

To study the Sex determination & morphometric parameters of human mandible

Dr. Ashish Kumar Dubey¹, Dr. Vimal Modi², Dr. Rakesh Kumar Tiwari³

1. Dr. Ashish Kumar Dubey, PhD Research scholar, Department of Anatomy, Malwanchal University, Indore, MP, India, wwwdrwww@gmail.com
2. Dr. Vimal Modi, Professor and HOD, Department of Anatomy IMCH&RC, Indore, MP, vimalmodi31@gmail.com
3. Dr. Rakesh Kumar Tewari, Assistant Professor, Department of Anatomy, Autonomous State Medical College, Auraiya, UP, Kr.rakeshtiwari97@gmail.com

Corresponding author:

Dr. Ashish Kumar Dubey, PhD Research scholar, Department of Anatomy, Malwanchal University, Indore, MP, India, wwwdrwww@gmail.com

Abstract

Background: The knowledge about the anatomy of the mandible and its variations in age, sex and race will help physicians, surgeons, medico-legal authorities and anthropologists to give correct interpretations for the diagnostic procedures in living.

Aim and objective: To study the Sex determination & morphometric parameters of human mandible. **Material and method:** We collected the human mandible bones (N=122) from the department of Anatomy, Index Medical College Hospital & Research Centre, Indore.

region to study the morphological and morphometric features. **Results:** Among all parameters Six dominating parameters that possibly explain the nature of the mandible are height of the ramus, body thickness, anthropometric arch width, inter incisor width, mandibular index and mandibular angle are useful to determine the unknown sex of the mandible upto an extent of 75.2% in south Indian population. The incidence of the above mentioned sex determination parameters considered together and treated statistically. **Conclusion:** The present study reveals that the mandible of unknown gender can be sexed to the extent of 75% accuracy by six dominating parameters and not to consider these for complete sex determination of the mandible bone in osteometric studies.

Keywords: Mandible bone, Ramus, Angle, Index

INTRODUCTION

The mandible is the largest, strongest bone in the skull, the skull includes mandible and cranium. Mandible has a curved body that is convex forwards and two broad rami that ascend posteriorly, the rami has coronoid and condylar processes. The lingula is a tongue-shaped bony projection on the medial surface of the mandibular ramus close to the posterior margin of the mandibular foramen [1]. The exact location of the mandibular foramen on radiographs is not always easy to be established due to its radiolucency and the superimposition of contralateral mandibular structures[2].

The teeth along with skull are best preserved part of human remains. Sex can be more accurately determined after the attainment of puberty. The differences are well marked in bony pelvis and skull. Mandible next to the pelvis in human remains will help us in identification of age, sex and race. [3-4] To evaluate the mandibular angle and to analyze the relationship of the angle and height & breadth of the ramus of the mandible to the gender, so as to study its role in the anthropological diagnosis.[5] Sex determination based only on characteristics of teeth and their supporting structures had been a difficult task where as X-ray examination of the mandible gives definitive information about the sex. The mandibular condyles are smaller in females. By radiological examination sex determination of skull is possible to the extent of 88 percent.[6] Mandible and its variations in age, sex and race will help physicians, surgeons, medico-legal authorities and anthropologists to give correct interpretations for the results of diagnostic procedures in living. [4,7]

METHODS

The material used for the study contained 122 human mandibles of unknown sex obtained from the department of Anatomy, Index Medical College Hospital & Research Centre, Indore. The bones collected are free from any pathological lesions or fractures. Totally edentulous mandibles with absorbed alveolar margins were excluded from this study. The bones collected roughly belong to the age group of 18 to 60 years. By using sliding caliper and mandibulometer we studied the 18 parameters of mandible to determine the sex and recorded. Symphyseal height, Coronoid height, Minimum breadth of ramus, Maximum breadth of ramus, Height of ramus –right, Height of ramus – left, Body height, Body thickness, Body length, Bigonial diameter, Bi condylar diameter, Bi mental breadth, Mandibular angle, Length of lower jaw, Inter incisor width, Inter premolar width, Inter molar width, Arch length, Anthropometric arch length, Anthropometric arch width, Bicononoid width, Mandibular index. This study was under clearance with ethical committee.

INCLUSION CRITERIA:

All adult (mandible with presence of bilateral molar teeth; prominent alveolar sockets; intact condylar and coronoid processes; well developed bone), intact and well-formed mandible were taken.

EXCLUSION CRITERIA: Broken, deformed, pathological bones were excluded

STATISTICAL ANALYSIS: Was performed using SPSS software. The P value < .05 were considered as significant.

RESULTS

The study was conducted on 122 adult dry human mandibles in the Department of Anatomy, Index Medical College Hospital & Research Centre, Indore.

Morphological Parameters

Table 1: Gonial angle of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (degrees)	116.7- 141	124.6 – 151.3

Mean $\pm$ SD	126.41 $\pm$ 14.84	137.5 $\pm$ 8.96
Calculated range	110 – 145	111 – 160
P value	< 0.0000085	
t-value	-4.65	

The gonial angle of the male mandible was between 116° and 141° with an average of 126.41°. The average gonial angle of the female mandible is 137.5 °. The mandibular angle was less than 162 °in men and > 110 °in women. The maximum angle of the mandible was 134 °, which was correctly estimated in 84 % of men and 67 % of women. The mean mandibular angle values for men and women were significantly different ($p < 0.001$) for the mandible. [Table 1].

Table 2: Bigonial width of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	85 – 105	77 – 104
Mean $\pm$ SD	96.44 $\pm$ 8.11	88.64 $\pm$ 5.44
P value	< 0.05	

The bigonial width of a male mandible can range from 85 to 105 mm, with an average of 96.44 $\pm$ 8.11 mm. The bigonial width of the female mandible can range from 77 to 104 mm, with an average of 88.64 mm. Bigonial width was defined as > 108 for men and less than 79 for women. Bigonial width was capped at 91.21, at which point 74% of the males and 80% of the females were correctly identified. The difference between the male and female mean values of bigonial width was statistically significant ($p < 0.05$) for the mandible. [Table 2]

Table 3: Ramus breadth of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	38 to 60	30 to 53
Mean $\pm$ SD	42.48 $\pm$ 6.84	39.03 $\pm$ 5.23
P value	< 0.003	

The breadth of the ramus varies from 38 to 60 mm in male mandibles, with an average of 42.48 $\pm$ 6.84 mm. In female mandibles, it ranges from 30 to 53 mm, with an average of 39.03 $\pm$ 5.23 mm. The height of ramus had a dividing line of more than 63.2 for men and less than 30 for women. Breadth of ramus had a cutoff point of 51, which was accurate for 88 % of males and 71% of females. The difference between male and female mean values for Height of Ramus was statistically significant ($p < 0.05$) for the mandible. [Table 3].

Table 4: Ramus height of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	62 to 76	41 to 63

Mean $\pm$ SD	67.59 $\pm$ 5.52	53.63 $\pm$ 8.14
P value	< 0.001	

The height of the ramus varies from 62 to 76 mm in male mandibles, with an average of 67.59 $\pm$ 5.52 mm. In female mandibles, it ranges from 41 to 63mm, with an average of 53.63 $\pm$ 8.14 mm. The height of ramus had a dividing line of more than 70 for men and less than 54 for women. The height of the ramus had a cutoff point of 60.7, which was accurate for 95% of males and 83% of females. The difference between male and female mean values for Height of Ramus was statistically significant ($p < 0.05$) for the mandible. [Table 4]

Table 5: Bicondylar breadth of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	101 to 121	85 to 115
Mean $\pm$ SD	106.11 $\pm$ 5.90	106.21 $\pm$ 6.81
P value	0.931	

The male mandibular bicondylar breadth ranges from 101 to 121 mm, with an average of 106.11 $\pm$ 5.9 mm. The female mandible bicondylar breadth ranges from 85 to 115 mm, with an average of 106.21 $\pm$ 6.81 mm. The bicondylar breadth was more than 129.8 mm for males and less than 95.2 mm for females. At a Bicondylar breadth limit of 106, 74% of males and 72 % of females could be correctly identified. The difference between the male and female mean values of the bicondylar breadth was statistically significant ($p < 0.05$) for the mandible. [Table 5].

Table 6: Mandibular length of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (degrees)	64 to 81	60 to 81
Mean $\pm$ SD	75.7 $\pm$ 4.4	69.7 $\pm$ 4.7
P value	< 0.05	

The length of a man's mandible can range from 64 to 81 mm, with an average of 75.7 $\pm$ 4.4 mm. A woman's mandible can be anywhere from 60 to 81 mm, with an average of 69.7 $\pm$ 4.7 mm. For men, the length of the mandible had to be more than 84.9, and for women, it had to be less than 62.4. The limiting point for mandible length was 72.6 mm, which correctly sexed 82 % of men and 73 % of women. The difference between male and female mean values for mandibular length was statistically significant ($p < 0.05$) for the mandible. [Table 6]

Table 7: Lower jaw length of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	50 to 65	44 to 66

Mean $\pm$ SD	59.46 $\pm$ 5.19	55.57 $\pm$ 6.2
P value	< 0.05	

The length of the man's lower jaw ranges from 50 to 65 mm, with a mean of 59.46 $\pm$ 5.19 mm. A woman's lower jaw ranges from 44 to 66 mm, with a mean of 55.57 $\pm$ 6.2 mm. For men, the length of the lower jaw had to be more than 73.1 and less than 48.2 for women. At a lower jaw length limit of 59 mm, 76% of males and 72 % of females could be correctly sexed. The difference between men and women in the average length of their lower jaws was statistically significant ($P < 0.05$) for the mandible. [Table 7]

Table 8: Mandibular index of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	43.5 to 59.5	39.5 to 62.5
Mean $\pm$ SD	53.52 $\pm$ 4.7	52.88 $\pm$ 8.33
P value	< 0.591	

The mandibular index ranges from 43.7 to 59.9, with an average of 53.52 $\pm$ 4.7, and the mandibular index ranges from 39.7 to 62.6, with an average of 52.88 $\pm$ 8.33. The mandibular index had a cutoff point of more than 69.2 for men and less than 41.3 for women. The upper limit for the Mandibular Index was 54.6, which correctly identified 54 % of males and 43 % of females. The mean mandibular index was not significantly different between the men and women ($p > 0.591$). [Table 8].

Table 9: Body thickness of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	12 to 20	10.3 to 16.8
Mean $\pm$ SD	16.18 $\pm$ 2.59	14.28 $\pm$ 2.44
P value	< 0.000073	

The body thickness of a male mandible can be anywhere from 12 to 20 mm, with a mean of 16.12 $\pm$ 2.59, and a female mandible can be anywhere from 10 to 16 mm, with a mean of 13.5 $\pm$ 1.6. The body thickness cutoff point for men was higher than 18 and lower than 11 for women. At a body thickness limit of 15, 85% of the males and 83 % of the females could be sexed correctly. The difference in the mean values of body thickness between men and women was statistically significant ($p < 0.05$) for the mandible. [Table 9].

Table 10: Coronoid height of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	52.4 to 72.2	43.6 to 61.3
Mean $\pm$ SD	61.44 $\pm$ 4.91	50.15 $\pm$ 6.87

Calculated range	46.9 – 74.9	37.1 – 66.7
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The male mandibular coronoid height ranges from 52.4 to 72.2 mm, with an average of 61.44 ± 4.91 mm. Female mandible coronoid height ranges from 43.6 to 61.3 mm, with an average of 50.15 ± 6.87 mm. Coronoid height was defined as more than 66.8 for males and less than 46.91 for females. At the height limit of 55.64 mm, 82 % of the males and 82 % of the females were correctly sexed. The difference between the male and female mean values of the coronoid height was statistically significant ($p=0.0001$) for the mandible. [Table 10].

Table 11: Bimental breadth of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	39.8 to 47.9	34.9 to 44.9
Mean $\pm$ SD	42.82 ± 6.67	39.21 ± 4.2
P value	< 0.05	

The breadth of the male mandible ranges from 39.8 to 47.9 mm, with an average of 42.82 ± 6.67 mm. Female mandible breadth ranges from 34.9 to 44.9 mm, with an average of 39.21 ± 4.2 mm. Bimental breadth had a dividing line of more than 54.8 for men and less than 38.8 for women. At a Bimental breadth limit of 42.1, 67% of males and 63% of females could be correctly identified. Men and women had different mean values for mandibular width, and this difference was statistically significant ($p < 0.05$). [Table 11].

Table 12: Symphyseal height of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	22.7 to 36.9	16.7 to 27.9
Mean $\pm$ SD	27.64 ± 3.7	22.53 ± 4.63
P value	< 0.05	

The male mandible symphyseal height ranges from 22.7 to 36.9 mm, with an average of 27.64 ± 3.7 mm. Female mandibular symphyseal height ranges from 16.7 to 27.9 mm, with an average of 22.53 ± 4.63 mm. Symphyseal height was defined as > 33.7 for men and less than 19.7 for women. At a Symphyseal height limit of 25.9, 89 % of males and 77 % of females could be correctly identified. The difference between male and female mean symphyseal height values was statistically significant ($p < 0.05$) for the mandible. [Table 12].

Table 13: Body height of the present study specimen

Measurement	Male	Female
No. of bones	70	52
Range (mm)	24.8 to 33.8	15.8 to 27.9
Mean $\pm$ SD	26.33 ± 5.4	21.5 ± 3.83
P value	< 0.05	

Male mandible body height ranges from 24.8 to 33.8 mm, with an average of 26.33 ± 5.4 mm. Female mandible body height ranged from 15.8 to 27.1 mm, with an average of 21.5 ± 3.83 mm. The dividing line for body height was more than 34.6 for men and less than 20.1 for women. At a Body height limit of 26.1, 91 % of the males and 78 % of the females could be sexed correctly. The difference between the male and female mean values for body height was statistically significant ($p < 0.05$) for the mandible [Table 13].

DISCUSSION

The Index Medical College and Hospital, Department of Anatomy, Indore, Madhya Pradesh, India. Bones from male and female human jaws, dried, and unidentified. We retained 122 mandibles for additional analysis after removing those that did not fit for reasons other than size. The five different characteristics that were measured for each mandible are detailed in greater depth in the section devoted to the materials and methodology.

The Symphyseal height varies from 22.7 to 36.9 mm, with a mean value of 27.64 mm. When this compared to the range of the known sex 122 mandibles out of 244 could be identified as belonging to male and 70 to female while 52 remain undecided. However, when other parameters are taken into consideration the significance of Symphyseal height deciding the sex decrease. The height of the ramus is measured on right and left sides for all the mandibles; right side mean value shows slight higher value by 3 mm than left side. This difference may be due to the difference in the chewing habit of the individual. This needs further investigation since there were no such observations in the past. Body thickness ranges from 12 mm to 20 mm with mean value of 16.18 mm by which 70 belong to male, 50 female. Body length ranges from 60 mm to 82 mm with a mean value of 7.4 mm. The body height, length and thickness though facilitating to sex the mandibles at higher percentage, this is regarded as an insignificant factor in the known sex. [8] Anthropometric arch width ranges from 33 mm to 54 mm with a mean value of 43.5 mm by which mandibles can be grouped as males and as females. In the known sex the difference between the male and female of anthropometric arch width is said to be a significant parameter. Mandibular angle ranges from 116.7° to 141° with a mean value of 126.41° by which 70 mandibles can be said to be male and 50 to be female. White races mandibles have greater and everted gonial angle. [9]Eversion of angle is characteristic of male and inversion is that of female.[10] It was concluded that round chin mandible with inversion or eversion cannot be a female one and 59.26 percent of accuracy in sex determination is possible with mandible. [11] Male mandibles will have well developed and flaring gonial regions. [12] Mean value of mandibular angle was more in females – males 118.60, females 123.00. [13] In males the lateral aspect of the angle of the mandible shows rough or rigid appearance. In females the angle of the jaw is often more rounded and gracile in construction. The attachment surface of the masseter muscle is often much smoother. [14] In the present study, those that are considered as females presented with higher mandibular angle and males with lower mandibular angle. These findings are in agreement with the findings of literatures. Bicondylar diameter ranges from 101 mm to 121 mm with a mean value of 106.11 mm.. It is stated that sharp tubercles on the medial and lateral aspects of anterior surfaces of mandibular

condyles are stress indicators. [15]Mandibular condyles were smaller in females. [6] In the present study those mandibles that are designated as belonging to females showed smaller condyles resulting in lesser diameters. Mandibular is calculated by Bicondylar breadth, length of lower jaw multiplies with 100 also significant parameter for sex determination.

CONCLUSION

The measurements were compared to the values of known sex to distinguish the sex of mandible. Every parameter, independent of other parameters provides certain percentage of certainty about the sex of mandible of unknown sex. This percentage of certainty significant shifts when considered in combination with other parameters. The present study reveals that mandible of unknown gender can be sexed to the extent by using the all above parameters.

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