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Morphometric study on Dry Mandible for Sex determination

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Abstract:

Background:
Mandible is commonly studied bone by forensic pathologists, anthropologist for determination of sex from skeletal remains. It has been extensively studied by both metric and non-metric methods. Geographically the morphology and morphometry varies from region to region based on the race and sex. Hence, the current study is done with the objective to study the most important morphometric measurements for sex determination.
Material and Methods: A total of 100 dry mandible was included in the study. All the measurements were done using vernier caliper's by individual authors to minimize bias. The obtained values were entered in excel sheet and statistical analysis was done to know the significant value. P value <0.05 was considered as significant.

Results: Mean value of symphysial height, angle of the mandible, bigonial breadth and bicondylar breadth was observed to be significantly higher in male compared to female in the given population with a p-value <0.05.

Conclusion: The findings suggest that single parameter is not sufficient to decide the gender. Multiple variables need to be studied to confirm the gender based on the race and geographical distribution of population.

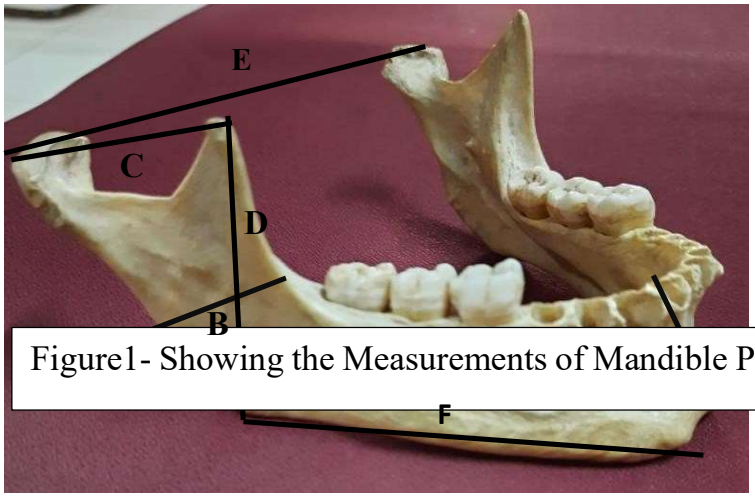
Key words: Mandible, Ramus, Sex determination, mandible length, Bigonial angle

Introduction:

Mandible is the strongest and movable part of the skull and forms the most important articulating segment of skull. It is one of the most bone which shows morphological changes with reference to age, sex and race [1,2]. Various imaging techniques such as CT scan, MRI, X-rays, are used to study mandible in living individuals for procedural and treatment purposes. With the help of the knowledge of the Mandibular anatomy and its relations it makes very easy for the surgeons, general physicians, anthropologists and medico-legal authorities to give their interpretations and variations regarding the age, gender, and race [3,4]. The identification of gender from skeletal remains is of paramount importance in anthropological and medico-legal aspects and can be done based on morphological features or parametrical analysis or as a judicious combination of both as in the present study [5,6].
The objective of the present study is to examine the morphological and morphometric measurements of the human mandibles of unknown sex. Furthermore, a statistical analysis of the parameters is conducted to determine the difference between men and women.

Materials and Methods:

The study included 100 mandibles chosen at random, regardless of gender from the Department of Anatomy, Andhra Pradesh. Damaged or defective mandibles were excluded. Mandibles that were completely edentulous and had their alveolar margins absorbed and paediatric mandibles were not included in the study. Each mandible was painted with varnish and examined separately by numbering from 1 to100. Sex of the mandible was determined by identifying the morphological features such as contour of the base, mandibular angle, muscular markings on the ramus of mandible. The morphometric features was measured using digital caliper's with a precision of 0.01 mm .All measurements were taken on both the sides and the measurements were taken by two independent observers, and the mean values was used for analysis. The data obtained were analysed statistically using SPSS software. Descriptive statistics such as means, standard deviations, and Standard error of mean (SEM) was calculated for each parameter. The level of significance was set at $p < 0.05$.



A- Symphysial height
B- Minimum breadth of ramus
C- Maximum breadth of ramus
D- Height of ramus
E- Bicondylar diameter
F-Horizontal length of mandible

Figure1- Showing the Measurements of Mandible Parameters

Results:

Based on the morphological feature such as shape of the chin Figure 2 shows the distribution of type of chin in male and female mandibles. Table 1 Shows the distribution of Morphometric measurements. The Mean, Standard deviation (SD) and Standard error of mean (SEM) and p value for the measured parameters in male and female is also shown in the table. Based on the findings, out of 100 mandibles studied, 66 were male and 34 were female. Figure 3 shows the maximum and minimum breadth of ramus.

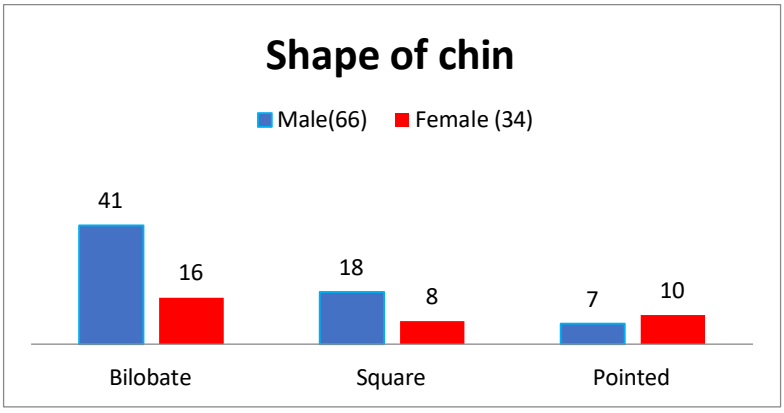


Figure 2: Distribution of Shape of chin in male and female mandibles.

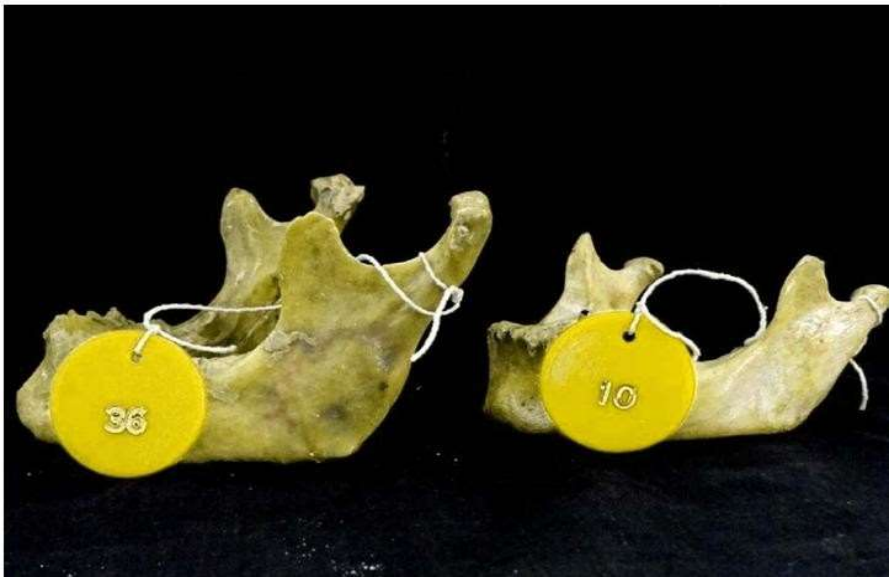


Figure 3: Maximum and Minimum breadth of Ramus

Table 1- Shows the distribution of Morphometric measurements

No	Name of the variable	Male (66)			Female (34)			P Value
		Mean	SD	SEM	Mean	SD	SEM	
1	Symphyseal height	26.71	2.71	0.33	23.11	0.80	0.13	<0.0001
2	Minimum breadth of ramus	30.09	4.74	0.58	29	3.16	0.54	0.22
3	Maximum breadth of ramus	41.72	2.37	0.29	39.02	3.53	0.60	<0.0001
4	Height of ramus – right	60.69	5.83	0.71	58.61	5.48	0.94	0.08
5	Body Height	28.90	1.97	0.24	26.79	1.53	0.26	<0.0001
6	Body length	78.72	2.62	0.32	77.44	3.75	0.64	0.04
7	Bigonial diameter	91.51	6.80	0.83	88.11	7.00	1.20	0.02
8	Bicondylar diameter	114.96	10.26	1.26	111.88	9.15	1.57	0.14
9	Mandibular angle	119.34	8.45	1.04	114.76	7.92	1.35	0.01
10	Mandibular index	53.06	6.56	0.8	53.88	5.96	1.02	0.54

Discussion:

The present study aimed to investigate the morphologic and morphometric parameters of the mandible in a specific population and to determine whether there are differences in these parameters based on gender and age. Mandibular ramus and condyle are the sites associated with the greatest morphological changes in size and remodelling, and are most dimorphic during growth [7,8,9]. Morphologically, based on the shape there are three types of mandible- Bilobate, Square and Pointed. In the present study, the most common shape in male was

bilobate (63.16%), square (29.82%) and least was pointed, whereas in females pointed shape (51.16%), bilobate (45%) and least was square shape.

The **symphyseal height** varies from 22mm to 45mm with a mean value of 27.09mm (table-2). When this compared to the range of the known gender out of 100 mandibles 66 could be identified as belonging to male and 34 to female. However, when other parameters are taken into consideration, the significance of symphyseal height as a deciding parameter for determination of gender is not significant.

Breadth of ramus is crucial for both age and gender assessment, accordingly minimum breadth of the ramus ranges from 24mm to 40mm with a mean value of 30.26mm. This mean value coincided with the mean value of 30.47mm reported by Saini et al [10]. Maximum breadth of ramus ranges from 32mm to 47mm with a mean value of 41.7mm in male and 39.02mm in female (Figure 3). With the help of this parameter, out of 100 mandibles 66 were identified as male, 34 as female with p value < 0.0001. Similarly, earlier studies by Maneesha Sharma et al [4] and Tejashree Bhagwatkar et al [11] found significant difference between male and female having p value 0.01 and 0.026 respectively. **The height of ramus** ranges from 45mm-74mm mean value of height 60.23mm. This was consistent with studies of Saini V et al. According to the study reported by Giles, 85% classification accuracy was noted based on mandibular ramus height, maximum ramus breadth and minimum ramus breadth in American whites and Negroes [12]. But in the given population, only 69% accuracy is obtained which is less when compared to that of Giles. This could be due to difference in the racial population studied and unknown age of the mandibles.

Mandibular length - mean values in Males (78.7mm) and in Females (77.44mm). Earlier studies have also reported similar results with males having more length than females 13,14. In the present study also the horizontal length in male was greater than female but on further analysis it was found to be statistically insignificant with p value > 0.05.

Bigonial diameter- distance between the two gonial angles. In males, the Mean value was 91.5 and in females it was 88.1. The obtained values were statistically significant with a p value of 0.02. Earlier studies done in Indian population also reported the same. Hence, bigonial diameter can be considered as one of the most important parameter for sex determination [14].

Bicondylar diameter ranges from 98mm to 126mm with a mean value of 114.17mm by which 66 mandibles can be said to be male, 34 female. In the current study bicondylar diameter of male and female mandibles are reported to be insignificant. This is in contrast to earlier reports with increased bicondylar diameter in male compared to female. [14,15] .

Mandibular angle ranges from 110 to 126 degrees with a mean value of 119^0 by which 62 mandibles were male and 32 were female with p value < 0.01. Increased angle was noted in male compared to female, whereas study by Babita et al reported increased angles in female compared to male in the Indian population, but the sample size was less. Few studies in western countries have reported increased angle in male compared to female . Hence, angle of mandible cannot be considered as a significant parameter for sex determination.

In the present study mean values of symphysial height, angle of the mandible, bigonial breadth and bicondylar breadth was observed to be significantly higher in male compared to female in the given population with a p-value less than 0.05. The findings of the present study suggest the above parameters could be used to differentiate the mandible.

Conclusion:

The results of the study reveals that every parameter independent of other parameters contributes certain percent of certainty to decide the gender of mandible which is unknown. There were significant differences in the mean values of the parameters between males and females among different age groups. The findings of this study was that males had a

significantly increased symphyseal height, mandibular breadth of ramus,larger angle of the mandible, ramus height, and body length than females. Therefore, it is clear that based on a single parameter, gender of mandible cannot be decided. All the parameters have to be considered together.

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Mini curriculum:

1. Barla Aparna-MBBS; MD. Contribution: Effective scientific and intellectual participation for the study; dissections; data acquisition, data interpretation; preparation and draft of the manuscript

2. Sony Jhansi Priya – MBBS; MD. Contribution: Effective scientific and intellectual participation for the study; dissections; data acquisition, data interpretation; preparation and draft of the manuscript

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