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Sex Determination Using Craniometric Measurements Of Mastoid Process

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ABSTRACT

This study is to evaluate the accuracy of different craniometric parameters of mastoid process in sex determination. Sex determination is one of the most important parameters in anatomy and forensic science. In the skull, the mastoid process is a compact permanent process and is more resistant to damage. Hence, it can be used as a marker of sex determination in unidentified human skull remains.

The study was conducted on 50 adult dry human skulls of unknown age from the Department of Anatomy at Sree Balaji Dental College and Hospital, Chennai. The craniometrical points like highest part of external auditory meatus (porion), lowest point of mastoid process (mastoidale), Asterion (the meeting point of three sutures i.e. lambdoid, occipitomastoid and parietomastoid) were selected as area of our study. A triangle was prepared/drawn using these three points on skull bone on both sides. The measurements were taken from both sides, i.e., right and left side, and then an average of both sides was considered for statistical analysis. The outcome showed a significant higher values in male than the female dry specimens.

The mastoid measurements can serve as an invaluable tool to the forensic scientist with respect to identifying the sex of unknown individuals and as a relevant tool for craniofacial surgeons.

Keywords: *Mastoid process, External auditory meatus, Asterion, Morphometric*

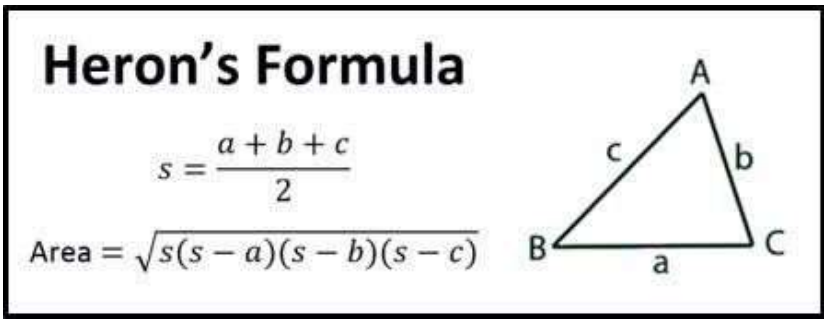
1. INTRODUCTION

Morphometric osteological parameters can play a significant role in identifying the gender of skeletal remains and provide the groundwork for complete identification. Identifying gender is often the first step for many anthropologists whether they are unearthing skeletal remains or dealing with unplanned disasters. Petaros et al. (1) and Kruger et al. (2) claimed that one of the most sexually dimorphic characteristics of the human skull is the mastoid process, which is why skeleton sex is frequently determined using it. The temporal bone can be viewed on the lateral aspect of the skull, forms lateral wall and floor of middle cranial fossa. This process has five components like the squamous part, tympanic part, styloid process, petrous and mastoid part. The mastoid process being located in the posterior section of a temporal bone as a conical projection. For sex determination, the pelvic bone provides the best assessment of sex, however it is frequently injured. So,

the mastoid process has been scrutinized for sex determination due to its anatomical placement within the skull. Numerous criminal or civil cases need the identification or determination of uniqueness. Medical characteristics and anatomy are two ways to define oneself. In today's forensic environment, dismemberment or bodily mutilations are now common ways to hide the victim's identification. In these situations, the best bone to identify a person's sex is thought to be the pelvis. Many people also believe that the skull is the greatest way to determine sex when the pelvis is not available. By measuring the area of the mastoid triangle created by projecting three craniometric points namely, the porion, the mastoidale and the asterion, the current study aimed to ascertain the accuracy of the mastoid process in determining sex

2. MATERIALS AND METHODOLOGY

The study was conducted using fifty dried adult skulls from the Sree Balaji Dental College and Hospital's anatomy department. In order to create the illusion, dry human skulls, a digital camera, and a sliding vernier calliper were used (Fig 1 C). Maintaining the mastoid process (Fig1 A) without destroying any craniometric points was a requirement for participation. The exclusion criteria included immature skulls, a damaged or malformed mastoid process, etc. A single observer indicated the three craniometric sites on the skull in order to prevent interobserver mistakes. Using "Heron's formula,"(3) the area of the triangle (Fig 1 B) created by combining the three craniometric points was determined. We have measured the distance between the three craniometric points porion, mastoidale and asterion of both the sides of the skull and have tabulated. An average of this measurement for both the sides was taken. Subsequently the average of the craniometric measurements was applied in the Heron's formula to produce the area of mastoid triangle.



3. RESULT

The craniometrical points porion, mastoidale and asterion are measured (Fig 1 B). An average of all the craniometric measurements for both the sides of the male and female skulls are calculated. These measurements were considered as "a" (asterion-porion), "b" (porion-mastoidale) , "c" (mastoidale-asterion) and were collectively used to find the value of "s" and then the values were applied in the Heron's formula to determine the area of the triangle. The values showed a statistically significant variation between males and females were shown table 1.

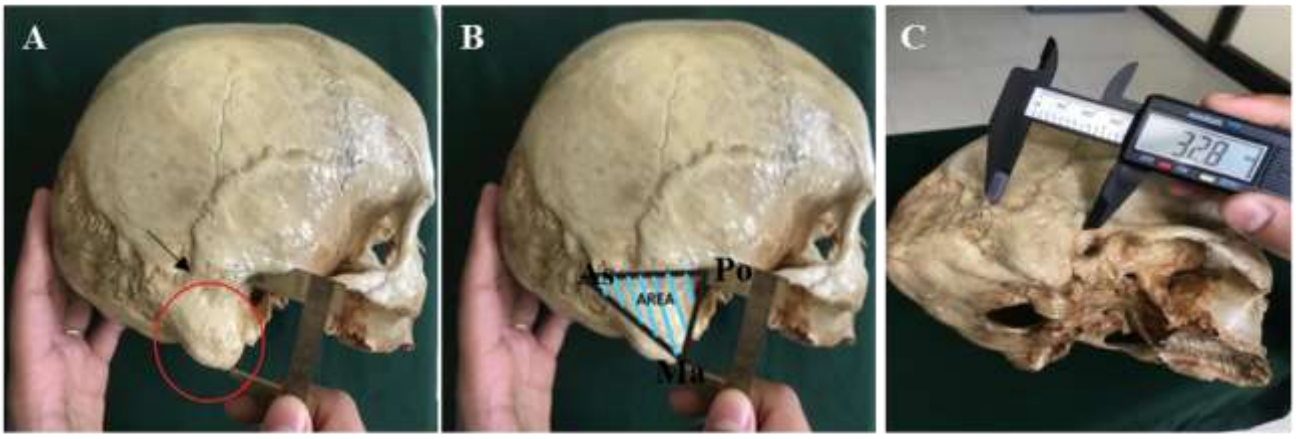


Fig 1 A. Mastoid process (black arrow) **B.** Area of mastoid triangle **C. Measured using vernier caliper**
Porion (Po): Highest point on the surface of the external auditory meatus.; **Mastoidale** (Ma): Lowest point at the mastoid process ; **Asterion** (As): Meeting point of lambdoid, occipitomastoid, and parietomastoid sutures.

Table 1: AVERAGE OF THE CRANIOMETRIC MEASUREMENTS FROM BOTH SIDES OF A SKULL

ASTERION-PORION (in mm)		PORION-MASTOIDALE (in mm)		MASTOIDALE-ASTERION (in mm)	
MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
30.5	24.0	46.75	40.3	47.5	45.5
33.5	24.3	53.0	41.0	50.5	45.2
30.7	25.0	53.5	43.5	45.5	45.0
30.0	24.6	52.5	40.5	47.5	39.0
32.8	27.5	43.2	49.5	39.0	39.5
26.5	27.0	46.5	46.0	45.5	40.0
27.0	28.5	47.4	49.0	45.5	43.5
28.5	28.0	52.5	55.5	49.5	48.5
30.0	28.5	53.5	54.0	50.0	47.0
30.3	25.5	53.5	43.0	51.0	37.0
33.5	26.5	55.5	48.0	51.5	41.0
30.0	2.6	52.5	5.05	47.5	4.4
31.5	24.0	53.5	40.5	47.0	39.0
29.8	23.1	53.3	41.5	49.5	38.5
27.5	2.4	49.5	4.05	43.0	3.9

Area of mastoid triangle (mm sq):

The area of the mastoid triangle proved to have a higher value in males compared to females

Male: 650.29 ± 50.45 mm sq

Female: 590.61 ± 47.7 mm sq

4. DISCUSSION

Morphometric analysis of mastoid was chosen because it is strong against injuries, maintain its strength as people ages because of its anatomical location, and could be an efficient predictor of sex. Passey et.al., (4) reported on the use of mastoid process as a tool for sex estimation in unidentified human skeleton in different populations were the lineal dimension of the mastoid length was higher in males than in females. Our research demonstrates the utility of the triangle area measurement, which is defined by the projection of craniometrical sites associated with the mastoid process, in skull sexing, which coincide with Shah S and Patel P (5). According to Madadin et al. (6) sex identification is part of the demographic evaluation of skeletal remains in forensic investigations. Bhayya et.al., (7) concluded that, all the parameters in their study are considered, the mastoid process is a good indicator for sex determination with an accuracy of 82%. Jung and Woo (8) evaluated the difference in the size and shape of the mastoids between male and female among modern white Americans and were statistically significant sex indicators, which interrelated with our study.

De Paiva et al. [7], Kemkes and Gobel [8], and Sumati et al.

[9] also stated that the qualitative aspects of the mastoid process, such as their size and muscular

impressions, are very good indicators of sexual dimorphism

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5. CONCLUSION

The area of the mastoid triangle, the asterion-porion distance, the mastoidale-asterion, and the porion-mastoidale all showed statistically significant differences with a higher value in males than in females. Data analysis revealed that the porion-mastoidale length was the second best predictor of sex, behind the area of the mastoid triangle. The study's positive findings provide a greater chance to use the mastoid process to detect sex. Mastoid parameters were used in the current investigation to determine sex in the South Indian population when either a fragmented skull or just the mastoid region was acquired. It was determined that men had a higher mean mastoid triangle area as compared to females. This evident difference in mastoid triangle area is observed in all populations irrespective of race and region.

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