

## Sexual Dimorphism in Human Mandible: A Morphometric Study

Dr. Deepak N Kawale<sup>1</sup>, Dr. Pratima R Kulkarni<sup>2</sup>, Dr. Sukre B Shivaji<sup>3</sup>,

Dr. Diwan V Chaya<sup>4</sup>

<sup>1</sup>Asst. prof., Dept. of anatomy, GMCH Aurangabad. <sup>2</sup>Asso. prof., Dept. of anatomy, GMCH Aurangabad.

<sup>3</sup>Prof & HOD, Dept. of anatomy, Grant Medical college, Mumbai.

<sup>4</sup>Dean, Prof & HOD, Dept. of anatomy, GMCH Aurangabad.

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### **Abstract:**

**Aims:** Knowledge about the anatomy of mandible and its variations in age, sex and race will be useful for anatomists, anthropologists, anesthetist, orthopedics and experts in the field of forensic medicine to give correct interpretations for the diagnostic procedures in living as well as post mortem confirmation of findings.

**Methods:** 100 (Males 50, Females 50) human mandibles of known sex from the department of Anatomy, Government Medical College, Aurangabad, Maharashtra, India for the sexual dimorphism with the help of 14 different morphometric parameters.

**Results:** Amongst the parameters studied bigonial width, bicondylar breadth, maximum ramus height, mandibular angle and intermolar distance were found to be statistically significant for determination of sex of mandible with 95% confidence interval. Out of these significant five parameters maximum ramus height and intermolar distance shows highly significant p value that is 0.000. The incidence of the above mentioned sex determining parameters considered together and treated statistically.

**Conclusion:** Accuracy of determination of sex of human can be increased when measurement of these significant mandibular parameters correlated with parameters of another sex determining bone like pelvis, skull in osteometric studies.

**Keywords:** Human Mandible, Bignonial Width, Bicondylar Breadth, Maximum Ramus Height, Mandibular Angle.

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### **I. Introduction**

The mandible is a Latin word which means lower jaw. Mandere means to chew. Thus the word mandible is derived. The mandible is the largest, strongest and lowest bone in the face. This is only bone in the skull (with the exception of tympanic ossicles) that is capable of separate movement. Mandible is formed to carry the lower teeth opposing those of upper jaw, gives insertion to the muscles of mastication and origin to muscles of tongue, floor of the mouth and some muscles of facial expression. Identification of human skeletal remains is a critical problem and is very important in medico legal and anthropological work. The determination of sex of an individual is important and necessary both in the living and the dead for medico legal purpose. It is particularly essential when only skeletal remains are available. In the living and the dead, in fresh conditions, difficulty arises when sex is to be decided based on a few skeletal remains. Mandible next to the pelvis in human remains will help us in identification of age, sex and race. Morphometric study of the mandible and its correlation with sex performs valuable role in the anthropological diagnosis.

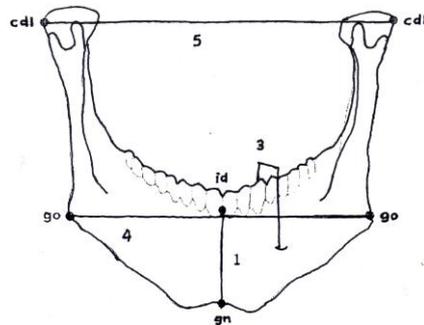
### **II. Materials And Methods**

The material used for the study contained 80 human mandibles of known sex obtained from department of Anatomy, Government Medical College, Aurangabad, Maharashtra. The bones collected are free from any pathological lesions or fractures. Totally edentulous mandibles with absorbed alveolar margins were excluded from this study. The following parameters were taken and measured on mandible with digital sliding Vernier calliper, Mandibulometer (fig.1)

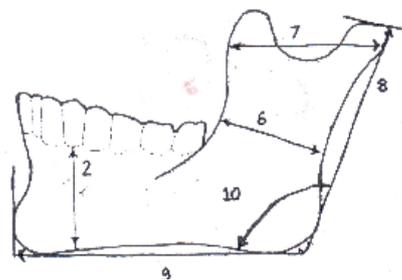


**Photo1 : Mandibulometer**

1.Symphyseal height, 2.Height of mandibular body,3.Breath of mandibular body,4.Bigonial width,5.Bicondylar breath,6.Minimum ramus breath,7.Maximum ramus breath,8.Maximum ramus height,9.Mandibular length,10.Mandibular angle,11.Intermolar distance,12.Intercanine distance,13.Arch perimeter,14.Ant-post distance of mandible



**Figure 1**



**Figure 2**

The data collected is statistically analyzed with the help of SPSS (Statistical Packages for Social Sciences) software and tabulated.

### III. Discussion

In the present study, symphyseal height in males had a mean 2.2020 cm, with standard deviation 0.3858 and standard error of mean 0.0551 while in females the mean was 2.1166 cm, standard deviation 0.3185 and standard error of mean 0.0750. On comparing the values in males and females with the help of unpaired 't' test, as 'p' value was found to be 0.365 statistically insignificant. The findings of the present study correlated well with the findings of Punarjeevan k. et al. and Jaychandra p. et al. while the study conducted by Mallik found that symphyseal height was more in males as compared to female.

The mean of height of mandibular body in males is 2.3959 cm, standard deviation 0.4092 and standard error of mean is 0.0584 while in females mean is 2.2833 cm, standard deviation 0.3091 and standard error of mean is 0.0728. The p value is 0.235 which is not significant. Similar values reported in study done by Punarjeevan k. et al. and Jaychandra P. et al.

Breath of mandibular body in males have mean 1.1183 cm, standard deviation 0.1495, standard error of mean is 0.0213 and in females mean is 1.0222 cm, standard deviation 0.1895, standard error of mean is 0.0446 and p value is 0.064. Study done by Punarjeevan k. et al. and Jaychandra P. et al. shows near about similar values.

Bigonial width of mandible in males is having mean 9.5632 cm, standard deviation 0.6146 and standard error of mean is 0.0878 while in females mean is 8.9833 cm, standard deviation is 0.7679 and standard error of mean 0.1810. Sexual dimorphism of mandible with help of bigonial width is statistically significant as p value is 0.002. In the study done by Vinay G. et al., Jayakaran et al., Franklin et al., Ranganath et al., Ongkana et al., Punarjeevan k. et al., Jaychandra p. et al. showed similar values as in present study.

When bicondylar breadth of all the mandibles under investigation is measured in males its having mean 11.2693 cm, standard deviation 0.6468 and standard error of mean is 0.0924 while in females mean is 10.75 cm, standard deviation is 0.6617 and standard error of mean is 0.1559. Study of bicondylar breadth shows association in sex determination of mandible (p value 0.005). In the studies done by Vinay G. et al., Jayakaran et al., Ranganath et al., Ongkana et al., Fabian f. et al. showed statistically significant difference between male and female mandible values. The mean value of bicondylar breadth of mandibles in the present study was almost similar to previous studies.

Minimum ramus breadth of mandible in males having mean 3.1346 cm, standard deviation 0.3243, standard error of mean is 0.0463 with values of female mandible have mean 2.9 cm, standard deviation 0.23, standard error of mean 0.0542. The p value is 0.006 which decreases the importance of minimum ramus breadth in sex determination of mandible. Study done by Annamalai p and Maria p, Punarjeevan k. et al. and Jaychandra P. et al. showed similar result about minimum ramus breadth.

In the present study maximum ramus breadth in males having mean 3.8938 cm, standard deviation 0.335, standard error of mean 0.0478 while in females mean is 3.6666 cm, standard deviation 0.3067 and standard error of mean is 0.0723 and p value is 0.013. Annamalai p and Maria p, Punarjeevan k. et al. and Jaychandra P. et al. got similar findings in their studies related to maximum ramus breadth.

Maximum ramus height of mandible in males is having mean 6.0061 cm, standard deviation 0.5249 and standard error of mean is 0.0749 while in females mean is 5.0888 cm, standard deviation is 0.3878 and standard error of mean 0.0914. Sexual dimorphism of mandible with help of maximum ramus height is highly significant as p value is 0.000. Studies done by Fabian f. et al., Annamalai p. et al., Punarjeevan k. et al. and Jaychandra P. et al. showed similar findings as in present study.

When mandibular length of all the mandibles in present study is measured in males its having mean 7.2265 cm, standard deviation 0.4376 and standard error of mean is 0.0625 while in females mean is 7.0166 cm, standard deviation is 0.5617 and standard error of mean is 0.1324. Study of mandibular length shows no association in sex determination of mandible (p value 0.113). In the studies done by Vinay G. et al., Jayakaran et al., Ranganath et al., Ongkana et al., Punarjeevan k. et al. and Jaychandra P. et al. The mean value of mandibular length in the present study was almost similar to earlier studies.

The mean of mandibular angle in males is 121.8571°, standard deviation 9.6003 and standard error of mean is 1.3714 while in females mean is 130.9444°, standard deviation 7.7949 and standard error of mean is 1.8372. The p value is 0.001 which is statistically significant showing association of mandibular angle in sex determination. Similar findings was in studies done by Punarjeevan k. et al. and Jaychandra P. et al.

Intermolar distance in males have mean 3.4469 cm, standard deviation 0.2062, standard error of mean 0.0294 while in females mean is 3.1611 cm, standard deviation 0.3517 and standard error of mean 0.0828. The p value is 0.000 which is statistically highly significant.

Inter canine distance of mandible in males having mean 1.7408 cm, standard deviation 0.2169, standard error of mean is 0.0309 with values of female mandible have mean 1.6222 cm, standard deviation 0.2016, standard error of mean 0.0475. As p value 0.045 decreases importance of inter canine distance in sex determination of mandible.

Arch perimeter of mandible in males having mean 5.9571 cm, standard deviation 0.364, standard error of mean is 0.052 while in female mean 5.7555 cm, standard deviation 0.4287, standard error of mean 0.101. The p value is 0.088.

Ant-post distance of mandible in males have mean 10.0449 cm, standard deviation 0.5824, standard error of mean 0.0832 while in females mean is 9.7 cm, standard deviation 0.4922 and standard error of mean 0.116. The p value is 0.021 which is statistically insignificant.

Studies on Intermolar distance, Inter canine distance, Arch perimeter, anterior-posterior distance of mandible by the Punarjeevan k. et al. and Jaychandra P. et al. showed similar results as in present study.

#### **IV. Result**

**A statistically significant** difference in the measurement of five parameters that is bigonial width, bicondylar breadth, maximum ramus height, mandibular angle, intermolar distance was found between males and females considering 95% confidence limit interval. Moreover measurement of maximum ramus height and intermolar distance showed highly significant gender difference (p value 0.0000).

#### **V. Conclusion**

Accuracy of human sex determination can be increased when measurements of mandibular parameters showing significant differences are analyzed. Furthermore evaluation of other sex determining bones like skull, pelvis in addition to mandible will definitely increase the sex determination percentage of unidentified specimen.

**Future Scope:** 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 results of diagnostic procedures in living.

**Table 1: Descriptive Statistics**

No.	PARAMETER	MALE			FEALE			P VALUE
		MEAN	S.D.	Std.Error of Mean	MEAN	S.D.	Std.Error of Mean	
1	CHIN HEIGHT	2.20204	0.385946	0.055135	2.11667	0.318544	0.075082	0.405
2	HEIGHT OF MANDIBULAR BODY	2.39592	0.409247	0.058464	2.28333	0.309173	0.072873	0.293
3	BREATH OF MANDIBULAR BODY	1.11837	0.149546	0.021364	1.02222	0.189599	0.044689	0.034
4	BIGONAL WIDTH	9.56327	0.614646	0.087807	8.98333	0.767923	0.181001	0.002
5	BICONDYLAR BREATH	11.26939	0.646853	0.092408	10.75	0.661771	0.155981	0.005
6	MINIMUM RAMUS BREATH	3.13469	0.324391	0.046342	2.9	0.230089	0.054233	0.006
7	MAXIMUM RAMUS BREATH	3.89388	0.335042	0.047863	3.66667	0.306786	0.07231	0.014
8	MAXIMUM RAMUS HEIGHT	6.00612	0.524964	0.074995	5.08889	0.387889	0.091426	0.000
9	MANDIBULAR LENGTH	7.22653	0.437691	0.062527	7.01667	0.561772	0.132411	0.113
10	MANDIBULAR ANGLE	121.8571	9.600347	1.371478	130.9444	7.794962	1.83729	0.001
11	INTERMOLAR DISTANCE	3.44694	0.206258	0.029465	3.16111	0.3517	0.082896	0.000
12	INTERCANINE DISTANCE	1.74082	0.216909	0.030987	1.62222	0.201627	0.047524	0.048
13	ARCH PERIMETER	5.95714	0.364005	0.052001	5.75556	0.428708	0.101048	0.06
14	ANT-POST DISTANCE OF MANDIBLE	10.0449	0.582402	0.0832	9.7	0.492294	0.116035	0.029

All measurements are in centimeter (CM).

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