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Research article

Gender Differentiation using Inter-Canine Distances among South Indians

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Abstract:
Teeth play an important role in the field of forensic investigations. Their ability to survive in mass disasters makes them an important tool in identification of the victim. Though the morphology and structure is similar in both males and females, there are subtle differences. Variation in dental size can give a clue about differences between the sexes. Many authors have measured the width of teeth in both males and females and found certain variations. Canines, reported to survive in air crash and hurricane disasters, are perhaps the most stable teeth in the oral cavity because of the labiolingual thickness of crown and the root anchorage in the alveolar process of the jaws. Not only the Mesio-distal width of canines but also the intercanine distances help in identifying the gender as a part of identification. Measurement of inter-caninedistances of the mandible and maxilla provides good evidence of sex identification due to dimorphism.

Key words: Identification; Inter-canine distance; Mandibular; Sexual Dimorphism.

Article citation:-

INTRODUCTION

Assessment of sex differences from human remains will be of immense help to the investigating officer as it would narrow down his field of search to 50%. The skeletal components most often investigated for gender determination are the pelvis, skull and long bones. Sometimes the diagnostic procedure may be extremely complicated as these bones are invariably fragmented or destroyed in mass disasters like train accidents, hurricanes, earthquakes and fire accidents. In such cases teeth being the hardest and chemically, the most stable tissue (most resistant to decomposition) in the body, which gets selectively preserved and fossilized, are of great help. Their durability in the
face of fire, trauma and bacterial decomposition makes them invaluable for identification.\textsuperscript{2}

Identification of humans using the unique features of teeth and jaws has been used since Roman times, because humans show dimorphism in jaw and teeth dimensions.\textsuperscript{3} “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 oral cavities are alike.\textsuperscript{4} Variation in dental size gives clue not only about the dietary habits of a population but also differences between the sexes.\textsuperscript{5} Whenever the jaws with the teeth, fragmented jaws with teeth or teeth alone are available at the crime scene or accident, then sex determination can be made using teeth. This identification of gender using odontometric techniques is of real interest in case of major catastrophes when bodies are often damaged beyond recognition.\textsuperscript{6}

Many authors have done the measurements of crown in teeth of both males and females and found certain variations. Boshert & Marks\textsuperscript{7} stated that the study of the permanent mandibular and maxillary canine teeth offers certain advantages. These advantages emanate from the fact that they are the teeth least used in the oral cavity, less affected by periodontal disease and least frequently extracted with respect to age.\textsuperscript{8} The canines are commonly referred to as the “Cornerstone” of the dental arches as four canines are placed at the “corners” of the oral cavity. The shape of the crowns, with their single pointed cusps, their locations in the mouth and the extra anchorage furnished by the long strongly developed roots make these canines resemble those of the carnivore. This resemblance to the prehensile teeth of the carnivore gives rise to the term ‘canine’.

Canines are perhaps the most stable teeth in the oral cavity because of the labiolingual thickness of crown and the root anchorage in the alveolar process of the jaws. The crown portions of the canines are shaped in such a manner that promotes cleanliness. This self-cleansing quality and efficient anchorage in the jaws tend to preserve these teeth throughout life.\textsuperscript{9} These findings indicate that canines can be considered as the ‘key teeth’ for personal identification.\textsuperscript{4} Measurement of mesiodistal width of the mandibular canines and inter-canine distance of mandible, provides good evidence of sex identification due to dimorphism.\textsuperscript{8} The present study establishes the impact of the mandibular and maxillary teeth in medicolegal identification. The study identifies the gender differentiation of intercanine distances in mandible and maxilla in the Karnataka population in India.

MATERIALS AND METHODS

Materials for the present study consisted of 500 students from Manipal and Udupi comprising of 250 males and 250 females in the age group of 15-25 years belonging to various parts of Karnataka. This age group was selected as all the canines would have erupted by this age and attrition is expected to be minimal\textsuperscript{10} and the intercanine distance do not increase after 12 years of age.\textsuperscript{11} Methods for the study consisted of measuring the mandibular canine widths and inter-canine distance of mandible in these students.

Subjects with bad oral hygiene, with abnormal over jet & overbite, having spacing or crowding in the anterior teeth, with missing anterior teeth, with attrition of canines or caries canines and with previous orthodontic treatment were excluded from the study.

After selecting the subjects randomly, the aims and objectives of the study were explained to them and written informed consent was obtained in the prescribed form. The measurements were taken intra orally either side of the jaw using digital calipers with a resolution of 0.01 millimeters with the provision to fix it in position to the desired position so as to avoid any errors in recording the exact measurements of inter-canine canine distance The following measurements were taken in the subjects with the oral cavity wide open.

- Intercanine Distances of the mandible and maxilla: (Fig. 1 and 2)

![Figure 1 Direct measurement of Intercanine Distance of the mandible.](image-url)
The intercanine distance was measured using digital caliper by placing the two pointed ends of its jaws over the canine tip and the values were noted (Direct method). The intercanine distance was also measured using coloured drawing sheets (Indirect method). The subject was asked to open his/her mouth wide. The coloured drawing sheet was placed between the acrylic sheet and black carbon paper and positioned in the oral cavity as shown in the figure (Fig. 3). Then the subject was asked to bite these sheets firmly and the impressions of the incisal surfaces of the teeth were obtained on the drawing sheet. Using the digital caliper, the inter canine distance markings on the drawing sheet, corresponding to the canine teeth were measured, and values noted, as shown in the figure (Fig. 4). Yellow and pink coloured drawing sheets were used to take the impressions of the maxillary and mandibular teeth respectively. In case of non-pointed impression of canine, the midpoint of the impression was considered for inter canine distance.

The data obtained were quantified and analyzed statistically using SPSS (Statistical Package for the Social Sciences, Version 11.5) to determine the significance of differences between the sex. This was done through the use of various descriptive statistics (mean, standard deviation, frequencies and measurement of agreement) and comparison of group means. In order to test repeatability of measurements, three authors recorded the intercanine distances independently at different times. The intra and inter-observer variations between the three series of measurements were assessed by using an Intra-class Correlation Coefficient (ICC) and a paired t-test. \( P < 0.05 \) was considered as significant. The reliability of measurements between direct and indirect methods was also assessed statistically using Pearson Correlation which was significant at 0.01 level (2-tailed).

RESULTS
The intercanine distances were determined intraorally in men and women using both the methods. It was observed that the mean value of the intercanine distance for mandibular canines was 25.25 ±1.22 among males and 24.75 ±1.08 among females when the direct method was used as shown in Table 1. This value was statistically significant (\( P \), 0.001). When these values were compared with the values measured by indirect method, statistically there was no significant change. Similarly the mean value for maxillary intercanine distances for male and females were
34.17 ±1.68 and 33.47 ±1.32 by direct method as shown in Table 2. These values were also statistically significant (P, 0.001).

The genderwise distribution of values of intercanine distances of mandible and maxilla are shown in Figure 5 and Figure 6 respectively.

![Figure 5 Genderwise distribution of Mandibular Intercanine distances](image1)

![Figure 6 Genderwise distribution of MaxillaryIntercanine distances](image2)

### Table 1: Gender wise distribution of Inter-canine Distance (ICDm) of Mandible

<table>
<thead>
<tr>
<th>ICDm (mm)</th>
<th>Range</th>
<th>Mean</th>
<th>±S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males (n=250)</td>
<td>21.26 - 27.78</td>
<td>25.25</td>
<td>1.22</td>
</tr>
<tr>
<td>Females (n=250)</td>
<td>21.49 - 27.90</td>
<td>24.75</td>
<td>1.08</td>
</tr>
</tbody>
</table>
DISCUSSION
Identification through uncharacteristic features is the basis of individuality of a person. Numerous methods of identification are in use, and most of these methods have their own merits and limitations. As teeth are the most durable human remains, they should be frequently incorporated in forensic practice. Tooth can help to estimate age, determine sex and race of a person even in decomposed and burnt bodies. Studies of sexual dimorphism provide information about the evolution and dietary habits of a population and for that matter, an individual too. In this study an attempt has been made to establish the sex of a person by using the respective Intercanine Distances in the Karnataka population. Our study revealed a greater mean Mandibular Intercanine Distance for males (25.25 ± 1.22 mm) when compared for females (24.75 ± 1.08 mm) with a statistically significant p value of <0.001. Our observations were comparable with the studies done by Kaushal S. et al., on North Indians (Male: 25.87 ± 1.25& Female: 25.07 ± 1.19), Anderson & Thomson on Canadians (Male: 26.08 ± 1.99 & Female: 25.53 ± 1.69), Al-Rifaïy MQ et al., on Saudi Arabians (Males: 27.01 & Females: 26.46), Yogitha et al., on Indians (Males: 27.98 & Females: 26.86), Sherifudhin et al., on Saudi Arabians (Males: 27.30 & Females: 26.11), Muller et al., on French population (Males: 26.28 & Females: 25.03), Aggarwal B et al., on Indians (Males: 26.003 & Females: 25.001), Yadav S et al, (Male: 27.27 ± 1.48 &Female: 25.42 ± 1.46) and Hashim HA & Al-Ghamdi SAF et al. study on Saudi Arabians (Males: 25.96 ± 2.44& Females: 24.92 ± 2.61). But the study done by Olav18 on Norwegian population showed the comparatively low values for both the gender (males: 19.06 and females: 18.24). The studies conducted by various authors and our study revealed the mandibular intercanine distance to be greater in males when compared to females. Similarly, the mean Maxillary Intercanine Distance was greater for males (34.18 ± 1.68 mm) when compared to females (33.47 ± 1.32 mm) with a statistically significant p value of <0.001. The values obtained in our study were similar to studies done on Saudi populations by Al-Rifaïy MQ et al., (males: 34.76 ± 2.86& females: 26.46 ± 2.78) and Hashim HA & Al-Ghamdi SAF et al. (Males: 33.90 ± 2.29 & Females: 32.58 ± 2.58).

CONCLUSION
The intercanine distance of the mandibular canines was found to be more in the males than the females in all the populations mentioned above and the difference was statistically significant. It can thus be concluded that the sexual dimorphism in mandibular canines and maxillary canines is evident in its inter canine distance.

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Competing interest / Conflict of interest
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