

## Anthropometric Analysis of Human Mandibles for Sex Differentiation in Medico-Legal Autopsies at S.V. Medical College, Tirupati (2015-2016)

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### Abstract

Forensic Anthropometry is an important tool in establishing the identity of mortal remains. This study aimed to investigate various dimensions of the mandible for sex determination in forensic and anthropological research. 50 normal mandibles from individuals between 20-50 years old were collected and measured using vernier calipers, mandibulometer, and measuring tape. The study found that mandible dimensions can accurately determine sex in highly decomposed or mutilated bodies. The Symphyseal Height, Body Height, Length of the Lower Jaw, Minimum Breadth of Ramus, Maximum Breadth of Ramus, Bigonial Breadth, Bicondylar Width, and Bimental Width were all found to be larger in males than females, with statistically significant differences observed for each of these parameters. The study found that Body Thickness and Body Length were not significantly different between males and females.

**Keywords:** Sex determination, Mandible, Sexual dimorphism, Forensic anthropology, Skeletal remains.

### Introduction

Forensic anthropometry entails the measurement and analysis of the human body for identification, investigation, and interpretation of forensic casework. It plays a critical role in medico-legal investigations by providing valuable information on the age, sex, ancestry, stature, and individualizing features of the skeletal remains. Despite the highly specialized nature of the fields like forensic anthropology and forensic anthropometry, the responsibility

of applying their principles in their routine work falls on autopsy surgeons in India. Depending on the accessible bones for study, the accuracy of sex determination varied, with the entire skeleton being the most accurate and long bones alone being the least accurate. Adults' mandibular accuracy for determining sex is reported to range from 80.2 to 92%. It is challenging to determine sex based on the characteristics of teeth and supporting tissues, but a radiological examination of the mandible can yield clear-cut answers<sup>1</sup>.

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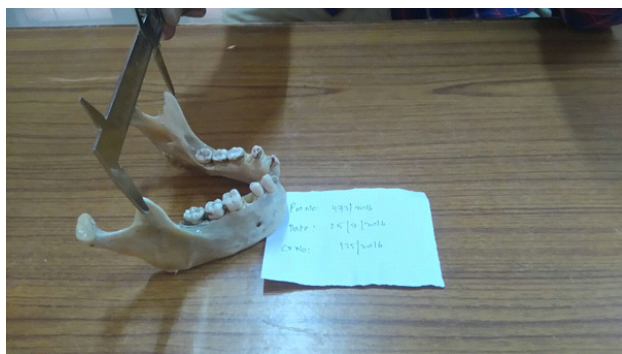
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The aims and objectives of this study were to investigate various dimensions and parameters of the mandible for sex determination. The study aimed to identify the best variables for determining the sex of the mandible and to compare the mean, standard deviation, and p-value of the current study with those found in the literature on various populations.

### Materials and Methods

The present study was conducted for a period of one and a half years at the Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India. Mandibles were collected for anthropometry from dead bodies that were brought in for post-mortem examination at the medical college. Only normal mandibles from individuals between the ages of 20 and 50 were included in the study. A total of 50 Mandibles were included in the study, with 25 from males and 25 from females. Damaged, mutilated, and deformed Mandibles were excluded from the study. The instruments used for measuring various parameters were vernier calipers, mandibulometer, and measuring tape. Each measurement was recorded twice, and the average of the two measurements was taken to minimize error. The standard method of measurement used is in accordance with previous studies<sup>2,3,4</sup>. Some of the measuring methods are shown in Figures 1-6.

The study presented the results as mean values with standard deviation. To compare differences between male and female mandibles, an independent t-test was used. A statistically significant difference was considered when the p-value was less than 0.005. The data analysis was performed using Statistical Product and Service Solutions (SPSS) version 12.



**Figure 1: Measuring Bi-Coronoid Width**



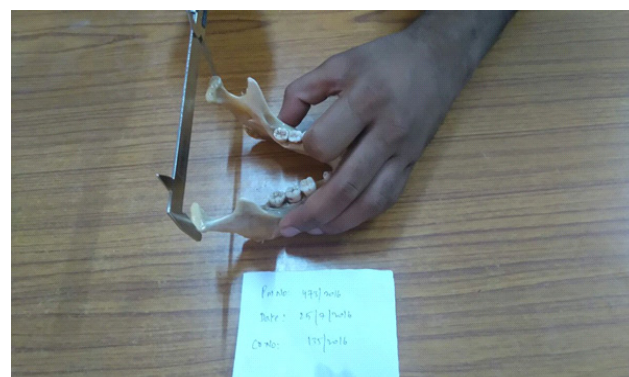
**Figure 2: Measuring Anthropometric Arch Width**



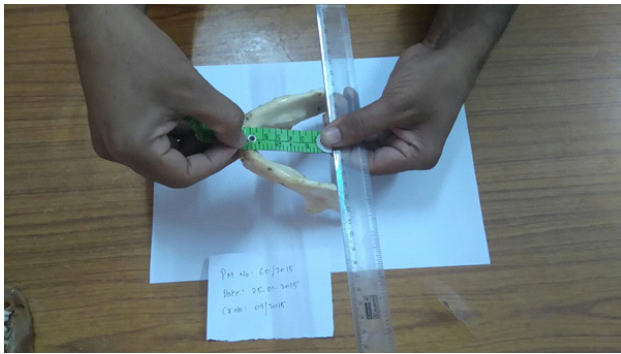
**Figure 3: Measuring the Height of the Coronoid**



**Figure 4: Measuring Inter-Incisor Width**



**Figure 5: Measuring Bi Condylar Width**



**Figure 6: Measuring Anthropometric Arch Length**

## Results and Discussion

The following are the results of our study concerning each morphometric parameter used to study sexual dimorphism.

### 1. Symphyseal Height (SH)

The symphyseal height of the male and female mandibles was measured, with the male range being 26.00-35.00 mm (mean 31.10, standard deviation 2.61) and the female range being 23.00-32.00 mm (mean 27.80, standard deviation 2.07). The difference in mean values between males and females is statistically significant ( $p=0.000$ ) with a 't' value of 4.578. Our results are similar to the studies by E. Sessaiah et al, Anupam Datta et al, Elena F Kranioti et al, FM Fabian et al, and Mihai Marinescu et al<sup>2,5,6,7,8</sup>.

### 2. Body height (BH):

The body height of the male Mandible varied from 23.00 - 32.00 mm (mean of 27.28, standard deviation 2.01) and that of the female Mandible varied from 20.00 to 28.00 mm (Mean 25.32 and a Standard deviation of 1.93). The gender differences in mean values of body height are statistically highly significant ( $p=0.001$ ) for Mandible. 't' value is 3.443. Our results are concordant with E. Sessaiah et al, Anupam Datta et al<sup>2,5,7</sup>.

### 3. Body thickness (BT):

The body thickness of the male mandible ranged from 11.00-18.00 mm (mean 14.6, standard deviation 1.83) and that of the female mandible ranged from 10.00-16.00 mm (mean 13.4, standard deviation 1.63). The

difference in mean values of body thickness between male and female mandibles is not statistically significant ( $p=0.006$ ,  $t=2.90$ ). Our results are concordant with E. Sessaiah et al, Anupam Datta et al and Fabian et al<sup>2,5,7</sup>.

### 4. Body length (BL):

The body length of the male mandible ranged from 70.00-84.00 mm (mean 74.6, standard deviation 3.79) and that of the female mandible ranged from 65.00-81.00 mm (mean 71.8, standard deviation 3.40). The difference in mean values of body length between male and female mandibles is not statistically significant ( $p=0.011$ ). Our results are concordant with E. Sessaiah et al<sup>2</sup>.

### 5. Length of the lower jaw (LLJ):

The length of the lower jaw of the male mandible ranged from 58.00-71.00 mm (mean 63.5, standard deviation 3.78) and that of the female mandible ranged from 52.00-69.00 mm (mean 58.4, standard deviation 4.02). The difference in mean values of lower jaw length between male and female mandibles is statistically highly significant ( $p=0.000$ ,  $t=4.507$ ). Our results are similar to E. Sessaiah et al, Anupam Datta et al, Vinay G, Mangala Gowri SR et al<sup>2,5,9</sup>.

### 6. Minimum breadth of Ramus (MnBR):

The minimum breadth of the ramus of the male mandible ranged from 28.00-36.00 mm (mean 31.2, standard deviation 2.18) and that of the female mandible ranged from 26.00-33.00 mm (mean 28.7, standard deviation 1.80). The difference in mean values of the minimum breadth of the ramus between male and female mandibles is statistically highly significant ( $p=0.000$ ,  $t=4.433$ ). The results in this parameter are similar to the studies by E. Sessaiah et al, Elena F. Kranioti et al, M.A.A. Kharoshah et al, and Rishi pokhrel et al<sup>2,6,10,11</sup>.

### 7. Maximum breadth of Ramus (MxBR):

The maximum breadth of the ramus of the male mandible ranged from 36.00-46.00 mm (mean 40.3, standard deviation 2.31) and that of the female mandible ranged from 34.00-

41.00 mm (mean 36.8, standard deviation 1.59). The difference in mean values of the maximum breadth of the ramus between male and female mandibles is statistically highly significant ( $p=0.000$ ,  $t=5.987$ ). Our results are concordant with E. Sessaiah et al, and Rishi pokhrel et al<sup>2,10</sup>.

8. **Bigonial breadth (BB):**

The bigonial breadth of the male mandible ranged from 92.00-102.00 mm (mean 96.7, standard deviation 3.34) and that of the female mandible ranged from 83.00-97.00 mm (mean 90.6, standard deviation 3.48). The difference in mean values of bigonial breadth between male and female mandibles is statistically highly significant ( $p=0.000$ ,  $t=6.202$ ). Our results are similar to E. Sessaiah et al, Elena F. Kranioti et al, Vinay G, Mangala Gowri SR, et al and Rahul et al<sup>2,6,9,12</sup>.

9. **Bicondylar width (BW):**

The bicondylar width of the male mandible ranged from 101.00-122.00 mm (mean 110.5, standard deviation 5.32) and that of the female mandible ranged from 95.00-106.00 mm (mean 99.9, standard deviation 3.23). The difference in mean values of bicondylar width between male and female mandibles is statistically highly significant ( $p=0.000$ ,  $t=8.319$ ). Our results are similar to all the studies previous studies cited in this paper.

10. **Bimental width (BmW):**

The bimental width of the male Mandible ( $48.3 \pm 3.44$  mm) was significantly larger than that of the female Mandible ( $41.8 \pm 3.38$  mm) ( $p=0.000$ ,  $t=6.612$ ). Our results are concordant with E. Sessaiah et al, Anupam Datta et al and Fabian et al<sup>2,5,7</sup>.

11. **Gonial angle (GA):**

The gonial angle of the male mandible has a mean of 123.5 degrees with a standard deviation of 6.04, while that of the female mandible has a mean of 131.2 degrees with a standard deviation of 5.58. The gender differences in mean values of the gonial

angle for male and female mandibles are statistically highly significant ( $p=0.000$ ) with a t-value of -4.596. The results in this parameter are similar to the studies by E. Sessaiah et al, M.A.A. Kharoshah et al, and Anupam Datta et al<sup>2,5,11</sup>.

12. **Height of the ramus or condylar height (HR):**

The height of the ramus of the male Mandible ranged from 60.00 to 73.00 mm with a mean of  $66.00 \pm 3.41$ , while that of the female Mandible ranged from 55.00 to 69.00 mm with a mean of  $62.00 \pm 3.03$ . Gender differences in the mean values of ramus height were found to be statistically significant ( $p=0.000$ ,  $t=4.250$ ) for Mandible. The results in this parameter are similar to the studies by E. Sessaiah et al, Vineeta Saini et al, and Anupam Datta et al<sup>2,5,13</sup>.

13. **Height of the coronoid (HC):**

The height of the coronoid of the male Mandible varied from 53.00 to 72.00 mm with a mean of 65.2 and standard deviation of 5.03 and that of the female Mandible varied from 49.00 to 69.00 mm with a mean of 60.05 and Standard deviation of 5.02. The gender differences in mean values of height of the coronoid of male and female are statistically significant ( $p=0.002$ ) for Mandible. 't' value is 3.246. The results in this parameter are concordant with the studies by E. Sessaiah et al, Vineeta Saini et al, and Anupam Datta et al<sup>2,5,13</sup>.

14. **Bicoronoid width (BcW):**

The coronoid width of the male Mandible varied from 82.00 to 105.00 mm with a mean of 94.3 and a standard deviation of 6.62 and that of the female Mandible varied from 74.00 to 101 mm with a mean of 90 and a Standard deviation of 6.30. The gender differences in mean values of coronoid width of males and females are statistically not significant ( $p=0.028$ ) for Mandible. 't' value is 2.271. Our results are concordant with E. Sessaiah et al<sup>2</sup>.

**15. Mandibular index (MI):**

The mean Mandibular Index of males and females was not statistically significant ( $p=0.244$ ) with mean values of 57.1 and 58.6 and standard deviations of 4.31 and 4.58, respectively. The 't' value was -1.178. Our results are similar to E. Seshaiyah et al, Anupam Datta et al, Vinay G, Mangala Gowri SR et al<sup>2,5,9</sup>.

**16. Inter incisor width (IIW):**

The mean inter-incisor width of the male Mandible is 17.00 mm with a standard deviation of 1.42, while that of the female Mandible is 14.1 mm with a standard deviation of 1.40. The gender differences in mean values of inter-incisor width between males and females are statistically highly significant ( $p=0.000$ ) for Mandible, with a 't' value of 7.043. Our results are concordant with E. Seshaiyah et al<sup>2</sup>.

**17. Inter premolar width (IPW):**

The mean inter-premolar width of male mandibles is 35.3 mm (SD=2.78) and that of females is 32.5 mm (SD=2.95). The difference in mean values between males and females is statistically significant ( $p=0.001$ ,  $t=3.380$ ) for the mandible. Our results are concordant with E. Seshaiyah et al<sup>2</sup>.

**18. Intermolar width (IMW):**

The mean intermolar width of male mandibles is 45.2 mm with a standard deviation of 3.13, while that of female mandibles is 42.4 mm with a standard deviation of 3.49. The difference in mean values is statistically significant ( $p=0.004$ ) with a t-value of 3.005. Our results are concordant with E. Seshaiyah et al<sup>2</sup>.

**19. Arch length (AL):**

The arch length of the male Mandible varied from 31.00 to 45.00 mm with a mean of 38.9 and a standard deviation of 3.29 and that of the female Mandible varied from 32.00 to 42.00 mm with a mean of 36.7 and a Standard deviation of 2.42. The gender differences

in mean values of arch length of male and female is statistically highly significant ( $p=0.000$ ) for Mandible. 't' value is -3.492. Our results are concordant with E. Seshaiyah et al<sup>2</sup>.

**20. Anthropometric arch width (AAW):**

The anthropometric arch width of the male Mandible (mean=58.6, SD=4.75) ranged from 49.00 to 66.00 mm, and that of the female Mandible (mean=55.9, SD=4.91) ranged from 47.00 to 65.00 mm. The gender differences in mean values of Anthropometric arch width of males and females for Mandible are statistically not significant ( $p=0.054$ ,  $t=1.977$ ). Our results are concordant with E. Seshaiyah et al<sup>2</sup>.

**21. Anthropometric arch length (AAL):**

The anthropometric arch length of the male Mandible varied from 47.00 to 59.00 mm with a mean of 51.5 and a standard deviation of 3.47 and that of the female Mandible varied from 42.00 to 55.00 mm with a mean of 48.8 and a Standard deviation of 3.34. The gender differences in mean values of Anthropometric arch length of male and female is statistically not significant ( $p=0.008$ ) for Mandible. 't' value is 2.761. Our results are concordant with E. Seshaiyah et al<sup>2</sup>.

The findings of different morphometric parameters in the present study are similar to previous studies in this area<sup>14-18</sup>.

### Conclusion

In conclusion, this study found significant sexual dimorphism in the Mandibles of humans, with 15 out of 21 parameters (SH, BH, LLJ, MnBR, MxBR, BB, BW, BmW, GA, HR, HC, IIW, IPW, IMW, AL) showing higher means in males. However, six parameters including body thickness, body length, bi-coronoid width, Mandibular index, anthropometric arch width, and anthropometric arch length did not show significant differences between males and females. These findings add to the growing body of literature on sexual dimorphism in human skeletal features and may have implications for forensic investigations and clinical practices.

**Limitations:**

The study measured and recorded feasible parameters in the mandible of individuals aged 20 to 50 years in and around Tirupati, but omitted certain parameters, such as mandibular flexure, antegonial notch, and posterior flexure of the Ramus, due to difficulty in measurement. It acknowledges the limitation of small sample size and recommends increasing the sample size for more robust and generalizable findings.

**Competing Interests:** None to declare

**Financial Support:** Nil

**Ethics Committee Approval:** The Institutional Ethics Committee, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh accorded permission to conduct the study under its purview.

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