Odontometric study analysis of mandibular canine teeth to establish sexual dimorphism in North Indian population

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Citation: Gover M, Balamurugan A, Bhavya T, Poturaju V, Puri PM.Odontometric study analysis of mandibular canine teeth to establish sexual dimorphism in North Indian population. *Int J Eth Trauma Victimology 2015*; 1(2):9-13.doi: 10.18099/ijetv.v1i2.6812

Article history

Received: May 25, 2015
Received in revised form: September 11, 2015
Accepted: Oct 23, 2014
Available online: December7, 2015

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Abstract

Knowledge of sex of a person becomes the first priority of a forensic investigator in the process of identification. Dental evidence pours in an invaluable informative data towards achieving the final positive results in establishing the unknown's identity. Studies have shown that the mandibular canine resist disease, survive extreme post-mortem 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 Index (MCI) in assessing sex in North Indian population. In a sample size of 80 males and females (40 male and 40 female) in the age group 21-24years, mandibular canine width and Inter canine distance measurements were noted intra-orally and the MCI was calculated and compared with stranded MCI values.

Keywords: Sexual dimorphism, intercanine distance, canine width, mandibular canine index.

Introduction

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

The crime scene investigators and researchers have been employing various methods to achieve this goal. However, in anthropological or odontological analysis ofcases where the remains are completely skeletonized or in highly decomposed or putrefied state,and moreover even the ability to perform an autopsy or collect fingerprints seems very difficult or inappropriate, methods are limited.

The durability of the dentition to survive such 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 in nominate 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 post-mortem radiographs and the accuracy of sex differentiation by using such methods ranges from 96-100% (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 ante mortem 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). The Canines are least frequently extracted teeth which are 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 and 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 theMandibular canines. The results indicate that the dimorphism in mandibular canines can be of immense medico legal use in identification. The study defines the morphometric criteria for mandibular canines in North Indian population. This is of definite significance, as tooth morphology is known to be influenced by cultural, environmental and racial factors (7). Many other studies on different groups of population have indicated the sexual dimorphism of mandibular canine.

Material and Methods

After obtaining the participation consent of the subjects, the cross sectional perspective study was conducted on 80 North Indian individuals (40 males and 40 females). The sample also included undergraduate students of Gujarat Forensic Science University, IFS, Gandhinagar along with other population. The age range between 18 and 21 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.

The significant exclusion criteria employed for selection of the study sample included malalignment, mal-rotation, mal-occlusion, spacing, missing incisor, dental restoration, dental wiring and prosthetics, and attrition. Persons suffering from chronic systemic diseases were also excluded.

Following measurements were taken intra-orally in clean and well-illuminated room, keeping all the aseptic precautions, using digital Vernier calipers with resolution of 0.02 mm.

Fig. 1: Recording of inter canine width

1. **The mandibular canine width:** was taken as the greatest mesio-distal width between the contact points of the teeth on either side of the lower jaw. Measurements were taken with the calliper beaks placed occlusally (see fig 1).
2. **The inter-canine distance:** was measured as the linear distance between the tips of right and left mandibular canine in the lower jaw. (See Fig 2.)

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

Fig. 2: Recording of mandibular canine width

The observed mandibular canine width and intercanine width were recorded on an excel spread sheet and subjected to statistical analysis to assess sex difference using student's "t-test".

The observed mandibular Canine Index (MCI): was calculated based formula given below: (8),(9),(10).

Observed MCI=
Mesio Distal width of mandibular canine
Mandibular Canine width

The standard MCI value is used as a cut-off point to differentiate males from females, which is obtained from the measurements taken from the samples by applying the formula given below:

Standard mandibular canine index =
(Mean male MCI - SD) +(Mean femaleM CI+SD)
2

The observed MCI was compared with the standard MCI value obtained in this study and correlated with previous studies like Ready VM1, Rao et al, Muller et al and Hashim and Murshad(11).

Results
The results of the present study are depicted in following tables. (Table1-4)

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

Sex	No of students/samples	Mean RMCW (in mm)	SD of RMCW (in mm)	Mean LMCW (in mm)	SD of LMCW (in mm)
Male	40	6.8245	±0.291	6.81	±0.277
Female	40	6.42775	±0.402	6.44925	±0.499

Table 2: Mandibular canine arch width

Sex	No of students/samples	Mean intercanine distance	SD
Male	40	32.26	±1.465
Female	40	30.27125	±1.897

Table 3: Mandibular canine Index

Sex	No of students/samples	Mean mandibular canine index (in mm)
Male	40	Right 0.1935 Left 0.2110
Female	40	Right 0.212336 Left 0.213048

Table 4: Sexual dimorphism

Measurements	side	Sexual dimorphism
Mesiodistal canine width	Right Left	6.172% 5.5931%
Mandibular canine index	Right Left	8.870% 0.938%
Mandibular canine arch width		6.570%

Discussion

The distinguishable morphological features present in canine tooth makes it 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 (12).

The result of this study again emphasized on the already established fact about the great potentiality of mandibular canine and intercanine distance as dimorphic tool in forensic investigations. The mandibular canine and intercanine distance were significantly higher in males than in females for the selected population group.

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 (13).

Kaushal *et al* found significant dimorphism in the mandibular canine from their statistical study on 60 North Indian Subjects. As per them, the mandibular canine exhibited more than(8.8%)sexual dimorphism as compared to the mandibular left canine(7.9%).They also concluded that in case of mandibular canine width more than 7 mm,the probability of that person being male is 100%(4).Similarly, Nair *et al*, Garn & Lewis and Lysell&Myberbin their separate studies on different samples concluded that the mandibular canine demonstrates maximum sexual dimorphism(14),(15),(16).

This remarkable capability of Canine teeth towards 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 (15).

It must be however noted here that, the method of sex determination via canine measurement has its limitations also; the sex of the subject to whom the fragment of the mandible belongs can be determined satisfactorily only when the fragment is found in the geographical area where the subject was born.It is of not much use in cases where the

proper identification of '*that*' fragment is not established.

The results obtained from the present study give a definitive indication of sexual dimorphism characteristics of the mandibular Canine teeth in Gujarati Population of the selected age group. Proper handling of the dental evidence and implementation of these studies can give near to accurate results thus contributing a lot towards establishing the identity of the unidentified.

Conclusion

The role of forensic odontologist in identifying an unidentified deceased is gradually gaining importance. The roles and responsibilities of a trained forensic odontologist are quite defined and sought after in developed countries, however, the utilization of their expertise, in India, is supposedly taking some more time. Moreover, our country needs to focus on addition of specialized training curriculums for the interested dentists towards further improvement and upgradation of the upcoming sector of forensic odontology. 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 (17) requires availability of sophisticated equipment's and in Fourier's analysis (18) complex mathematical equations needs to be solved, thus the dependenceon this simple and less complicated method of sex differentiation from Canine teeth maintains significant importance in the field of Forensic Investigations.

Conflict of interest

None

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