Original article

IMPORTANCE OF MAXILLARY AND MANDIBULAR INTERCANINE DISTANCE IN SEX DETERMINATION IN MAHARASHTRA POPULATION
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IMPORTANCE OF MAXILLARY AND MANDIBULAR INTERCANINE DISTANCE IN SEX DETERMINATION IN MAHARASHTRA POPULATION
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Abstract
Gender determination of skeletal remains is a part of many medico-legal as well as anthropological examinations. Many anatomical structures have been studied, but the teeth and their measurements seem to be the most reliable method since teeth represent the most durable and resilient part of the skeleton. The present study was aimed at investigating the accuracy of a method with which gender can be differentiated by the intercanine distance of maxillary and mandibular arch in a sample of adult Indian population. The study was carried out at department of Orthodontics and Dentofacial Orthopedics, Rural Dental College, Loni, India on students and patients reporting at OPD. The study was conducted on 70 subjects (35 males, 35 females) of 17 to 25 years age group. Impressions of the upper arch were made using alginate and casts poured in dental stone. Maxillary and Mandibular inter-canine width were measured with vernier calipers. From these measurements the percentage of sexual dimorphism was calculated. The data were subjected to statistical analysis using students unpaired ‘t’ test and results were analyzed. It was observed that there was sexual dimorphism in the intercanine distance of maxillary (3.82%) and mandibular (3.10%) arch. It is inferred that the technique employing intercanine distance of maxillary and mandibular arch can provide predictive equations useful for gender determination in a sample of Maharashtrian adult individuals.

Keywords: Sexual dimorphism, intercanine distance, canine

Introduction
The methods of gender determination of skeletal remains vary and depend on the available bones and their condition. The only method that can give a totally accurate result is the DNA technique, which is not feasible in many cases and cannot be readily used. This might be due to the expensive, time consuming, laborious technique of DNA isolation. Also the need for qualified experts in DNA identification highlights the need for alternative simple, rapid and reliable methods for gender determination.

DNA concentration of teeth extract was found to decrease after storage of teeth in soil, this decrease exceeded 90% after being kept for 6 weeks in soil. Teeth are known to be unique organs made of the most enduring mineralized tissues in the human body.

As such, teeth are extraordinarily resistant to putrefaction and the effect of external agents (physical, thermal, mechanical, chemical or biological) which makes them invaluable elements for anthropological, genetic, odontologic, evolutionary and forensic investigations. Sexual dimorphism refers to the systemic difference in form (either in shape or size) between individuals of different gender in the same species. Teeth of various species are known to exhibit sexual dimorphism. Teeth measurements seem to be the most reliable method in forensic investigations due to its advantages of being quick, less time consuming, non-invasive and easy to perform.

The maxillary and mandibular canines are not only exposed to less plaque, calculus, abrasion from brushing or heavy occlusal loading than other teeth, they are also less severely affected by periodontal disease and so, usually are the last teeth to be extracted with respect to age. These findings indicate that maxillary and mandibular canines can be considered as
the ‘key teeth’ for personal identification. In the field of forensic odontology, permanent canine teeth and their arch width (distance between the canine tips) have been reported to show sexual dimorphism.

Bosset and Marks and Krogh 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 least frequently extracted teeth and being less affected by periodontal disease. Canine teeth have also been reported to survive in air and hurricane disasters.

The present study establishes the impact of the ‘sex factor’ on the intercanine distance of the maxillary and mandibular arch in Maharashtrian Indian population. The results indicate that the maxillary and mandibular intercanine distance can be of immense medico-legal use in identification.

Materials and Methods

The sample composed of 70 dental casts that belonged to 35 males and 35 females students selected from Rural Dental College Loni, Maharashtra, India. Subjects were selected after careful oral examination and were chosen to fulfill the following criteria:

1. Age 17-25 years
2. Free from malocclusion
3. Have no missing anterior teeth
4. Having canine teeth free from:
   a. Proximal restorations
   b. Excessive incisal attrition.
   c. Dental erosion or abrasion
   d. Dental trauma.
   e. Previous orthodontic treatment.

Materials:
1. Alginate impression material.
2. Type IV Dental Stone
3. Electronic Digital Vernier Callipers giving readings upto two decimal points. (with resolution of 0.02mm). (Figure1)
Methods:
1. Making of study casts: Impressions of maxillary and mandibular arches were taken in alginate impression
2. Measurement of Canine Arch Width [Intercanine Distance]:
   Vernier caliper is used to measure maxillary and mandibular canine arch width. To measure distance, tip of one end of caliper is kept over the center of the tip of one side canine tooth and another end of caliper is kept over the center of tip of opposite side canine tooth. Figure (2, 3)
   All the measurements were done by a single examiner to eliminate inter-observer error. Each measurement was taken three times and the average distance of Maxillary arch of three values was obtained to minimize the intra-observer error. The descriptive statistics were calculated (mean, range and standard deviation), for maxillary and mandibular intercanine distance. From these measurements the percentage of sexual dimorphism was calculated.
   The observed maxillary and mandibular intercanine width were subjected to statistical analysis to assess sex difference using unpaired t-test. The level of statistical significance was set up at p<0.001.

Statistical Analysis
The intercanine measurements of maxillary and mandibular arch were entered in a Microsoft Excel spread sheet with the corresponding gender. The mean and standard deviation were calculated for both sexes and used for description of quantitative variables. Student (t) test was applied for comparison between two groups. In all tests the Probability, i.e., P< 0.001 was considered highly significant.
Sexual dimorphism: Sexual Dimorphism in maxillary and mandibular intercanine distance was calculated using formula given by Garn & Lens (1967). Sexual dimorphism was calculated using the formula:
Sexual dimorphism = (Xm÷Xf)-1×100
Where: Xm - Mean mesiodistal width in males and Xf - Mean mesiodistal width in females

<table>
<thead>
<tr>
<th>Sex</th>
<th>Maxillary intercanine (n=35)</th>
<th>Mandibular intercanine (n=35)</th>
<th>Student’s Unpaired ‘t’ test value</th>
<th>‘p’ valve and Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>36.11±1.41</td>
<td>27.20±1.38</td>
<td>38.24</td>
<td>p&lt;0.001, Highly significant</td>
</tr>
<tr>
<td>Female</td>
<td>34.78±1.78</td>
<td>26.38±1.58</td>
<td>20.89</td>
<td>p&lt;0.001, Highly significant</td>
</tr>
<tr>
<td>Student’s Unpaired ‘t’ test value</td>
<td>3.47</td>
<td>3.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘p’ valve and Result</td>
<td>p&lt;0.01, Highly significant</td>
<td>p&lt;0.01, Highly significant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Sex wise comparison of mean values of maxillary and mandibular intercanine

Results:
The study results are presented in table form (Table 1). There was a statistically significant difference between males and females in the intercanine distance of maxillary and mandibular arch. The mean intercanine distance for maxillary and mandibular arch was found
to be 36.11±1.41, 27.20±1.38mm in males and 34.78±1.78mm, 26.38±1.58 mm in females respectively.(Table 1).

**Table 2:** shows sexual dimorphism of maxillary and mandibular intercanine distance of both male and female.

**Discussion:**
The study was conducted to determine the sexual dimorphism that exists in the maxillary and mandibular permanent canines. This was done by measuring the intercanine distance. The study was conducted on 70 subjects, out of which 35 were males and 35 were females. The study established the existence of a definite statistically significant sexual dimorphism. Comparison of intercanine distance between the different populations was done as variation in tooth size is influenced by genetic and environmental factors such as race, sex, heredity, environment, secular changes and bilateral asymmetry. (Table No. 3, 4)

<table>
<thead>
<tr>
<th>Population</th>
<th>Author</th>
<th>Inter Canine Distance (mm)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egyptian</td>
<td>Aliaa Omar</td>
<td>36.823</td>
<td>34.653</td>
<td></td>
</tr>
<tr>
<td>Indian(Gujarat)</td>
<td>Dhara Parekh</td>
<td>34.477</td>
<td>32.789</td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>Zirahei</td>
<td>37.80</td>
<td>35.34</td>
<td></td>
</tr>
<tr>
<td>Saudi Arabian</td>
<td>Al-Rifaiy</td>
<td>34.76</td>
<td>26.46</td>
<td></td>
</tr>
<tr>
<td>Indian(Punjab)</td>
<td>Sharma</td>
<td>34.70</td>
<td>33.09</td>
<td></td>
</tr>
<tr>
<td>Indian(Gujarat)</td>
<td>N. Parekh</td>
<td>30.62</td>
<td>28.62</td>
<td></td>
</tr>
<tr>
<td>Indian(Uttar Pradesh)</td>
<td>Gupta</td>
<td>41.00</td>
<td>36.05</td>
<td></td>
</tr>
<tr>
<td>Present study</td>
<td></td>
<td>36.11</td>
<td>34.78</td>
<td></td>
</tr>
</tbody>
</table>

Table No. 3: Comparison of maxillary intercanine distance in different populations

The canine teeth were chosen for this study because they were found to have greater resistance to periodontal diseases and severe trauma. This is attributed to their long roots which are firmly anchored in alveolar bone and the labio-lingual thickness of the crown and root which enables them to sustain stress and trauma. These characteristics of canine teeth tend to preserve them throughout life; therefore, the canines are usually the last teeth to be lost.  

<table>
<thead>
<tr>
<th>Population</th>
<th>Author</th>
<th>Inter Canine Distance (mm)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian</td>
<td>Anderson &amp; Thompson</td>
<td>26.08</td>
<td>25.33</td>
<td></td>
</tr>
<tr>
<td>French</td>
<td>Muller</td>
<td>26.28</td>
<td>25.03</td>
<td></td>
</tr>
<tr>
<td>Indian(North India)</td>
<td>Kaushal</td>
<td>25.83</td>
<td>25.07</td>
<td></td>
</tr>
<tr>
<td>Norwegian</td>
<td>Olav</td>
<td>19.06</td>
<td>18.24</td>
<td></td>
</tr>
<tr>
<td>Saudi Arabian</td>
<td>Abdullah</td>
<td>27.01</td>
<td>26.46</td>
<td></td>
</tr>
<tr>
<td>Saudi Arabian</td>
<td>Sherfudin</td>
<td>26.36</td>
<td>26.11</td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td>Ibeachu</td>
<td>34.20</td>
<td>32.64</td>
<td></td>
</tr>
<tr>
<td>Indian(Uttar Pradesh)</td>
<td>Reddy</td>
<td>26.86</td>
<td>26.28</td>
<td></td>
</tr>
<tr>
<td>Indian(South Indian)</td>
<td>Grover</td>
<td>30.78</td>
<td>29.41</td>
<td></td>
</tr>
<tr>
<td>Present study</td>
<td></td>
<td>27.20</td>
<td>26.38</td>
<td></td>
</tr>
</tbody>
</table>

Table No. 4: Comparison of mandibular intercanine distance in different populations
Similar observations were made by Kumar et al. (1989), who demonstrated that inter canine distance and mandibular canine index are useful parameters in differentiating the sexes. Aliaa Omar et al. (2009) studied that maxillary inter-canine distance showed statistically significant differences between both sexes. Neelampari Parikh (2013) showed that the most sensitive predictors for gender determination were the maxillary and mandibular inter-canine distance & canine index. M. Abdulla et al. (1998) showed that inter-canine distance of the maxillary and mandibular dental arches were significantly greater in males than in females in his Saudi population group study. Olav studied casts of 64 females and 80 males of Norwegian decent and found that the mean mandibular inter canine width were 19.06 mm in males and 18.24 mm in females. Muller studied 424 students of University of Nice Sophia Antipolis split between 214 men and 210 women. The lower canine arch was 26.280 mm in males and 25.030 mm in females. Contrary to results of current study, Kaddah (1998) stated that no statistically significant differences were obtained between males & females while measuring the inter canine distance.

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

Conclusion:

The present study revealed that males show larger mean dimensions of intercanine distance than females in the study group and the difference was statistically significant (P<0.001). This study indicates that Inter canine distance show significant and consistent results for sexual dimorphism and can be used in forensic investigations as an adjunct along with other accepted procedures for sex determination.

References:


