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Mastoid length a important tool in sex differentiation in dried skull bone

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Abstract
Skull is the 2nd most reliable bone after pelvis showing sexually dimorphic features, because skull has a high resistance to adverse environmental conditions over time, resulting in the greater stability of dimorphic features. In skull mastoid region also exhibiting sexual dimorphic traits. Present study is an observational study. In which total of 49 human dry skull of known sex (26 males 23 females) were included. mastoid length in Frankfurt's plane was measured in both side of each skull and made marking on the skull. The measurements of mastoid were taken on an anatomically sound basis using a digital vernier caliper, taking into account the error if any. The mean mastoid length in male was 30.2mm with the standard deviation of 2.64. In female skulls the mean mastoid length was 26.2mm and the standard deviation obtained was 3.57. (Table.No.1). Mastoid mean length found greater in males than in females which was highly significant (p value <0.0001). Present study aims to determine the difference in mastoid morphometry between male and female skull bone and using mastoid as a tool showing sexual dimorphism.

Keywords: Skull, mastoid, length, digital vernier caliper

1. Introduction
Study of human skeletal for sex determination has been a great importance in the field of life science and it has been interesting subject among researchers. Skeletal remains have been used for sexing the individual as bones of the body are last to perish after death, next to enamel of teeth. Almost all bones of the human skeleton show some degree of sexual dimorphism. Osteometric studies using individual bones exhibiting sexual dimorphism has been reported among different populations [1]. The pelvis and skull bones are widely used reporting almost 100% accuracy [2, 3]. Sex is best assessed from the pelvis but it is very often damaged [4]. In the skull, the temporal bone is highly resistant to physical damage; and in case of burning, petrous part of temporal bone is generally preserved because of its compact structure and protected position at the base of skull [5, 6].
Skull requires the most frequent sexing in medico legal cases. It appears to be the main reliable bone exhibiting sexually dimorphic traits, because skull has a high resistance to adverse environmental conditions over time, resulting in the greater stability of dimorphic features as compared to other skeletal bony pieces [7] Mastoid region is one of the most dimorphic traits [8, 9] Earlier traditional studies by nonmetrical methods were centred on morphological traits which were not reliable because more features depends on occupation, nutrition, race, geographical regions and visual impressions change from person to person. Subsequently trends changed to morphometry and statistical methods [10]. Osteometric studies using individual bones exhibiting sexual dimorphism have been reported among different populations [11]. Present study aims to determine the difference in mastoid morphometry between male and female bone and to determine the critical cut-off point for these measurements for sex differentiation.

2. Materials and methods
A total of 49 human dried skull of known sex (26 males 23 females) were obtained from the Department of Anatomy, G.R. Medical College, Gwalior M.P. Digital Vernier calipers had been used for taking measurements. For measuring mastoid length Frankfurt's plane was chosen and made marking on the skull. This line starts from the infraorbital margin, and upper border of the external acoustic meatus. (Figure 1).

From this line on the mastoid process a vertical length was measured up to the tip of the mastoid process.10 Length of the mastoid process was taken by digital verneir caliper from the upper border of the external auditory canal at the level of the Frankfurt's plane to the tip of the mastoid process on both sides of skull.

2.1 Instrument

The measurements of mastoid were taken on an anatomically sound basis. All measurements were taken using a digital vernier caliper, taking into account the error if any, in the instrument. A divider with fixing device was also used for taking the measurements.

Fig 1: Digital Vernier calipers using for taking measurement of mastoid process.

3. Observations & Result

All measurement taken calculated statistically and mean, standard deviation and p value were calculated. The mean mastoid length in male was 30.2mm with the standard deviation of 2.64. In female skulls the mean mastoid length was 26.2mm and the standard deviation obtained was 3.57. (Table.No.1). Mastoid mean length is greater in males than in females which was highly significant (p value <0.0001).

Table 1: Statistical significance of mean length of mastoid process in males and females.

Sex	Mastoid length (m.m.)	Mean (m.m.)	s.d	P value	Significance
Male	34.25	33.99	2.99	<0.0001	Highly significant
Female	27.72	27.54	2.94		

4. Discussion

Many studies have been conducted on mastoid length in western countries. In Caucasian population [12] the mean mastoid length was 28.06 mm in males and in females it was 25.10 mm. As compared to Negroes, mean length was less in Caucasians. In Nigroes male mastoid length was 30.32 mm whereas female mastoid length was 26.34mm. Our study is comparable to Negro population. Mastoid length measured by the use of points porion, mastoidale and asterion is the best method for the sexual dimorphism showing in a study by Nidugala H *et al.* [13] Still mastoid length was used as the better predictor for the sexual dimorphism by Dasgupta A *et al.* [14]

In another study by Deshmukh AG *et al* mastoid length was found the sex determinant in another craniometric study which included mastoid length as one of the parameters it was found that mastoid length was a significant parameter for sex determination with p value < 0.05 and also revealed 90% accuracy of male crania and 85.29% accuracy of female crania [15] Mastoid process length (p=0.006) was stated to be an independent predictors of sex determination [16].

Hoshi H11 *et al.* Studied the mastoid process length and divided the mastoid process into three categories viz, M, N and F types. Male, neutral and female categories. As the mastoid length is more in males as compared to females, skull lies on mastoid process in males and lies on occipital condyles in females when skulls are kept on flat surface.

5. Conclusion

The present study is an attempt to provide data of osteometric study of mastoid morphometry of male and female skull bone in different populations and using this data in exhibiting sexual dimorphism in mastoid bone.

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