Original Research Article

Mandibular canine index in gender determination: A viewpoint of a forensic odontologist

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Abstract

Introduction: Mandibular canines are considered as the "key teeth" for victim identification in the living as well as the dead in the field of forensic investigations and mandibular canines exhibit the greatest sexual dimorphism amongst all teeth in the human dentition.
Aim and objective: To determine the accuracy with which gender can be differentiated by using mandibular canine index.
Materials and methods: A descriptive cross-sectional study was conducted on 70 subjects (35 males and 35 females) in the Department of Oral Pathology, GDC & H, Srinagar. Mandibular canine index was determined intraorally in millimeters using sliding-anthropometric digital caliper.
Results: In the present study, significant difference observed between mandibular intercanine width, right and left canine width as well as right and left mandibular canine index between males and females. Sexual dimorphism was more on left permanent mandibular canine teeth than right permanent mandibular canine teeth. The overall percentage of accuracy observed was 85.71%.
Conclusion: Mandibular canine index is a simple, quick, inexpensive, and reliable method for gender determination of an individual.

Key words

Sexual dimorphism, Forensic dentistry, Victim identification, Mesiodistal width, Intercanine width.

Introduction

Sexual dimorphism is an important concern for the forensic anthropologists as it is a key to individual identification. Teeth are the hardest and most indestructible part of the body in both living as well as non-living populations for

anthropological, genetic, odontologic and forensic investigations [1]. Teeth also show least turnover of natural structure and identified even when rest of the body has undergone decomposition or mutilation; especially for identification on fragmentary adult skeleton [2]. The identification of sex is of prime significance in case of major disasters where bodies are often damaged beyond recognition [3, 4]. Sexual dimorphism refers to those differences in size, stature and appearance between male and female that can be applied to dental identification because no two mouths are alike. Teeth are readily accessible for examination and thus no two teeth have similar morphology, they form an excellent forensic tool for sex determination. Of all the teeth in the human dentition, canines are least exposed to plaque, calculus, abrasion from brushing, heavy occlusal loading and periodontal disease than other teeth. Canines are preferred as ideal teeth to study in view of their durability in the oral cavity [5]. Mandibular canines are considered as the "key teeth" for victim identification in the living as well as the dead in the field of forensic investigations and have the mean age of eruption of 10.87 years [6, 7]. Mandibular canines are found to exhibit the greatest sexual dimorphism amongst all teeth in the human dentition [6, 8]. The aim of the present study was to determine the accuracy with which gender can be differentiated by using mandibular canine index.

Materials and methods

A descriptive cross-sectional study was conducted on 70 subjects (35 males and 35 females) in the Department of Oral Pathology, GDC & H, Srinagar. Mandibular canine index was determined intraorally in millimeters using sliding-anthropometric digital caliper. Subjects with fully erupted, healthy non-worn out mandibular canine, well-aligned mandibular arch, healthy state of gingiva and periodontium, normal overjet and overbite, normal molar and canine relationship were included in this study. Signs of wasting diseases i.e. attrition, abrasion, erosion etc. on mandibular canine, mandibular canine affected by caries or fracture, crowding or spacing in the mandibular arch, developmental anomalies in relation to number, size, shape and structure of teeth, partially erupted and ectopically erupted teeth were excluded from the study. All the measurements were taken by one observer in millimeters (mm) on right and left side so as to avoid inter-observer bias. The greatest intraoral mesiodistal crown width of the mandibular right and left canines was measured between the contact points of the tooth, using sliding-anthropometric digital caliper as well as mandibular intercanine distance was also measured intraorally between the cusp tips of right and left canines. The formula used to determine canine index were:-

Mandibular canine index (MCI) = mesiodistal crown width of mandibular canine/intercanine distance.

The mean values for male MCI and female MCI were obtained. After this, the standard MCI value was calculated by applying the following formula:-

Standard mandibular canine index (MCIs) = (mean male MCI − standard deviation [SD]) + (mean female MCI + SD)/2.

Statistical analysis was done to determine the significance of findings observed between both the genders using statistical software (SPSS version 21.0). Mean, standard deviation and coefficient of variation were calculated. They were compared by using the test of significance i.e. independent t-test. A probability value (p) of $\leq$ 0.05 was considered to be statistically significant. Gender was determined on the basis of observed canine index and standard canine index. If the observed canine index was more than that of the standard canine index, then the individual was considered to be male and if the observed canine index was less than that of standard canine index, then the individual was considered to be female.

Results

The present study comprised of 35 males and 35 females. The average age of the patients were in the range of 18-25 years. The mean value of the mandibular intercanine width in males was 27.24 (3.03) mm with the coefficient of variation observed to be 0.56 whereas the mean value in females was 25.93 (1.49) with the coefficient of variation observed to be 0.06. The mean value was found to be higher in males as compared to females with a statistically significant p-value. The mean value of right and left mandibular canine width in males was 7.35 (2.26) mm and 7.42 (2.72) mm respectively with the coefficient of variation determine to be 0.16 and 0.19 respectively. The mean value of right and left mandibular canine width in females was 6.20 (0.69) mm and 6.32 (0.84) mm respectively. The p-value was found to be statistically significant. The mean value of mandibular canine width was greater in males than that in females and the mean values was found to be lesser on right side (**Table - 1**).

Table - 1: Gender wise distribution of mandibular intercanine width, right and left mandibular canine width.

Parameters	Gender	Mean ± SD	Coefficient of variation	T-test	P-value
Mandibular intercanine width (mm)	Males	27.24 ± 3.03	0.56	3.75	0.001
	Females	25.93 ± 1.49	0.06		
Right mandibular canine width (mm)	Males	7.35 ± 2.26	0.16	2.72	0.040
	Females	6.20 ± 0.69	0.00		
Left mandibular canine width (mm)	Males	7.42 ± 2.72	0.19	2.92	0.040
	Females	6.32 ± 0.84	0.00		

SD- Standard deviation

Table - 2: Gender wise distribution of left and right mandibular canine index.

Parameters	Gender	Mean ± SD	Coefficient of variation	T-test	P-value
Right mandibular canine index	Males	0.26 ± 1.79	0.16	2.62	0.040
	Females	0.25 ± 0.45	0.00		
Left mandibular canine index	Males	0.26 ± 2.06	0.19	2.65	0.040
	Females	0.25 ± 0.48	0.00		

In males, the mandibular canine index (MCI) on the right side was found to be 0.26 (1.79) with a coefficient of variation of 0.16 whereas on the left side it was found to be 0.26 (2.06) with a coefficient of variation of 0.45. In females, the MCI on the right side was found to be 0.25 (0.45) whereas on the left side it was found to be 0.25 (0.48). The mandibular canine index was found to higher in males than in females on both left and right sides (**Table - 2**).

In the present study, the calculated standard MCI for both males and females were found to be 0.256. The percentage of accuracy obtained on both right and left sides were 82.86 % in males and 88.57% in females. The overall percentage of accuracy was 85.71% (**Table - 3**).

Table - 3: Percentage of gender predictability using mandibular canine index.

Gender	Total (percentage)
Males	29/35 (82.86%)
Females	31/35 (88.57%)
Overall	60/70 (85.71%)

Discussion

Gender determination in damaged and mutilated dead bodies or from skeletal remains establishes the prime step for identification in medico-legal examination and bioarcheology [9]. Studies of sexual dimorphism provide evidence about the evolution of a population and for that matter, an individual too [10]. A study carried out by Garn, et al. at Fels Institute had correlated sexual dimorphism in canines with variety of variables such as stature, weight, subcutaneous fat thickness, bone age, menarche in girls and the time of epiphyseal union. These correlations proposed that direct influence of steroidal hormones on tooth development and maturation. They determined that tooth eruption has accelerated in early maturing girls; indicating that the steroid hormones of gonadal and adrenal origin may be involved in the relationship between sexual maturation and dental development [11].

The mandibular permanent canines have been considered as a key teeth for the purpose of personal identifications as they are lesser exposed to the periodontal disease, abrasion, or heavy occlusal loading; hence, one of the last teeth to be extracted with respect to age. Furthermore, the mandible canines can be readily accessible as the mandible is the strongest bone in the human body and persists in a well-preserved state longer than any other bone [12, 13]. The present study was carried out to determine the accuracy with which gender can be differentiated by using mandibular canine index. In the current study, the mean value of mandibular canine width was greater in males than that in females and the mean values was found to be lesser on right side. There was a significant difference observed between the right and left mandibular canine width of males and females. These results were in accordance with the previous studies carried out by Kaushal, et al. and Reddy, et al. [2, 14]. The difference in width of canine between male and female teeth has been elucidated as part of the genetic expression of the male being larger than the female. It is the Y chromosome that intervene mostly in the size of teeth by controlling the thickness of dentin, whereas the X chromosome responsible for the thickness of enamel. The sexual dimorphism in mandibular canines can be predictable on the basis of functional activity due to evolution and socialization [15].

In the present study, the mean value of intercanine mandibular width was found to be higher in males as compared to females and there was a significant difference between the intercanine mandibular width of males and females. These finding were similar to the studies done by Kaushal, et al. and Patnaik, et al. [2, 16]. In this study, the mandibular canine index was found to be significantly higher in males than in females on both left and right sides and these results were in accordance with the studies carried out by Kaushal, et al. and Patnaik, et al. [2, 16]. In the present study, the percentage of accuracy obtained by comparing observed mandibular canine index with standard mandibular canine index using both right and left sides was 82.86% in males and 88.57% in females. The overall percentage of accuracy was 85.71%. These finding was close to the percentage of accuracy attained by Nair, et al. and Singh, et al. [17, 18].

Conclusion

In the present study, significant results were obtained on comparison of right and left mandibular canine indices in males and females and thus mandibular canine index can be used as a tool for gender determination of an individual. These findings postulate that the dimorphism in mandibular canines can be of great importance in medicolegal cases. Hence, ozonometric parameters being simple, inexpensive, easy to measure and can be used for determining gender in forensic practice in living, dead, decomposed, and unidentified bodies.

References

1. Whittaker DA. An introduction to forensic dentistry. Quintessence International, 1994; 25: 723-730.

2. Kaushal, S, Patnaik VVG, Agnihotri G. Mandibular canines in sex determination. J Anat Soc India, 2003; 52: 119-124.
3. Kapila R, Nagesh KS, R Iyengar A, Mehkri S. Sexual dimorphism in human mandibular canines: A radiomorphometric study in South Indian population. J Dent Res Dent Clin Dent Prospects, 2011; 5: 51-54.
4. Muller M, Lupi-Pegurier L, Quatrehomme G, Bolla M. Odontometrical method useful in determining gender and dental alignment. Forensic Sci Int., 2001; 121: 194-197.
5. Boaz K, Gupta C. Dimorphism in human maxillary and mandibular canines in establishment of gender. J Forensic Dent Sci., 2009; 1: 42-44.
6. Kaushal S, Patnaik VV, Sood V, Agnihotri G. Sex determination in North Indians using mandibular canine index. J Indian Acad Forensic Med., 2004; 26: 45-49.
7. Padmavati K, Farah VM, Syed AA, Ather SA. Mandibular canine index: A tool for sex determination. J Indian Dent Assoc., 2011; 5: 18.
8. Garn SM, Lewis AB, Swindler DR, Kerewsky RS. Genetic control of sexual dimorphism in tooth size. J Dent Res., 1967; 46: 963-972.
9. Dahberg AA. Dental traits as identification tools. Dent Prog., 1963; 3: 155–160.
10. Camps FE. Gradwohl's legal medicine. In: Identification by the skeletal structures. 3rd edition, Bristol: JohnWright and Sons; 1976, p. 110.
11. Garn SM, Lewis AB, Kerewsky RS. Sex difference in tooth size. J Dent Res., 1964; 43: 306.
12. Chandra A, Singh A, Badni M, Jaiswal R, Agnihotri A. Determination of sex by radiographic analysis of mental foramen in North Indian population. J Forensic Dent Sci., 2013; 5: 52–55.
13. Shaliputra M, Wanjari P. Dimorphism of mandibular canine index in establishing in sex identity. J Indian Acad Oral Med Radiol., 2011; 23: 195–198.
14. Reddy VM, Saxena S, Bansal P. Mandibular canine index as a sex determinant: A study on the population of western Uttar Pradesh. JOMFP, 2008; 12: 56-59.
15. Narang RS, Manchanda AS, Malhotra R, Bhatia HS. Sex determination by mandibular canine index and molar odontometrics: A comparative study. Indian J Oral Sci., 2014; 5: 16-20.
16. Patnaik VV, Kaushal S, Sood V, Agnihotri G. Sex determination in North Indians using mandibular canine index. JIAFM, 2004; 26: 45-49.
17. Nair P, Rao BB, Annigeri RG. A study of tooth size, symmetry and sexual dimorphism. J Forensic Med Toxicol., 1999; 16: 10-13.
18. Singh SK, Gupta A, Padmavathi B, Kumar S, Roy S, Kumar A. Mandibular canine index: A reliable predictor for gender identification using study cast in Indian population. Indian J Dent Res, 2015; 26: 396-399.