

# IOA Index – The Predictor of Gender Dimorphism

Pinki Kumari<sup>1</sup>, Aman Kumar<sup>2</sup>, Mukesh Prasad<sup>3</sup>, Sanjeev Kumar<sup>4</sup>

<sup>1</sup>Senior Resident, Department of FMT, IGIMS, Patna, Bihar.

<sup>2</sup>Professor & HOD, Department of FMT, IGIMS, Patna, Bihar.

<sup>3</sup>Assistant professor, Department of FMT, IGIMS, Patna, Bihar.

<sup>4</sup>Associate professor, Department of FMT, IGIMS, Patna, Bihar.

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## ABSTRACT

**Background:** Sex determination is utmost important for forensic experts and Anthropological studies. **Aim:** The aim of this study is to compare cranial morphology between male and female skull using IOA Index. **Methods:** A total of 100 adult dry skull (50 male and 50 female) were used for study using a digital Vernier calliper. **Results:** The male parameters were significantly higher than female parameters with no significant difference in Right and Left side of male and female. **Conclusion:** The skull is most commonly site for sexual dimorphisms in human Skeleton and IOA Index can be additive value gender differentiation.

**Keywords:** IOA Index, Sex Determination.

## INTRODUCTION

The curiosity to explore the morphological characteristics of human skeleton has been the interest of researchers since antique. The measurement of the dry skull from osteological landmark is called Craniometry. Anthropologist pioneered the scientific approach to characterize craniofacial skeleton. The increasing demand from medicolegal investigation of skeletal remains created a surge for more precise identification of the species and its associated attributes. In forensic science the identification of the skeletal remains starts from the determination of sex. The existence of sexual dimorphism in human skeletons and its importance in medicolegal investigations have long been acknowledged. Therefore, human skull is probably the most fascinating bone in the series.

The reliability gender differentiation is almost 100% with entire skeleton, 92% using the skull alone, and 98% when skull combined with pelvis. Krogman and Iscan Even though several postcranial elements have proven to be more effective in sex prediction,<sup>[1]</sup> the skull still demonstrated the most dimorphic parts of the skeleton.<sup>[2]</sup> There are mainly four available methods of gender differentiation i.e. Morphological, metrical, geometrical morphometries and molecular. Out of these bone morphology is the

oldest. The sexual dimorphism in the human skull is grossly determined by certain factors like general size, nuchal crest, mastoid process, supraorbital ridges, mental eminence etc.

The MAP (mastoidale, asterion and porion) technique of triangular area calculation for sex determination is well established. Saavedra de Paiva and Segre developed the MAP area calculation of the triangular landmark on temporal bone is the easiest technique.<sup>[3]</sup> This was further described by Hey. A value of 1447.40 mm<sup>2</sup> or more is suggestive of male skull, and a value near to 1260.36mm<sup>2</sup> or less is indicative of female skull. 3 MAP is most studied method worldwide and the reports in this regards are available for different racial and ethnic groups.<sup>[4-12]</sup> The racial ethnic variation in the morphological characteristics of skull is obvious. Despite the increase in research on sex prediction using craniofacial characteristics the data for inion, opistocranium, and asterion landmark is sparse. Therefore, the aim of this study was to develop a sex determination technique using inion, opistocranium, and asterion triangle for north Indian population

## MATERIALS AND METHODS

The study was conducted at Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna, using 100 fully ossified and dry adult human skulls (males=50 and Females=50). The study was approved by institutional research committee. A digital vernier caliper and micro-tip pencil was used for carrying measurement. The following landmarks were marked

### Name & Address of Corresponding Author

Dr. Sanjeev Kumar,  
Associate Professor,  
Department of FMT,  
IGIMS, Patna,  
Bihar.

- Inion- Inion is the most prominent point in the posterior aspect of the occipital calvarium occurring at the intersection of the left and right superior nuchal lines.
- Opistocranium- Opistocranium is the most posteriorly protruding point on the back of the skull, located in the mid-sagittal plane.
- Asterion- Asterion is the meeting point of the lambdoid, occipitomastoid, and parietomastoid sutures or the point.

**Length were measured for**

- 1) Asterion- Opistocranium (AO) length.
- 2) Asterion-Inion (AI) length.
- 3) Inion- Opistocranium (IO) length.

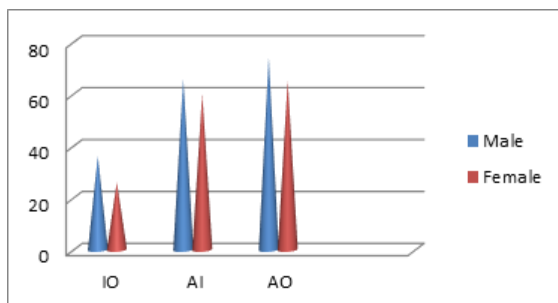
IOA index was calculated as:

IOA INDEX =	Inion-Opistocranium	X 100
	Inion –Asterion	

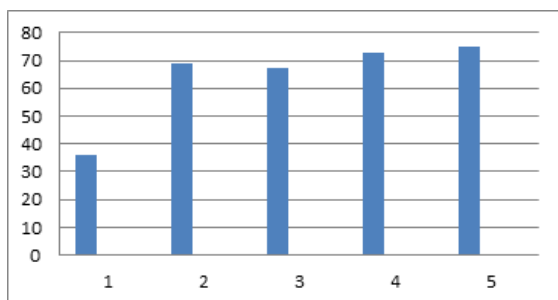
The observed data was subjected statistical analysis using SPSS software version 10.

**RESULTS**

The observed data revealed, the mean values for Asterion- Opistocranium (AO) length, Asterion-Inion (AI) length and Inion- Opistocranium (IO) length the male cranium were significantly greater than the female. [Figure 1]



**Figure 1: mean measured values of male and female skull**

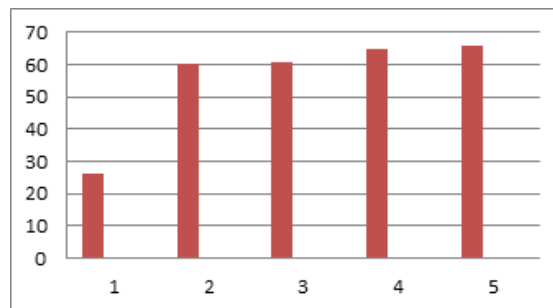


**Figure 2: Mean values of male skull observed data**

The mean observed values of the male skull was found to be 36mm, 69mm 67mm 73mm and 75mm respectively for 1. Inion –Opistocranium length, 2.

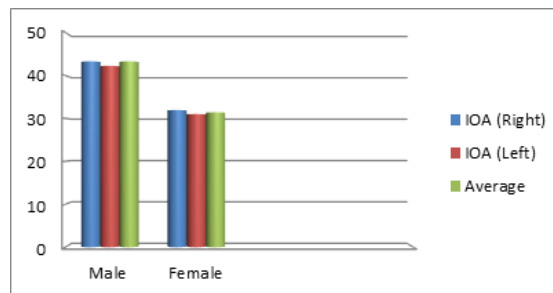
Asterion Inion Length (Right), 3. Asterion Inion Length (Left), 4. Asterion-Opistocranium length (Right), and 5. Asterion-Opistocranium length (Left). [Figure 2]

The mean observed values of the male skull was found to be 36mm, 60mm, 61mm, 65mm and 66mm respectively for 1. Inion –Opistocranium length, 2. Asterion Inion Length (Right), 3. Asterion Inion Length (Left), 4. Asterion-Opistocranium length (Right), and 5. Asterion-Opistocranium length (Left). [Figure 3]



**Figure 3: Mean values of male skull observed data**

The IOA index amongst the gender was significantly different, but was comparable and non-significant for the right and left for the same gender. [Figure 4]



**Figure 4: IOA index amongst the gender**

**DISCUSSION**

Determination of sex plays a key role for anatomists, anthropologists and forensic experts. Numerous techniques have been described for sex determination including clinical and radiological examination, anthropometry, growth charts, chromosomal analysis but anthropometric measurement of bone still remains supreme.<sup>[13-18]</sup> Cranial bone analysis whether morphometric or morphological have played an important role in sex determination.

Body size, proportions and architectural differences are the three primary biological differences amongst genders.<sup>[19]</sup> Males generally have more body mass index than females as they have more muscular and more weight of axial skeleton. Lots of studies were done for sex determination using skull for various parameters like foramen magnum, mastoid triangle, mastoid process, mandible and various

lengths and landmarks.<sup>[20,21]</sup> The present study of sex determination using IOA Index showed, a significant difference between male and female parameters, with higher values for males. This was in consonance with the previous study of Orish et. al.; and Gupta et.al. In this study area of IOA triangle of male was found to be significantly higher than that of female.

## CONCLUSION

The present research showed high level of sexual dimorphism and will be of immense help to forensic expert.

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