A Study to Determine and Compare Dimorphic Trait of Mandibular Canine between Gujarati and Non-Gujarati Populations

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Introduction: Among all teeth, mandibular canine shows greatest variation in dimensions between the sexes, a phenomenon known as sexual dimorphism. This can be immensely beneficial to the forensic investigator for the purposes of both investigation and identification, as it significantly narrows down the possibilities, as the probable perpetrators and/or victims are concerned. Sex identification is an absolute necessity in cases of suicide, homicide, mass, casualties (both manmade or natural), and a tooth, which shows obvious sexual dimorphism can be a useful means of personal identification, especially where there has been extensive decomposition or destruction of facial soft tissue features. Another facet of forensic investigation is identification of racial origin. So, any odontometric parameter showing significant racial divergence can be used as a means of identification.

Aim and Objective: The aim of this study was to determine and compare cervico-incisal heights and mesiodistal widths of both mandibular canines of the Gujarati and non-Gujarati subjects under study.

Materials and Methods: The study sample involved 100 participants, divided into four groups, each of the four groups included 25 participants, representing Gujarati males, Gujarati females, non-Gujarati males, and non-Gujarati females, respectively.

Results: When we compared the mesiodistal and cervico-incisal dimensions of the mandibular canine, both right and left, Gujarati males were found to possess significantly larger sized teeth in comparison to their female counterparts, and the same results were replicated for non-Gujarati males vis-a-vis their female counterparts. Non-Gujarati males and non-Gujarati females were found to have significantly higher odontometric values in comparison with their Gujarati counterparts.

Conclusion: Gujaratis have smaller sized mandibular canine in comparison with non-Gujaratis. However, studies comparing specific groups are required, as non-Gujaratis are a diverse racial group.

Keywords: Canine dimorphism, dimorphic trait, Gujaratis, non-Gujaratis

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cosmopolitan city, being home to a large population of migrants from other states of India.

Teeth are among the hardest and chemically stable tissues in the body, rendering themselves amenable to both medicolegal and archaeological investigations, in both of which, identification of the dento-osseous remains is of paramount importance.

Among all teeth, mandibular canine shows the greatest variation in dimensions between the sexes, a phenomenon known as sexual dimorphism.\(^2,3\) This can be immensely beneficial to the forensic investigator for the purpose of both investigation and identification, as it significantly narrows down the possibilities, as far as the probable perpetrators and/or victims are concerned.\(^4\) Sex identification is an absolute necessity in cases of suicide, homicide, and mass casualties (both manmade or natural); and a tooth, which shows obvious sexual dimorphism, can be a useful means of personal identification, especially where there has been extensive decomposition or destruction of facial soft tissue features.

When personal photo identification cards such as “Aadhaar” are being issued, which include biometric details such as fingerprint patterns and retinal scans, a case can be made for such future cards to include odontometric details too. This would aid in personal identification in cases of forensic investigations or other medicolegal situations.

This study aimed to determine and compare this trait in both Gujarati and non-Gujarati populations of the city of Vadodara, India, which might be immensely useful for medicolegal investigations, as it provides yet another tool for personal identification in criminal investigations.

**Materials and Methods**

The patient was seated on a dental chair, and a mandibular impression tray of appropriate size was taken, loaded with alginate impression material, and the impression was taken. A cast was made using dental stone. After this, the cast was numbered and grouped according to the patient’s demographic profile, and the cervico-incisal and mesiodistal dimensions were calculated in centimeters using a vernier caliper [Figures 1–3]. Only the maximum cervico-incisal and mesiodistal dimensions were considered, and the measurements were recorded in centimeters on an Excel sheet.

The study sample involved 100 participants, divided into four groups, such that each of the four groups consisted of 25 participants, represented by Gujarati males, Gujarati females, non-Gujarati males, and non-Gujarati females, respectively. The number was derived by the formula \(N/1 + Ne^2\), where \(N\) is the population and \(e\) = error.\(^5\)

**Inclusion criteria**

1. Age-group, 19–26 years
2. Willingness to participate in the study
3. For Gujarati patients, both the subject’s parents have to be of Gujarati origin
4. For non-Gujarati patients, both the subject’s parents have to be of non-Gujarati origin
5. Healthy gingival and periodontal status

![Mandibular study cast](image1)

![Mesiodistal width measurement of mandibular right canine](image2)
6. Intact, caries-free, fully erupted, unimpacted permanent mandibular canines, which have not been subjected to any restorative treatment
7. Absence of spacing or severe crowding in anterior teeth
8. Normal molar and canine relationship

Exclusion criteria
1. Age younger than 19 years and older than 26 years
2. Those of mixed Gujarati and non-Gujarati parentage
3. Unwillingness to participate in the study
4. Having any mandibular canine, which is carious, unerupted, partially erupted, rotated, impacted, or has undergone regressive alterations such as attrition, abrasion, erosion, or abfraction, or if the tooth (teeth) has been subjected to restorative procedures
5. Spacing or severe crowding in relation to these teeth

Discussion
Gender determination is one of the foremost steps of identification, as a part of medicolegal examination. Be it a living person or a damaged and mutilated dead body or skeletal remains, carrying out a process of identification is necessary, of which gender determination is an integral part.

One of the greatest gifts bestowed by nature to a forensic odontologist or an archaeologist is the fact that mandibular canine shows a distinct sexual dimorphism. In no other tooth are the odontometric differences as obvious as this tooth. An additional point, which favors the usage of canines as a tool of determining sex during identification, is that canines are least likely to be affected and more likely to survive trauma such as air disasters or burns.

In this study, we sought to establish the existence of sexual dimorphism in Gujarati population and a non-Gujarati population, and tried to determine whether there is a significant difference between the two population. When we compared the mesiodistal and cervico-incisal dimensions of the mandibular canine, both right and left, Gujarati males were found to possess significantly larger sized teeth in comparison to their female counterparts, with the P value being 0.000.

The results in Table 1 were consistent with that of Parekh et al. and contrasted with Pratibha rani RM et al. and Kaushal et al. When the mesiodistal and cervico-incisal dimensions of both right and left mandibular canines of the non-Gujarati population were compared, here too the males outscored the females, with the P value being 0.000, and therefore deemed to be statistically significant. The results in Table 2 were consistent with Rai B et al., Acharya AB et al. and Hashim and Murshid.

After this, we sought to compare the Gujarati and the non-Gujarati populations gender-wise to establish whether a racial difference exists [Table 3]. The mean mesiodistal width of the Gujarati males was found to be 5.808 ± 0.29 mm for the right side and 5.684 ± 0.27 mm for the left side, whereas for non-Gujarati males, the corresponding figures were 6.468 ± 0.39 and 6.516 ± 0.40 mm, respectively.

The mean cervico-incisal length for the Gujarati males was 7.73 ± 0.26 mm for the right side and 7.67 ± 0.30 mm for the left side, whereas for non-Gujarati males, the corresponding figures were 8.72 ± 0.92 and

| Table 1: Comparison between Gujarati males and Gujarati females |
|---------------------------------------------------------------|
| **Measurement**                              | **Males** Mean ± SD (in mm) | **Females** Mean ± SD (in mm) | **P value** | **Mean diff.** |
| Mesiodistal width (right)                  | 5.808 ± 0.29                | 5.376 ± 0.20                | 0.000       | 0.432          |
| Mesiodistal width (left)                   | 5.684 ± 0.27                | 5.336 ± 0.17                | 0.000       | 0.348          |
| Cervico-incisal length (right)             | 7.736 ± 0.26                | 6.984 ± 0.17                | 0.000       | 0.751          |
| Cervico-incisal length (left)              | 7.672 ± 0.30                | 7.036 ± 0.23                | 0.000       | 0.635          |
| SD = standard deviation                     |                               |                             |             |                |
5.808 ± 0.29
5.684 ± 0.27
7.73 ± 0.26
7.67 ± 0.30

Gujarati male
Non-Gujarati male

P value
Mean diff.

0.000
-0.65
0.000
-0.83
0.000
-0.98
0.000
-1.05

Table 3: Comparison between Gujarati males and non-Gujarati males

| Measurement                  | Gujarati male Mean ± SD (in mm) | Non-Gujarati male Mean ± SD (in mm) | P value | Mean diff. |
|------------------------------|---------------------------------|-------------------------------------|---------|------------|
| Mesiodistal width (right)    | 5.808 ± 0.29                    | 6.468 ± 0.39                       | 0.000   | -0.65      |
| Mesiodistal width (left)     | 5.684 ± 0.27                    | 6.516 ± 0.40                       | 0.000   | -0.83      |
| Cervico-incisal length (right) | 7.73 ± 0.26                   | 8.72 ± 0.92                        | 0.000   | -0.98      |
| Cervico-incisal length (left) | 7.67 ± 0.30                    | 8.72 ± 1.03                        | 0.000   | -1.05      |

SD = standard deviation

Table 4: Comparison between Gujarati females and non-Gujarati females

| Measurement                  | Gujarati female Mean ± SD (in mm) | Non-Gujarati female Mean ± SD (in mm) | P value | Mean diff. |
|------------------------------|----------------------------------|--------------------------------------|---------|------------|
| Mesiodistal width (right)    | 5.37 ± 0.20                      | 5.63 ± 0.20                         | 0.000   | -0.256     |
| Mesiodistal width (left)     | 5.33 ± 0.17                      | 5.63 ± 0.21                         | 0.000   | -0.30      |
| Cervico-incisal length (right) | 6.98 ± 0.17                     | 7.58 ± 0.23                         | 0.000   | -0.60      |
| Cervico-incisal length (left) | 7.03 ± 0.23                      | 7.53 ± 0.20                         | 0.000   | -0.50      |

SD = standard deviation

Innumerable Boaz and Gupta,[3] Kapila et al.[4] and Thoma et al.[12] Studies have proven that mandibular canine is the tooth, which shows maximum sexual dimorphism, and in our study, the result obtained points to the fact that the dimensions of the mandibular canine are significantly larger in males compared to females. When we compare the races, we find that the non-Gujarati outscores the Gujarati as far as the dimensions of the mandibular canine are concerned, tooth among males as well as females (Pratibha Rani RM et al.[6]), the difference being highly statistically significant in both sexes. Although there are studies, which have determined the odontometrics of the Gujarati race (Parekh et al.[2]) and other non-Gujarati populations (Kaushal et al.[7]) separately, any existing literature comparing the races was not found.

Gujaratis are an overwhelmingly vegetarian group of people, and this might have been one of the factors accounting for smaller tooth size. Moreover, the comparison was made between Gujarati and non-Gujarati, with the non-Gujarati being a diverse, heterogeneous, and multiracial group. Therefore, perhaps studies comparing specific groups are required.

Odontometrics (Rai B et al.[8]) has an important role to play in the establishment of identity, and in forensic, medicolegal, and archaeological cases. Therefore, much like fingerprints and retinal scans, odontometric details can
also be captured on identity documents such as Aadhaar, where the data can be captured using QR code. All of these can be accomplished by nationwide, multicentric studies, which will determine the personal and racial odontometric data.

**CONCLUSION**

In this study, in both Gujaratis as well as non-Gujaratis, the mandibular canine shows a significant sexual dimorphism. Moreover, the same dimorphism is seen racially too, with Gujaratis having smaller sized mandibular canine in comparison with non-Gujaratis. However, studies comparing specific groups are required, as non-Gujaratis are a diverse racial group.

**Ethical approval**

This study was conducted after obtaining the approval from the ethics committee of Sumandeep Vidyapeeth.

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**Conflicts of interest**

There are no conflicts of interest.

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