma[21].In our study sex estimation is perform by using mandibular canine index (MCI) among north Indian population. Using right MCI, sex is correctly predicted higher in female (70%) than male(56%) while using left MCI the correctly predicted sex is also higher in female (64%) than in male (62%). Overall sex prediction in our study using MCI is higher in female (67%) than male (59%) which is similar to study done by Rao et al[18], (85.7% female which is higher than male 84.3%),study of Yadav et al[22](72% in female which is higher than in male in their subject), Sonia et al (88.57% in female as compared to male 82.86%)[23]and study of Reddy et al[24]. Whereas study done by Al-Rifaiya et al[25]and Sunil et al[26]predicted the sex higher in male than female. Prediction of male sex was lower than present study,(59%) in the study of Hoshmani et al[27], Acharya et Al[28] in Indian population, Ahmad et al[29]in Iraqi population and Sunil et al in Nepali population[26].Similarly, the prediction of percentage of female in the study of Ahmad et al[28], Rao et al[18] and Hoshmani et al[27] was higher than our study (67%). In our study mesiodistal mandibular canine width both in right and left canine is found to higher in male than female and in both it foundto be statistically significant (p value <0.05) which is similar to the study done by Yadav et al[22]. The mean intercanine distance is found to be slightly higher in female than malein our study which is similar with finding of Kaddah[30] in adult Egyptians andVishwakarma and Guha[15] in the Indian population but it is opposite to many studies where value is higher in male than female.[25,26,27,28,29]These differences are proof of the fact that sexual dimorphism represented by canine tooth differ in different ethnicity socanine tooth sexual dimorphism varied among differentethnic groups[18].The finding of right MCI in present study is higher in male than female and is highly significant (p value <0.001) while left MCI, in present study is also higher in male than female and is significant (p value <0.05). Overall, in the present study MCI is higher in male than female which is similar to study done by Vishwakarma et al[14] and Rakhee R. Modak et al.[31]Our study showed that left mandibular canine (4.7%) has higher sexual dimorphism than right mandibular canine (4.5%) which is similar to study done by Maneel Grover et al.[32]

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. Mean MCI is greater in male than female in young north Indian population. Standard MCI value may consider as cut off value for determining gender i.e., value above standard MCI will be male and below it will be female.Overall sex prediction in our study using MCI is higher in female (67%) than male (59%).Our study showed that left mandibular canine (4.7%) has higher sexual dimorphism than right mandibular canine (4.5%).So, from study it can be concluded that mandibular canine index measurement is quick, reliable and easy method of gender identification.

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