Analysis of mandibular length, mandibular index, and body thickness of the mandible and their impact on gender determination

Archana Chaudhary[1], Dr.Avanatika Bamne[2]

1. *Ph.D scholar , Malwanchal University, Indore, MP*
2. *Professor, Department of Anatomy, IMCH&RC, Indore, MP*

Corresponding Author: Archana Chaudhary,Ph.D scholar , Malwanchal University, Indore, MP,

Abstract:
Introduction: *Finding a complete human skeleton at a disaster site is statistically less likely than finding broken bone fragments. These factors increase the possibility of incorrect sex determination.* ***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 mandibular length, mandibular index, and body thickness of the mandible in the population of Indore region.* ***Materials & methods:*** *Prior to starting, the study received approval from the institutional ethics committee. The Department of Anatomy's initiative is located at the Index Medical College and Hospital in Indore, India's Madhya Pradesh state. jawbones from dried humans, unknown in gender. 50 mandibles were chosen for additional inspection after the ones that did not fit due to circumstances other than size were eliminated. Four distinct parameters, each of which is described in more detail in the section devoted to the materials and methods, were carefully measured for each mandible.* ***Results:*** *After obtaining all the measurements, unpaired 't-test' was performed. the mandibular length, length of the lower jaw, and body thickness of the mandible showed statistically significant gender difference.* ***Conclusion:*** *The current study is a population-specific study that uses several parameters of the mandible to determine the credibility of the mandible in sex determination. These parameters were determined by measuring the distance between the two structures.*

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I.   Introduction:

The discovery of a human skeleton in its whole at the site of the disaster is statistically less likely than the discovery of bone fragments that have been shattered [1]. Because of these factors, there is an increased likelihood that the determination of sex will be incorrect [2,3]. There is a significant possibility that sexual differences can be discovered in the majority of bone tissues [4,5]. As compared to these, the human pelvis, when it is sourced as an individual bone, is the most exact. The human skull is the bone that is used for detecting sex the second most frequently, and it has an accuracy rate of 92% [6-8]. Sex determination can also be done through the use of certain teeth [9].

In addition to being the largest bone in the face, the mandible possesses the greatest amount of strength and substance of all the facial bones [10]. In addition to this, it displays distinct characteristics that are associated with sexual dimorphism [11,12]. One of the numerous ways in which males and females differ from one another is in the ways in which their growth patterns differ from one another [12]. As a consequence of this, these distinctions have the potential to serve as an essential indication for discriminating between different skeletal remains [13-16]. 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 mandibular length, mandibular index, and body thickness of the mandible in the population of Indore region.

II.   Materials & methods:

The current study was launched after receiving approval from the Institutional Ethics Committee. The Department of Anatomy is located at the Index Medical College and Hospital in Indore, India, in the state of Madhya Pradesh. dried human jawbones of an undetermined gender. After removing the mandibles that did not fit due to reasons other than size, 50 were chosen for further examination. Each mandible was meticulously measured for a total of twelve different parameters, each of which is described in greater detail in the materials and methods section. ***Inclusion criteria:*** This study included all intact, well-formed adult Mandibles. ***Exclusion***

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criteria: The study did not include mandibles that were fractured, pathologically ill, deformed, or edentulous, as well as those that were damaged, mutilated, or deformed. In this study, the mandibular ramus was measured, and the results were compared to another parameter.

- Mandibular length: distance of the anterior margin of the chin from a centre point on the protected straight line placed along the posterior border of the two mandibular angles. Instrument: Mandibulometer.
- Length of lower jaw: it measures the straight distancefrom the posterior margin of the chin to the tangent drawn at the two gonia. Instrument: Vernier Caliper and Mandibulometer.
- Mandibular index (Thomson criteria): Length of lower jaw/Bicondylar Breadth X 100. Range variation (According to Lindegard and Sonesson) - Dolichostenomandibular ≤ 97.9, Mesomandibular 98.0 – 104.9, Brachyeurymandibular ≥ 105.0.
- Body thickness: it measures the maximum thickness in the plane of foramen mentale perpendicular to the longitudinal axis of the body. Instrument: VernierCaliper.

Statistical analysis:
The data were presented as Mean SD, and the unpaired t-test was performed using IBM SPSS Statistics 21. After calculating average values and tabulating the results, the data was statistically analysed. The results of the measurements were recorded in both directions. Once all measurements had been collected, an unpaired "t-test" was used.

III. Results:

The length of a man's mandible can be anywhere from 65.2 to 82.2 mm, with an average of 76.8 ± 4.5 mm. A woman's mandible can be anywhere from 61 to 82 mm, with an average of 70.8 ± 4.8 mm. For men, the length of the mandible had to be more than 85.1, and for women, it had to be less than 63.5. The limiting point for the mandible length was 73.7 mm, which correctly sexed 83 % of men and 74 % of women. The difference between male and female mean values for mandibular length is statistically very important ($p < 0.001$) for mandible. [Table 1].

Table 1: Mandibular length of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (degrees)	65.2 to 82.2	61 to 82
Mean ± SD	76.8 ± 4.5	70.8 ± 4.8
Calculated range	63.5 – 90.1	56.5 – 85.1
P value	< 0.001	
t-value	4.612	

The length of a man's lower jaw ranges from 51.9 to 66.8 mm, with a mean of 61.6 ± 4.4 mm. A woman's lower jaw ranges from 45.9 to 67.2 mm, with a mean of 58.3 ± 5.1 mm. For men, the length of the lower jaw had to be more than 73.4 and less than 48.4 for women. At a lower jaw length limit of 59.2 mm, 76% of males and 70 % of females could be correctly sexed. The difference between men and women in the average length of their lower jaws is statistically significant ($p < 0.001$) for the mandible. [Table 2].

Male mandible mandibular index ranges from 44.8 to 60.1, with an average of 55.1 ± 4.8, and female mandible mandibular index ranges from 40.1 to 63.1, with an average of 55.0 ± 5.8. Mandibular index had a cutoff point of more than 70.1 for men and less than 42.8 for women. The upper limit for the Mandibular Index was 55.1, which correctly identified 59 % of males and 46 % of females. The difference between men and women in the mean values of the Mandibular index is not statistically significant ($p > 0.05$) for the mandible. [Table 3].

Table 2: Lower jaw length of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (mm)	51.9 to 66.8	645.9 to 67.2
Mean ± SD	61.6 ± 4.4	58.3 ± 5.1
Calculated range	48.4 – 74.8	43.6 – 73.4
P value	< 0.001	
t-value	3.165	

Table 3: Mandibular index of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (mm)	44.8 to 60.1	40.1 to 63.1
Mean ± SD	55.1 ± 4.8	55.0 ± 5.8
Calculated range	42.8 – 67.2	39.8 – 70.1

P value	< 1.012
t-value	0.092

The body thickness of a male mandible can be anywhere from 13.9 to 20.2 mm, with a mean of 16.8 ± 1.7, and a female mandible can be anywhere from 11.4 to 17.9 mm, with a mean of 14.6 ± 1.8. The body thickness cutoff point for men was higher than 19.5 and lower than 12.1 for women. At a body thickness limit of 15.51, 79 % of males and 74 % of females could be correctly sexed. The difference between men and women in the mean values of body thickness is statistically very important ($p < 0.001$) for the mandible. [Table 4].

Table 4: Body thickness of the present study specimen

Measurement	Male	Female
No. of bones	26	24
Range (mm)	13.9 to 20.2	11.4 to 17.9
Mean ± SD	16.8 ± 1.7	14.6 ± 1.8
Calculated range	12.1 – 21.8	9.8 – 19.5
P value	< 0.001	
t-value	4.992	

IV.   Discussion:

The Index Medical College and Hospital in Indore, India, which is in the state of Madhya Pradesh, is home to the department of anatomy. jawbones from dried humans, unknown gender. Fifty mandibles were chosen for additional examination after the ones that did not fit due to factors other than size were removed. Twelve different parameters, each of which is described in more detail in the materials and methods section, were carefully measured for each mandible. In order to distinguish between men and women in this population, the discriminant function analysis is used in this study to try to identify the mandibular measurement that offers the most accurate information.

Mandibular length:

The length of a man's mandible can range anywhere from 65.2 to 82.2 mm, with a mean value of 76.8 mm and a standard deviation of 4.5 mm. The length of a woman's mandible can range anywhere from 61 to 82 mm, with an average length of 70.8 mm (plus or minus 4.8 mm). The length of the mandible had to be greater than 85.1 mm in males, and it had to be less than 63.5 mm in females. The maximum length of the mandible, which was measured to be 73.7 mm, accurately classified 83% of males and 74% of females. The difference in the mean values for mandibular length between males and females is statistically significant (p 0.001) for the mandible. In their study of 207 mandibles, Jayakaran et al. [17] found that the average length of the male mandible was 7.44 cm, while the average length of the female mandible was 7.06 cm. For males, the standard deviation was 0.41, while for females it was 0.47. 6 In their research on 111 different mandibles, Ranganath et al. [18] found that the average angle of the male mandible was 6.78 cm, while the average angle of the female mandible was 6.63 cm. The standard deviation for males was 0.94, while it was only 0.76 for females. 7 According to the findings of Ongkana et al. [20], the average length of the male mandible measured 8.94 cm, while the average length of the female mandible measured 8.53 cm. The standard deviation for males was 0.60, while it was only 0.55 for females. Vinay et al. [16] found that the mean value of the mandibular length in males was 7.54 cm, while the mean value in females was 7.25 cm. Males had a standard deviation of 0.43 for their mandibular angles, while females had a standard deviation of 0.51. The length of the mandible at the point of demarcation was 8.81 mm for males and 6.22 mm for females. The cutoff point for the mandibular length was 7.36, and using this parameter, the researchers were able to correctly identify 66.02% of male and 53.01% of female subjects. The value of the t statistic for the mandibular length was 4.83. For the mandible bone, the gender differences in the mean values of mandibular length of male and female were statistically significant (p less than 0.0001) for both sexes. The current study found that there is a statistically significant difference between male and female mandibles, and the mean values of male and female mandibles show findings that are almost identical to those found in earlier studies.

Mandibular index:

Male mandible mandibular index ranges from 44.8 to 60.1, with an average of 55.1 ± 4.8, and female mandible mandibular index ranges from 40.1 to 63.1, with an average of 55.0 ± 5.8. Mandibular index had a cutoff point of more than 70.1 for men and less than 42.8 for women. The upper limit for the Mandibular Index was 55.1, which correctly identified 59 % of males and 46 % of females. The difference between men and women in the mean values of the mandibular index is not statistically significant ($p > 0.05$) for the mandible. Study conducted by [21], stated that though body thickness, body height facilitates to sex the mandibles at higher percentage. Present study also shows body thickness and body height facilitate to sex the mandibles at higher percentage and the mean values of body thickness and body height are not statistically significant for both male and female mandibles.

Mandible thickness & height:

The body thickness of a male mandible can range anywhere from 13.9 to 20.2 mm, with a mean of 16.8 mm and a standard deviation of 1.7 mm. The body thickness of a female mandible can range anywhere from 11.4 to 17.9 mm, with a standard deviation of 1.8 mm. The cutoff point for men's body thickness was greater than 19.5, while the cutoff point for women was lower than 12.1. At a body thickness limit of 15.51, it was possible to accurately determine the gender of 79% of males and 74% of females. The statistical significance of the difference between men and women in the mean values of body thickness for the mandible is very high (p 0.001) according to the test. According to a study that was carried out by [21], despite the body thickness, the body height helps to facilitate the sexing of the mandibles at a higher percentage. 14 The current study also demonstrates that body thickness and body height make it easier to determine the gender of the mandibles at a higher percentage, and that the mean values of body thickness and body height are statistically significant for both male and female mandibles.

V.   Conclusion:

First and foremost, in the process of person identification for identifying personnel is the determination of a person's sexual orientation. The determination of a person's gender comes after the determination of their age and ethnic background. The current study is a population-specific study that uses several parameters of the mandible to determine the credibility of the mandible in sex determination. These parameters were determined by measuring the distance between the two structures.

Conflict of interest:
None declared.

References:

[1]. Owens JF. Forensic odontology: With case report. Irish Journal of Medical Science (1968-1970). 1970 Mar;3(3):137-47.
[2]. Berketa JW, James H, Lake AW. Forensic odontology involvement in disaster victim identification. Forensic science, medicine, and pathology. 2012 Jun;8:148-56.
[3]. Pretty IA, Sweet D. A look at forensic dentistry–Part 1: The role of teeth in the determination of human identity. British dental journal. 2001 Apr;190(7):359-66.
[4]. Özer I, Katayama K, Sahgir M, Güleç E. Sex determination using the scapula in medieval skeletons from East Anatolia. Collegium antropologicum. 2006 Apr 10;30(2):415-9.
[5]. Ashkenazi M, Taubman L, Gavish A. Age- associated changes of the mandibular foramen position in anteroposterior dimension and of the mandibular angle in dry human mandibles. The Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology. 2011 Aug;294(8):1319-25.
[6]. Trost O, Salignon V, Cheynel N, Malka G, Trouilloud P. A simple method to locate mandibular foramen: preliminary radiological study. Surgical and radiologic anatomy. 2010 Dec;32:927-31.
[7]. Samanta PP, Kharb P. Morphometric analysis of mandibular foramen and incidence of accessory mandibular foramina in adult human mandibles of an Indian population. Rev Arg Anat Clin. 2013 May 3;5(2):60-6.
[8]. Feuerstein D, Costa-Mendes L, Esclassan R, Marty M, Vaysse F, Noirrit E. The mandibular plane: a stable reference to localize the mandibular foramen, even during growth. Oral radiology. 2020 Jan;36:69-79.
[9]. Gabriel AC. Some anatomical features of the mandible. Journal of anatomy. 1958 Oct;92(Pt 4):580.
[10]. Fabian FM. Observation of the position of the lingula in relation to the mandibular foramen and the mylohyoid groove. Italian journal of anatomy and embryology= Archivio italiano di anatomia ed embriologia. 2006 Jul 1;111(3):151-8.
[11]. Wani BA, Nazir N, Sheikh RA, Chalkoo AH, Jan T. Morphometric analysis of foramen magnum in the determination of sex using computed tomography. Journal of Forensic Science and Medicine. 2021 Jan 1;7(1):9.
[12]. Berlińska M, Misiejuk A, Komisarek O. Evaluation of the position variation of mandibular foramen. Journal of Education, Health and Sport. 2019 Jul 3;9(7):185-94.
[13]. Yilmaz S, Tokpinar A, Tastan M, Ates S, Degirmenci M, Unalmis D, Patat D, Susar H. Analysis of Average Index Values of Mandible.2019
[14]. Shakya T, Maharjan A, Pradhan L. Morphometric Analysis of Mandibular Ramus for Sex Determination on Orthopantomogram. Journal of Nepal Health Research Council. 2022 Jun 2;20(01):65-71.
[15]. Okkesim A, Erhamza TS. Assessment of mandibular ramus for sex determination: Retrospective study. Journal of Oral Biology and Craniofacial Research. 2020 Oct 1;10(4):569-72.
[16]. Vinay G [16], SR MG, Anbalagan J. Sex determination of human mandible using metrical parameters. Journal of clinical and diagnostic research: JCDR. 2013 Dec;7(12):2671.
[17]. Jayakaran F, Rajangam S, Janakiram S, Thomas IM. Sexing of the mandible. Anatomica Karnataka. 2000;1(1):11-6.
[18]. Vallabhajosyula R, Ravindranath Y, Ravindranath R. Sexual dimorphism in mandibular morphology: a study on South Indian sample. South Asian Anthropologist. 2008;8(1):9.
[19]. Ayoub F, Rizk A, Yehya M, Cassia A, Chartouni S, Atiyeh F, Majzoub Z. Sexual dimorphism of mandibular angle in a Lebanese sample. Journal of forensic and legal medicine. 2009 Apr 1;16(3):121-4.
[20]. Ongkana N, Sudwan P. Gender difference in Thai mandibles using metric analysis. Chiang Mai Med J. 2009;48(2):43-8.
[21]. Kumar A, Klinkhachorn PS, Mohammed CA. Measurement of metric and nonmetric parameters for determining the gender of the human mandible. National Journal of Clinical Anatomy. 2022 Jan 1;11(1):22.