

Sex Determination from Foramen Magnum Measurements in Population of Uttar Pradesh

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ABSTRACT

Background: Human skeletal remains examination plays an important role in Anthropology and Medicolegal works to identify the individual. The aim of the present study was to measure the Sagittal and Transverse diameters of the Foramen magnum intracranially and to study the possibility of sex determination using these measurements.

Materials and Methods: The present study was conducted using 48 human bodies in which 28 were male whereas 20 were female bodies in the age group of 18-60 year over the period of 6 months. The age group of 18-60 years was selected because the sexual characteristics of the bone do not begin to manifest themselves until the stage of puberty is attained. Hence the lower limit of age was fixed as 18 years. Since all the sutures of the cranium get fused by the age of 60, the upper limit was fixed at 60 years. Human bodies with age group of 18-60 years which were without any fracture of the cranium were included in the study. Human bodies with Congenital anomalies, Dwarfs were excluded from the study. The intra cranial transverse and sagittal diameter of foramen magnum was measured using digital vernier caliper to the accuracy of 0.5 mm. Statistical analysis was done by using SPSS, version 22 (SPSS, Inc., Chicago, IL) and $p < 0.05$ was considered statistically significant.

Results: The total bodies included were 48 in which 28(58.33%) were male bodies and 20 (41.66%) were female bodies. The mean value for sagittal diameter of the male cases alone was 18.0 ± 0.9 mm and the transverse diameter was

27.2 ± 1.0 mm. In female bodies the mean value of sagittal diameter was found to be 17.2 ± 1.4 mm and the transverse diameter was 22.0 ± 0.3 mm. The statistical analysis shows significant difference in the intracranial transverse diameter but there was no statistically significant difference in the sagittal diameter.

Conclusion: It was concluded from the study that there was a significant difference in the intracranial transverse diameter but there was no statistically significant difference in the sagittal diameter. Therefore, sagittal diameter cannot be used to differentiate the sex.

Keywords: Sagittal and Transverse Diameters, Sex Determination, Foramen Magnum.


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INTRODUCTION

Identification of human skeletal remains is very important and integral part of 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. According to Krogman, the degree of accuracy in sexing adult skeletal remains is entire skeleton 100%, Pelvis alone 95%, Skull alone 90%, Pelvis and skull 98% and long bones alone 80%.¹ Identification is the determination of the individuality of a person. The identification of a living person is based entirely on the known- fingerprints or birthmarks or several personal impressions with regard to characteristic gestures, movements or shape, features of the teeth, eyes, hair or voice. The determination of sex is statistically the most important criterion, as it immediately

excludes half the population. The identification of sex from human remains is of fundamental importance in forensic medicine especially in criminal investigations, in the identification of missing persons and in anthropology, in attempts at reconstructing the lives of ancient populations. The identification of a dead body is required in cases of sudden and unexpected death, fires, explosions, railway or aircraft accidents, mutilated or hidden decomposed bodies or foul play that often needs great medico-legal acumen. Osteometry includes the measurements of the skeleton and its parts i.e. the measurements of the bones including the skull. Through this technique, a forensic scientist can study the variation in bony skeleton of different populations of the world. The technique has been successfully used in the estimation

of stature, age, sex and race in forensic and legal sciences. These four parameters i.e. age, sex, race and stature is considered as the "Big Fours" of forensic anthropology. The accuracy of determination of the sex from skeletal remains varies with the age of the subject, the degree of available fragmented bones, fragmentation of the bones and biological variability.² The aim of the present study was to measure the Sagittal and Transverse diameters of the Foramen magnum intracranially and to study the possibility of sex determination using these measurements.

MATERIALS AND METHODS

The present study was conducted using 48 human bodies in which 28 were male whereas 20 were female bodies in the age group of 18-60 year over the period of 6 months. The study was approved by the Ethical Committee of the institution. The age group of 18-60 years was selected because the sexual characteristics of the bone do not begin to manifest themselves until the stage of puberty is attained. Hence the lower limit of age was fixed as 18 years. Since all the sutures of the cranium get fused by the age of 60, the upper limit was fixed at 60 years. Human bodies with age group of 18-60 years which were without any fracture of the cranium were included in the study. Human bodies with Congenital anomalies, Dwarfs were excluded from the study. The intra cranial transverse and sagittal diameter of foramen magnum was measured using digital vernier caliper to the accuracy of 0.5 mm. Statistical analysis was done by using SPSS, version 22 (SPSS, Inc., Chicago, IL) and $p < 0.05$ was considered statistically significant.

RESULTS

The total bodies included were 48 in which 28(58.33%) were male bodies and 20 (41.66%) were female bodies. The mean value for sagittal diameter of the male cases alone was 18.0 ± 0.9 mm and the transverse diameter was 27.2 ± 1.0 mm. In female bodies the mean value of sagittal diameter was found to be 17.2 ± 1.4 mm and the transverse diameter was 22.0 ± 0.3 mm. The statistical analysis shows significant difference in the intracranial transverse diameter but there was no statistically significant difference in the sagittal diameter.

Table 1: Distribution of gender

Gender	N(%)	p-value
Male	28(58.33%)	<0.05
Female	20(41.66%)	
Total	48(100%)	

Table 2: Mean diameter of foramen magnum

Measurement	Male	Female
Sagittal diameter	18.0 ± 0.9 mm	17.2 ± 1.4 mm
Transverse diameter	27.2 ± 1.0 mm	22.0 ± 0.3 mm.

DISCUSSION

A man is born with an identity and deserves to die with the same. However, at number of cases, such as natural calamities, mass disasters, and intentional/unintentional act of fellow human beings

bring forth unidentified bodies.³ Unidentified skeletal remains often cause problems in gender determination and the investigating team, or the forensic experts have to face challenge in these circumstances.⁴ Significant differences exist in the measurements of Foramen Magnum between males and females in different geographical regions.⁵ The Foramen Magnum is an important landmark of the skull base and is of important interest in anthropology, anatomy, forensic medicine, and other medical fields. It is a three-dimensional (3D) circular or oval aperture within the occipital bone centrally. It transmits the medulla oblongata and its membranes. Other structures that pass through it are spinal accessory nerve and vertebral arteries. In clinical forensic medicine, use of radiographs is noteworthy and widely accepted. They are acquired as a part of postmortem investigations to detect foreign bodies or document fractures or other injuries.⁶ In the present study the total bodies included were 48 in which 28(58.33%) were male bodies and 20 (41.66%) were female bodies. The mean value for sagittal diameter of the male cases alone was 18.0 ± 0.9 mm and the transverse diameter was 27.2 ± 1.0 mm. In female bodies the mean value of sagittal diameter was found to be 17.2 ± 1.4 mm and the transverse diameter was 22.0 ± 0.3 mm. The statistical analysis shows significant difference in the intracranial transverse diameter but there was no statistically significant difference in the sagittal diameter.

Uysal et al. did a study using 3D CT and took seven measurements of the foramen magnum on 3D. Foramen Magnum diameters were found to be statistically different in each sex ($P = 0.001$), with a sex determination accuracy rate of 81% in accordance to our study where the overall predictive accuracy found to be 83.6%.⁷

Tambawala et al. used the foramen magnum dimensions and got the overall accuracy rate for sex determination to be 66.4%. Out of these, 70.3% of males and 62.6% of females were sexed correctly. The best parameter for sex determination according to their study was the area of the foramen magnum.⁸

Another study conducted by Swami Nathan M.N. et al reported a value of 27.9mm for the transverse diameter of the Foramen magnum.⁹

Murshed K.A et al of Turkey in their study reported 40mm and 27mm as the maximum and minimum for male and 33mm and 24mm as the maximum and minimum values for females.¹⁰

CONCLUSION

It was concluded from the study that there was a significant difference in the intracranial transverse diameter but there was no statistically significant difference in the sagittal diameter. Therefore, sagittal diameter cannot be used to differentiate the sex.

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