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Sexual Dimorphism in Adult Human Mandible of South Indian Origin

Zafar Sultana[1], T Sreekanth[2], S Niveditha[3]

Abstract

Background: Mandible is the most durable and sexually dimorphic bone of the skull and resists postmortem changes too. Sexual dimorphism is seen in stages of mandibular development, growth rates and duration. Even by simple observation there is clear difference in size, height, thickness and muscle markings of mandible. *Context and purpose:* To establish and compare few metric parameters to assess sexual dimorphism in adult human mandibles of south Indian population. *Methods:* The present study was conducted on 60 dry adult human mandibles collected from anatomy dept of Shadan Institute of Medical Sciences and VRK Womens Medical College, Hyderabad. Only adult intact mandibles were included in study damaged, deformed broken bones excluded from study. First we classified bones depending on morphological features/non-metric parameters into males and females. Non-metric parameters were also recorded. *Results:* The mean bigonial breadth was 93.62 mm in males compared to 80.78 mm in females. Thus it was more in males compared to females and this difference was found out to be statistically significant. The bicoronoid breadth was 91.09 mm in males compared to 84.24 mm in females. Thus the bicoronoid breadth was more in males compared to females and this difference was found out to be statistically significant. Mandibular body height was significantly different for males and females mean for males was 28.13 mm and for females mean was 25.40 mm. Parameters like the mean bicondylar breadth, bimental breadth were not significantly different in males and females. *Conclusion:* The mean bigonial breadth, mean bicoronoid breadth and mandibular body height was significantly more in males compared to females. But other parameters were similar in both the sexes. *Potential implications:* Sexual dimorphism of skull is population specific due to combination of genetic as well as environmental factors. Racial and ethnic differences are also there. These metric data are useful for medicolegal, anthropological and dentofacial surgical procedures also.

Keywords: Sexual dimorphism; Human mandible; South Indian; Bigonial breadth; Bicondylar breadth; Bimental breadth; bicoronoid breadth; Mandibular body height.

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Introduction

Bones play important role to establish identity of an individual and they also help in establishing process of evolution, race and demographic profile.[1]

In adult skeleton, sex determination is usually first step of identification process and subsequent methods for age and stature estimation are sex dependent. 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 skull capable of separate movement. The accuracy of sex determination directly depends on availability of complete skeleton. It is 100 percent with complete skeleton, 95% with pelvis and 90% with skull.[2]

Mandible is the most durable and sexually dimorphic bone of the skull and resists postmortem changes too. Sexual dimorphism is seen in stages

Author's Affiliation: [1]Assistant Professor, [2]Professor and Head, [3]Assistant Professor, Department of Anatomy, Shadan Institute of Medical Sciences, Hyderabad, Telangana 500086, India.

Corresponding Author: Zafar Sultana, Assistant Professor, Department of Anatomy, Shadan Institute of Medical Sciences, Hyderabad, Telangana 500086, India.

E-mail: drszafarm@gmail.com

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of mandibular development, growth rates and duration.[3]

Even by simple observation there is clear difference in size, height, thickness and muscle markings of mandible.[4]

The knowledge about anatomy of mandible and its variations with age, sex, and race will help physicians, surgeons, medico-legal authorities and anthropologist to give correct interpretation for their diagnostic and surgical procedures in living and identity proof for skeletal remains. Pelvis exhibits greatest sexual dimorphism mandible is second most dimorphic bone. Mandible has horizontally curved body that is convex forward with upper alveolar border bearing teeth and lower border; i.e., base and two broad rami posteriorly bearing coronoid and condyloid process separated by mandibular notch.[5]

Mandibular size and shape affected by variable lifestyle, dietary behavior and racial groups.[6]

In cases like mass disasters where intact skull not available mandible may play vital role in sex determination as it is most dimorphic largest and strong bone of skull.[3]

Anthropologist use metric and non-metric parameters to study variations in human skeleton, metric parameters are more useful for comparative study.[5]

In present study has been undertaken to establish and compare few metric parameters to assess sexual dimorphism in adult human mandibles of south Indian population.

Materials and Methods

The present study was conducted on 60 dry adult human mandibles collected from anatomy department of Shadan Institute of Medical Sciences and VRK Women's Medical College, Hyderabad.

Only adult intact mandibles were included in study deformed, damaged and broken bones excluded from study

First we classified bones depending on morphological features/non-metric parameters into males and females

Non-metric parameters

Shape of chin-square in males and rounded in females.

Gonial flare-everted in males and inverted in females.

Muscle markings—more prominent in males than females

40 male bones and 20 were females as per non metric parameters

We studied total five parameters in each bone

Bigonial breadth–bgb; straight distance between two gonia [angle of mandible]

Bicondylar breadth–bcdb; the straight distance between the most lateral points on the two condyles

Bicoronoid breadth–bcrb; the straight distance between the most lateral points on the two coronoid processes

Bimental breadth–bmb; the straight distance between the inner margins of two mental foramina

Mandibular body height–mbht; it measures the distance from alveolar margin to lower margin of mandible at level of mental foramen perpendicular to base.

The metric parameters were measured using digital vernier callipers, all measurements in mm.

Statistical analysis: The measurements were recorded tabulated and analyzed statistically. Software used for data entry and calculation of mean and SD=Microsoft excel worksheet. Software used for calculation of students *t* test = graph-pad statistical software. *p*-value less than 0.05 was taken as statistically significant.

Results

Table 1 shows comparison of bigonial breadth in males and females. The mean bigonial breadth was 93.62 mm in males compared to 80.78 mm in females. Thus it was more in males compared to females and this difference was found out to be statistically significant ($p < 0.05$).

Table 1 shows comparison of bicoronoid breadth in males and females. The bicoronoid breadth was 91.09 mm in males compared to 84.24 mm in females. Thus the bicoronoid breadth was more in males compared to females and this difference was found out to be statistically significant ($p < 0.05$)

Table 1 shows comparison of various parameters in males and females. The mean bicondylar breadth was 110 mm in males and 109.3 mm in females. Though it was slightly more in males but the difference was not found out to be statistically significant ($p > 0.05$).

The bimental breadth was 43.93 mm in males compared to 43.71 mm in females. It was almost similar and thus statistically also the difference was not found out to be significant ($p > 0.05$).

The mean mandibular body height has shown significant gender difference with mean value of 28.13 mm for males and 25.40 mm for females ($p > 0.05$).

Table 1: Showing Statistical Analysis of All Studied Parameters

Parameters	Mean in, Males *N*=40 Bones	SD Male *N*=40	Mean in Female *N*=20 Bones	SD Female *N*=20	*t*-value	*p*-value	Interpretation
Bigonial breadth	93.62 mm	5.37	80.78 mm	6.88	7.9368	0.0001	Significant
Bicondylar breadth	110.00 mm	5.74	109.30 mm	9.35	0.3505	0.7272	Not significant
Bicoronoid breadth	91.09 mm	4.99	84.24 mm	20.19	2.0404	0.0459	Significant
Bimental breadth	43.93 mm	2.92	43.71 mm	2.13	0.2990	0.7660	Not significant
Mandibular body height	28.13 mm	3.16	25.40 mm	2.94	5.132	0.0001	Significant

Fig. 1: Measurement of bicondylar breadth.

Fig. 2: Measurement of bigonial breadth.

Fig. 3: Measurement of bicoronoid breadth

Discussion

In the present study, we found that the mean bigonial breadth was 93.62 mm in males compared to 80.78 mm in females. Thus it was more in males compared to females and this difference was found out to be statistically significant ($p < 0.05$).

Kumar MP *et al.*[7] found that the mean breadth of the bigonial was 92.22 mm overall for both the sexes which are comparable to the males in the present study.

Singh R *et al.*[3] observed the similar findings as found in the present study; i.e., more mean values of the bigonial breadth in males (96.2 mm) compared to females (84.3 mm) which was statistically significant.

Vinay G *et al.*[8] also reported similar findings which are comparable to the above two mentioned studies; i.e., more breadth in males compared to the females.

Datta A *et al.*[9] found in their study that the mean bigonial breadth was 95.7 mm in males and 88.75 mm in females. This difference was found to be statistically significant which is similar to the findings of the present study.

In the present study, we found that the mean bicondylar breadth was 110 mm in males and 109.3 mm in females and obviously the difference was not found to be statistically significant.

Kumar MP *et al.*[7] did all of their study in male mandibles and reported the mean value as 110.32 mm which is comparable to the findings of the present study.

Singh R *et al.*[3] observed that the mean bicondylar breadth in males was 112.2 mm and 101.7 mm in females and this difference was found out to be significant. This finding is in sharp contrast to the findings of the present study. The mean values are also slightly more compared to the present study.

Vinay G *et al.*[8] also reported that the mean bicondylar breadth in males was 112.72 mm and 107.48 mm in females and this difference was found out to be significant. This finding is in sharp contrast to the findings of the present study. The

Table 2: Showing Comparison With Previous Authors for Bicoronoid Breadth

Author	Bicoronoid Breadth in Males, Mean	Bicoronoid Breadth in Females Mean	Bicoronoid Breadth S.D\Males	S.D Females	*t*-value	*p*-value	Interpretation
Kumar MP *et al.*,50 Bones	91.97 mm		5.69				
Sarvesh Kumar *et al.* 53 Bones	94.88 mm	90.92 mm	0.613	0.41155		<0.05	Significant
Kanchankumar *et al.*, 82 Bones	95.3 mm	91.3 mm	0.065	0.113			
Present study	91.09 mm	84.24 mm	4.99	20.19	2.0404	0.0459	Significant

mean values are also slightly more compared to the present study.

Bimental breadth in our study not showing any significant gender difference. Kumar MP *et al.*[7] studied 80 adult mandibles; in their study bimental breadth was significantly different in males and females. Study of Anupam Datta *et al.*[9] done on 50 mandibles, for bimental breadth shows significant gender difference with *p*-value of 0.042.

Study done by Kranioti EF *et al.*[10] on Greek mandibles observed that mean value of bimental breadth in males was 44.55 mm and in females 43.82 mm but the difference was not statistically significant. Study done by Pillaji TJ *et al.*[11] for bimental breadth was statistically significant.

In the present study we found that the mean bimental breadth was 43.93 mm. Kumar MP *et al.*[7] in their study found that the mean bimental breadth was 43.19 mm which is comparable to the findings of the present study. Datta A *et al.*[9] in their study found that the mean bimental breadth was 44.38 mm which is comparable to the findings of the present study. The mean bicoronoid breadth is found to be 91.09 mm in the present study and this was found to be comparable with the study by Kumar MP *et al.*[7] (Table 2).

In the present study we found that the mean mandibular height has shown significant difference in male and female values. Table 3 shows comparison with other studies.

Anupam Datta *et al.*[9] in their study found that the mean mandibular height was 28.65 mm which is comparable to the findings of the present study (Table 3).

Sikka *et al.* in their study has shown significant gender difference with mean value of 24.9 mm for males and 22.8 mm for females, ($p > 0.05$).

Table 3: showing Comparison with Other Authors for Mandibular Body Height

Author	Mandibular Body Height, Mean In Males	Mandibular Body Height Mean, Females	SD Male	SD Female	*t*-value	*p*-value	Interpretation, Range Min-Max.
Sikka *et al.*	24.9 mm	22.8 mm	0.46	0.42		<0.01	Significant
Deepak N Kawale *et al.*	23.95 mm	22.83 mm	0.409	0.3091		0.235	Insignificant
Anupam Datta *et al.*	28.65 mm	22.83 mm	2.58	3.73	6.415	0.0001	25.03–34.51M 14.81–29.23 F Significant
Present Study	28.13 mm	25.40 mm	3.16	2.94	5.132	<0.0001	18.05–36.00 M 17.342–32.35 F Significant

Conclusion

Sex determination from bones is an important part of study in forensic medicine. Sex determination from skeletal remains is very important to establish identity in medico-legal cases. Mandible is second most dimorphic bone after skull to show sexual dimorphism. The advantage of metric analysis is that the data obtained can be easily comparable with different studies. Five parameters we studied in south Indian population, bigonial breadth of mandible. Bicoronoid breadth and mandibular body height have shown significant gender difference comparable with other studies. Bimental breadth, bicondylar breadth has not shown significant gender difference. Sexual dimorphism of skull is population specific due to combination of genetic as well as environmental factors. Racial and ethnic differences are also there. These metric data is useful for dentofacial surgical procedures also.

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