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Original Research Paper

Analysis of Bigonial Angle, Bigonial width. Ramus Breadth, and Ramus height of the Mandibles and their impact on Gender Determination

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ABSTRACT:
Introduction: The shape of a person's bones has a big impact on how they know what gender they are. Research in many different parts of our country and among many different ethnic groups has shown this to be true. Aim: The aim of the present study is as skeletal characteristics vary by population, we attempted to determine the sex using significant parameters in the bigonial angle, bigonial width, ramus breadth, and ramus height of the mandible in the population of Indore region. Materials & methods: The Institutional Ethics Committee approved the study before work began. The initiative of the Department of Anatomy can be found at the Index Medical College and Hospital in Indore, which is in the state of Madhya Pradesh in India. Dried human jawbones of an undetermined gender. After eliminating the mandibles that did not fit due to factors other than size, 50 mandibles were selected for further examination. Each mandible was meticulously measured for a total of four distinct parameters, each of which is described in greater detail in the section devoted to the materials and methods. Results: After obtaining all the measurements, unpaired 't-test' was performed. The Gonial angle, Bigonial width, ramus breadth, and height of ramus, showed statistically significant gender difference. Conclusion: The present study concludes that if a bone fragment is available, morphological, and metrical parameters can be used to determine sex or age.

INTRODUCTION:

The study of anatomy is the medical field's most traditional scientific area. In Alexandria during the third century B.C., the first rational and methodical dissections of a human corpse are permitted [1]. These dissections were performed on a human corpse after it had died. Dissecting animals, most frequently pigs and monkeys, was the primary method used by anatomists at the time to study the structural makeup of living things [2,3]. Since that time, contemporary anatomical science has been making tremendous strides each day towards the development of new concepts and discoveries [4-6]. Because of the clinical, surgical, anthropological, and racial importance of the different morphological variants of the skull, numerous research professionals have been fascinated by these variations for a number of decades [7-9]. The decrease in the gonial angle is due to the functional forces that are produced on the posterior border of the ramus by the masseter and medial pterygoid muscles [10]. It has been established that radiographs of the head that are cephalometric or panoramic in nature are not trustworthy for assessing anatomic structures [11-15]. The studies [11-20] did not divulge the procedure that was utilized to identify the posterior boundary or the method that was used to quantify the rami's total A-P width. Both processes were necessary in order to determine the size of the rami. The only distance that was measured was the one that extended from the lingula to the internal oblique line; the distance that extended from the anterior border of the ramus was not taken into consideration. Hence, the aim of the present study is as skeletal characteristics vary by population, we attempted to determine the sex using significant parameters in the bigonial angle, bigonial width, ramus breadth, and ramus height of the mandible in the population of Indore region.

Materials & Methods:

After obtaining Institutional Ethics Committee approval, the present study was started. The Department of Anatomy can be found at the Index Medical College and Hospital in Indore, which is located in the state of Madhya Pradesh in India. dried human jawbones of an undetermined gender. After eliminating the mandibles that did not fit due to factors other than size, 50 mandibles were selected for further examination. Each mandible was meticulously measured for a total of twelve distinct parameters, each of which is described in greater detail in the section devoted to the materials and methods. *Inclusion criteria:* All the intact, well-formed adult Mandibles were included in this study. *Exclusion criteria:* Damaged, mutilated and deformed mandibles, pathological diseased, fractured, developmental disturbances of the mandible, deformed and edentulous mandibles were excluded from the study. The length of the mandibular ramus was measured in this research project, and the results were compared to those of another parameter. In the present investigation, the first factor that was measured and analyzed was the length of the mandibular ramus (maximum ramus breadth, minimum ramus breadth, condylar height, projective height of ramus, coronoid height). The second parameter is the measurement of the distance from the superior border of the mandibular foramen to the inferior border of the mandibular foramen. This distance is measured relative to the lower border of the mandible. Gonial angle: Angle formed by the inferior border ofthe corpus and the posterior border of the ramus. Instrument: Mandibulometer.

- Bigonial width: it measures the straight distance between two gonia. Instrument: Vernier Caliper.
- Height of ramus: direct distance from the highest point on the mandibular condyle to gonion. Instrument: Vernier caliper
- Bicondylar breadth: it measures the straight distance between two condylia lateralia. Instrument: Vernier Caliper

Statistical Analysis:

The data were expressed as Mean ± SD and then analyzed by unpaired t-test by using IBM SPSS Statistics 21. After calculating the average values and tabulating the results, statistical analysis was performed on the gathered information. The results of the measurements were taken in both directions. After obtaining all the measurements, unpaired 't-test' was performed.

Results:

The gonial angle of the male mandible is between 115° and 140°, with an average of 126.9°. The average gonial angle of the female mandible is 136 °. The mandibular angle was less than 160 degrees for men and more than 109 degrees for women. The maximum angle of the mandible was 132 °, which correctly guessed the gender of 85 % of men and 65 % of women. The mean values of the mandibular angle for men and women are statistically different ($p < 0.001$) for mandible. [Table 1].

Table 1: Gonial angle of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (degrees)	115.2- 140.8	123.8 – 150.4
Mean ± SD	126.9 ± 5.6	136 ± 7.8
Calculated range	109 – 145	112 – 160
P value	< 0.001	
t-value	-5.432	

Table 2: Bigonial width of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (mm)	86.1 – 105.2	79 – 104
Mean ± SD	96.1 ± 5.9	89.1 ± 6.9
Calculated range	109.1 – 145.2	112.1 – 160.3
P value	< 0.001	
t-value	4.980	

The bigonial width of a male mandible can be anywhere from 86.1 to 105.2 mm, with an average of 96.1 ± 5.9 mm. A female mandible's bigonial width can be anywhere from 79 to 104 mm, with an average of 89.1 ± 6.9 mm. Bigonial width was defined as being more than 109.1 for men and less than 80.13 for women. Bigonial width was capped at 92.22, at which point 74% of males and 82% of females were correctly identified. The

difference between male and female mean values of bigonial width is statistically very important ($p < 0.001$) for the mandible. [Table 2]. The breadth of the Ramus varies from 38.9 to 58.1 mm in male mandibles, with an average of 42.1 ± 5.1 mm. In female mandibles, it ranges from 31.5 to 54.2 mm, with an average of 39.2 ± 5.8 mm. Height of Ramus had a dividing line of more than 64.2 for men and less than 31.5 for women. Breadth of Ramus had a cutoff point of 50.1, which was accurate for 88 % of males and 73% of females. The difference between male and female mean values for Height of Ramus is statistically very important ($p < 0.001$) for mandible. [Table 3].

Table 3: Ramus breadth of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (mm)	38.9 to 58.1	31.5 to 54.2
Mean ± SD	42.1 ± 5.1	39.2 ± 5.8
Calculated range	31.5 – 81.2	39.2 – 64.2
P value	< 0.001	
t-value	8.392	

The height of the Ramus varies from 63.8 to 77.9 mm in male mandibles, with an average of 68 ± 4.9 mm. In female mandibles, it ranges from 42 to 64.8 mm, with an average of 55.6 ± 5.4 mm. Height of Ramus had a dividing line of more than 71.2 for men and less than 55.6 for women. Height of Ramus had a cutoff point of 61.9, which was accurate for 95% of males and 83% of females. The difference between male and female mean values for Height of Ramus is statistically very important ($p < 0.001$) for mandible. [Table 4].

Table 4: Ramus height of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (mm)	63.8 – 77.9	42 – 64.8
Mean ± SD	68 ± 4.9	55.6 ± 5.4
Calculated range	54.9 – 81.2	39.2 – 71.2
P value	< 0.001	
t-value	9.421	

DISCUSSION:

The Department of Anatomy can be found at the Index Medical College and Hospital in Indore, which is located in the state of Madhya Pradesh in India. dried human jawbones of an undetermined gender. After eliminating the mandibles that did not fit due to factors other than size, 50 mandibles were selected for further examination. Each mandible was meticulously measured for a total of twelve distinct parameters, each of which is described in greater detail in the section devoted to the materials and methods. In this study, the discriminant function analysis is used to try to find the mandibular measurement that gives the most accurate information about how to tell men from women in this population. The goal of this research is to find a mandibular measurement that can differentiate between males and females in this population. The present study objectives are to measure, compare and evaluate the various measurements of the mandibular ramus; to assess its usefulness as an aid in sex determination; to analyze the position of the mandibular foramen in relation and assess its reliability as an aid in sex determination and to compare the efficacy in sex determination and to discuss its ramifications.

Mandible Gonial Angle:

The current investigation determined that the gonial angle of the male mandible is between 115° and 140°, with an average of 126.9°. The average gonial angle of the female mandible is 136 °. The mandibular angle was less than 160 degrees for men and more than 109 degrees for women. The maximum angle of the mandible was 132 °, which correctly guessed the gender of 85 % of men and 65 % of women. The mean values of the mandibular angle for men and women are statistically different ($p < 0.001$) for mandible. The values of the female mandibles were found to be significantly higher than those of the male mandibles. The mandibular angle of the male mandible ranges from 111° to 136°, with an average of 121° 6°. The mandibular angle of the female mandible ranges from 97° to 137°, with an average of 122° 7°, according to the findings of a study that was conducted by Vinay et al [16]. The angle of the mandible at its defining point was

143.42 degrees for males and 106.29 degrees for females. The limit for the mandibular angle was set at 123 degrees, at which point 43.51 percent of male and 42.42 percent of female subjects could be correctly sexed. The gender differences in mean values of mandibular angle of male and female are not statistically significant (p=0.99) for mandible. This is because male and female mandibles have virtually identical mandibular angles. 5 In their study of 207 mandibles, Jayakaran et al. [17] discovered that the average angle of the male mandible was 121.43 degrees, while the average angle of the female mandible was 124.19 degrees. The males had a standard deviation of 6.99, while the females had a standard deviation of 6.90. According to the findings of Vallabhajosyula et al. [18], the mean angle of the mandible in males was found to be 110.68 degrees, while the mean angle of the mandible in females was found to be 114.53 degrees. The males had a standard deviation of 15.50, while the females only had 6.95. 7 Ayoub et al. [19] observed that there was no significant difference in the mandibular angle in the process of determining sex in the young Lebanese population (83 young individuals, 40 males and 43 females) aged between 17 and 26 years. 8 In the current research, the comparison of male and female mandibles revealed a disparity that was statistically significant.

Bigonial width:

The bigonial width of a male mandible can range anywhere from 86.1 to 105.2 mm, with an average of 96.1 mm and a standard deviation of 5.9 mm. Bigonial width of a female mandible can range anywhere from 79 to 104 mm, with an average of 89.1 6.9 mm and a standard deviation of 6.9 mm. For men, a bigonial width of more than 109.1 was considered ideal, while for women, a bigonial width of less than 80.13 was considered ideal. The maximum value for the bigonial width was set at 92.22, at which point 74% of males and 82% of females could be accurately identified. The statistical significance of the difference between the male and female mean values of bigonial width for the mandible is very high (p 0.001) in terms of significance. The values obtained from the female mandible were lower than those obtained from the male mandible. In their study of 207 mandibles, Jayakaran et al. [17] found that the mean bigonial breadth of male mandibles was 9.38 cm, while the mean for female mandibles was 8.71 cm. The males had a standard deviation of 0.54, while the females had a standard deviation of 0.48. According to Vallabhajosyula et al [18] study on 111 participants, the mean bigonial breadth for males was 8.68 cm, while the mean for females was 8.62 cm. The males had a standard deviation of 1.37, while the females had a standard deviation of 0.72. In their study on 102 Thai mandibles, Ongkana et al. [20] found that the mean value of bigonial breadth for male mandibles was 9.68 cm, while the mean value for female mandibles was 8.97 cm. The standard deviation for males was 0.77, while it was only 0.59 for females. The statistical significance of the gender differences in the mean values of bigonial width between male and female mandibles was determined to be 0.001 for mandibles. According to the findings of this study, there is a statistically significant gap between the mandible values of males and females. The current study found that the mean value of male mandibles was almost identical to values found in earlier studies.

Mandibular Ramus Breadth:

Several mandibular ramal parameters were measured for the study that was conducted by Indira and colleagues [25]. According to the findings of this research, the maximum ramus breadth in males and females measured a mean of 74.20 mm and 68.98 mm respectively, and the minimum ramus breadth in males and females measured a mean of 51.35 mm and 46.96 mm in respective measurements. Saini et al. conducted anthropometric research in Varanasi using sliding calipers in mandibular ramus in 2011. [21] This study was published in 2011. It was determined to have been observed as follows: In their study, the maximum ramus breadth showed values of 42.81 mm in males and 40.34 mm in females, and the minimum ramus breadth showed values of 31.29 mm and 29.65 mm in males and females respectively. On the other hand, in our study, the breadth of the Ramus ranges from 38.9 to 58.1 mm in male mandibles, with an average of 42.1 5.1 mm. It can be anywhere from 31.5 to 54.2 mm in female mandibles, with a mean value of 39.2 mm and a standard deviation of 5.8 mm. The width of Ramus had a dividing line that was greater than 64,2 for males and less than 31,5 for females. The cutoff point for the Breadth of Ramus test was 50.1, and it accurately predicted the results for 88% of males and 73% of females.

Mandibular Ramus height:

The researchers Datta et al. [22] conducted a study in 2015 on determining a person's gender based on their mandible by using a variety of morphometric parameters, and their study came to similar conclusions as ours did. Their research was conducted on a total of fifty adult mandibles from Southern India, all of which were dry and intact. A mandibulometer and digital calipers were utilized in order to measure a variety of morphometric parameters, such as ramal height and coronoid height. They discovered that the average height of the ramus in males was 67.98 mm, while the average height in females was 55.10 mm. While the mean value of the height of the ramus of the mandible was found to be 55.6 in females and 68 in males, the difference

between the two was significant. Males had a standard deviation of 4.9 for their ramus height, while females had a standard deviation of 5.4. When compared to those obtained in male mandibles, the values obtained in female mandibles were lower. Similar to our own research, this study [22] discovered that the height of the ramus was significantly different between males and females, with the difference being statistically significant. This was the case when comparing males to females. There was a statistically significant correlation in the height of the ramus between the male and female mandibles (p=0.059), according to a study that was carried out by Rai et al [23]. The researchers found that the mean mandibular ramus height was greater in males (53.9 cm) than in females (51.8 mm). 10 A study that was carried out by Al-Shamout and colleagues [24] came to the conclusion that males have higher values of the height of the ramus in comparison to their female counterparts, and that statistically significant gender differences were recorded in the height of the ramus. Taleb and associates [27] in 2015 carried out a study among Egyptians, where 191 Panoramic images were analyzed for five mandibular ramus linear measurements, such as upper and lower ramus breadth, projective height, condylar and coronoid height. They found the mean maximum ramus breadth to be 42.2 mm in males and 40.2 mm in females. A statistically significant difference was found between male and female mandibles in the present study, which is consistent with findings from earlier studies.

CONCLUSION:

In the fields of Anthropology and Medicolegal work, the examination of human skeletal remains plays an important role in identifying the individual. Sometimes, if a part of the bone is also available, it is possible to determine sex or age based upon different morphological and metrical parameters. This is only possible if the bone is complete. In the current study, various metrical parameters were used to determine gender.

Conflict of interest: None declared.

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