ORIGINAL RESEARCH

An Odontologist's Key to Sex Determination: Study Analysis of Mandibular Canine Teeth in South Indian Population

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ABSTRACT

Sex determination of a person becomes the first priority of a forensic investigator in the process of identification. Dental evidence pours in an invaluable informative data toward achieving the final positive results in establishing the unknown's identity. Studies have shown that the mandibular canine resist disease, survive extreme postmortem environmental conditions and presents the highest sexual dimorphism amongst all teeth, making them an ideal teeth in forensic identification procedures. The aim of present study was to know the use of the mandibular Canine teeth's morphological measurements in assessing sex in South Karnataka population. In the sample size of 80 males and females (40 males and 40 females) in the age-group 18 to 22 years, mandibular canine width and intercanine distance measurements were noted intraorally. The MCI and sexual dimorphism was calculated.

Keywords: Sexual dimorphism, Intercanine distance, Mandibular canine index.

How to cite this article: Grover M, Bai RG, Ram T, Puri PM, Ghodke KR. An Odontologist's Key to Sex Determination: Study Analysis of Mandibular Canine Teeth in South Indian Population. J Orofac Res 2013;3(3):157-160.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

One's identity is what one has earned all through his or her lifetimes. What if it is just lost in cases of sudden unexpected death? In events like air, rail and road mishaps, chemical, nuclear bomb explosions, hurricanes or any other disastrous conditions, the bodies are usually destroyed beyond identification. In such situations when only the skeletal remains are found, the first priority of the forensic investigators is to establish the remains identity.

However, the methods that could be employed reduces to only anthropological or odontological analysis in such cases where the remains are completely skeletonized or in highly decomposed or purification stage where even the ability to perform an autopsy or collect fingerprints seems very difficult or inappropriate.

The durability of the dentition to survive extreme conditions of fire and bacterial decomposition makes them invaluable for identification.[1]

Typically, sex has to be determined first. The most reliable diagnostic features are the innominate bones of an adult. Depending upon the completeness of a sample, sex may be determined from the cranium, long bone dimensions, pelvic structures, etc. using postmortem radiographs and the accuracy of sex differentiation by using such methods ranges from 96 to 100%.[2,3] But in more severe cases of devastations and body fragmentation or decomposition, dental identification means are the most commonly used biometric methods of human identification. In such circumstances, dental identification becomes rather most dependable and reliable means of identification as the tooth enamel being the hardest substance in the human body, can withstand drastic atmospheric conditions like very high temperatures and humidity, prolonged immersion, desiccation, extensive trauma as well as advanced stage of decomposition. And moreover many people would have been to a dentist and may have antemortem data for comparison.

So, the first step of a trained forensic odontologist is to identify the sex from whatever human dental remains are present as a specimen. If available, the mandibular canine simplifies the investigators job to great extent in gender identification. As, among the teeth, canines have consistently shown the greatest sexual dimorphism[4] and also canines are least frequently extracted teeth being less affected by periodontal disease. Canines are also better likely to survive severe traumatic circumstances. These teeth have been reportedly recovered from the human remains even in extreme conditions as air disasters, hurricanes.[5] It is their resilience in case of fire and bacterial decomposition that makes them important for identification in forensic science.[1] These findings indicate that mandibular canines can be considered as the 'key teeth' for personal identification.[6]

The present study establishes the impact of the 'sex factor' on the morphometry of the mandibular canines. The results indicate that the dimorphism in mandibular canines can be of immense medicolegal use in identification. The study defines the morphometric criteria for mandibular canines in South Karnataka population. This is of definite significance, as tooth morphology is known to be influenced by cultural, environmental and racial factors.[7]

MATERIALS AND METHODS

After obtaining the participation consent of the subjects, the crossectional perspective study was conducted on 80 South Karnataka individuals (40 males and 40 females).

The sample also included undergraduate students of JSS University, Mysore along with other population. The age range between 18 and 22 years was selected as the attrition is minimal.[8] This ensured that the odontometric data obtained was of high value.

Inclusion Criteria

- Healthy state of gingiva and periodontium
- Caries free teeth
- Normal overjet and overbite
- Absence of spacing in the anterior teeth
- Normal molar and canine relationship.

Also, the significant exclusion criteria employed for selection of the study sample were malalignment, malrotation, malocclusion, spacing, missing incisor, dental restoration, dental wiring and prosthetics and attrition. Persons suffering from chronic systemic diseases were also excluded.

Following measurements were taken intraorally in clean and well-illuminated room, keeping all the aseptic precautions, using digital vernier callipers with resolution of 0.02 mm.

1. The mandibular canine width was taken as the greatest mesiodistal width between the contact points of the teeth on either side of the lower jaw. Measurements were taken with the calliper beaks placed occlusally (Fig. 1).
2. The intercanine distance was measured as the linear distance between the tips of right and left mandibular canine in the lower jaw (Fig. 2).

Each parameter was measured two times separately by two investigators and the average value was calculated, to identify any intra- and interobserver variability of these techniques.

The observed mandibular canine width and intercanine width were recorded on an Excel spread sheet and subjected to statistical analysis to assess sex dimorphism.

Fig. 1: Recording of mandibular canine width

Fig. 2: Recording of intercanine width

The mandibular canine index (MCI) was calculated based formula given below:[8-10]

$$MCI = \frac{\text{Mesiodistal width of mandibular canine}}{\text{Intercanine distance}}$$

Sexual dimorphism: Sexual dimorphism in right and left mandibular canines were calculated using formula given by Garn and Lens (1967) as follows:[11]

$$\text{Sexual dimorphism} = [\ Xm/Xf\ ] - 1 \times 100$$

where: X = Mean value for males; X = Mean value for females.

RESULTS

Results are depicted in following tables (Tables 1 to 4).

Table 1: Mean mandibular canine widths [MCW] with standard deviation [SD]

Sex	*No.of students/ sample*	*Mean RMCW (in mm)*	*SD of RMCW (in mm)*	*Mean LMCW (in mm)*	*SD of LMCW (in mm)*
Male	40	7.18	±0.355	7.02	±0.337
Female	40	6.52	±0.538	6.72	±0.502

Table 2: Mandibular canine arch width

Sex	*Sample*	*Mean intercanine distance*	*SD*
Male	40	30.78	±1.243
Female	40	29.41	±1.398

Table 3: Mandibular canine Index

Sex	*Sample*	*Mean mandibular canine index (in mm)*
Male	40	Right 0.25 ± 0.025 Left 0.23 ± 0.021
Female	40	Right 0.22 ± 0.031 Left 0.21 ± 0.028

Table 4: Sexual dimorphism		
Measurements	*Side*	*Sexual dimorphism*
Mesiodistal canine width	Right Left	10.11% 4.44%
Mandibular canine index	Right Left	9.43% 11.81%
Mandibular canine arch width		4.65%

DISCUSSION

Lund and Mornstad studied 58 dental casts of Swedish subjects and found the canines to be most dimorphic of all the teeth.[12] Lysell and Myrberg in an extensive study of more than 1000 subjects concluded that the mandibular canine demonstrated the greatest sexual dimorphism (5.7%) among all teeth.[13] Hashim and Murshid conducted a study on pretreatment orthodontic casts of 720 Saudi male and female subjects in the age group of 13 to 20 years and found that the mandibular canines were only teeth to exhibit sexual dimorphism.[14] Hence, the present study was conducted on mandibular canines to find out sexual dimorphism.

Kaushal et al in their study on 60 north Indian subjects, found left mandibular canine (9.796% in casts and 8.891% intraoral) to be more dimorphic than the right mandibular canine (7.96% in casts and 7.954% intraoral).[4] They also concluded that in case of mandibular canine width more than 7 mm, the probability of that person being male is 100%.[4] Nair et al concluded that the left mandibular canine revealed maximum sexual dimorphism (7.7%) followed by the right mandibular canine (6.2%).[15] However in the present study, the right mandibular canine (10.11%) was found to be more dimorphic than left mandibular canine (4.44%). The mandibular intercanine arch width was found to show significant sexual dimorphism (4.65%). In present study, right and left mandibular canine indices were also found to be different in males and females. This is in conformity with the findings observed by Kaushal et al.[4] Acharya and Mainali obtained similar results in their study of 63 males and 54 females of 19 to 28 years age group in Nepal.[16]

CONCLUSION

The distinguishable characteristic features present in canine tooth forms a valuable informative tool for the forensic investigators. This could be traced back to its evolutionary history as it was the only tooth recognized as a fossil material in evolution of human species. Eimerl and Devore (1967) postulated that in evolution of primates there was a transfer of aggressive function from canines in apes to the fingers in man and that until this transfer was complete; survival was dependent on the canines, especially those of the males. Canines differ from other teeth with respect to survival and sex dichotomy.[17]

Determination of sex by this method is a relatively quick, easy and an inexpensive one, owing to its high utility in identifying subjects from fragmented jaws and dental remains.

Thus, in the present day humans, sexual dimorphism in mandibular canines is not merely a coincidence but can be expected to be based on functional activity.[18]

This remarkable capability of canine teeth toward determining individual's sex is because of the influence of the Y chromosomes, which do not exhibit uniform influence on all teeth and controls the thickness of the dentin, whereas the X chromosome on the other hand plays a role in the thickness of enamel and is relatively uniform.[19]

The role of forensic odontologist in identifying an unidentified deceased is gaining importance gradually. The roles and responsibilities of a Trained Forensic Odontologist are quite defined and sought after in developed countries, however, the utilization of their expertize, in India, is supposedly taking some more time. In such circumstances the method of sex determination from canine teeth eases many difficulties for the investigating forensic experts, as it is quite simple to perform, less time consuming apart from being quite economical and reasonably accurate. Application of Moire's topography[20] requires availability of sophisticated equipments and in Fourier's analysis[21] complex mathematical equations needs to be solved, thus the dependability on this simple and less complicated method of sex differentiation from canine teeth maintains significant importance in the field of forensic investigations.

From the present study, it can be concluded that mesiodistal width of mandibular canine teeth is greater in male than female in age group 18 to 24 years which is statistically significant. Mandibular canine arch width is also greater in male than female which is statistically significant. Mesiodistal width of mandibular canine teeth shows maximum sexual dimorphism among all measurements.

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