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A MORPHOMETRIC STUDY OF FORAMEN MAGNUM

Anatomy

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ABSTRACT

The foramen magnum is a large opening in the posterior part of norma basalis of human skull. Various vital structures pass through the foramen magnum including medulla oblongata and tonsil of cerebellum. So the measurements of the foramen are important as these structures may get compressed in disorders like foramen magnum herniation and achondroplasia. Fifty human skulls of unknown age and sex were included in the present study. The antero-posterior and transverse diameters were found to be 3.4 ± 0.3 cm and 2.79 ± 0.21 cm respectively as measured by digital slide calipers. The area of foramen magnum was calculated to be 7.49 ± 1.11 cm^2 by suitable mathematical formula. These findings will be helpful for neurosurgeons, radiologists, anthropologists and forensic scientists.

KEYWORDS:

Foramen magnum, morphometry, variations.

INTRODUCTION:

The foramen magnum (great hole in Latin) is an opening in the occipital bone at the base of the skull. Various important structures passing through the foramen are medulla oblongata, vertebral artery, anterior and posterior spinal arteries, spinal accessory nerve, various ligaments connecting the dens of axis with the occipital bone and occasionally the tonsil of the cerebellum1. The measurements of foramen magnum are clinically important as the vital structures passing through it may get compressed in conditions like herniation of brain through foramen magnum2,3 and foramen magnum achondroplasia4. In Arnold-Chiari malformation there is expansion of the transverse diameter of the foramen magnum5. The size of foramen magnum is small in achondroplastic patients of all ages with grave neurological malformations6. So the variations in the dimensions of foramen magnum are clinically important. The knowledge of the dimensions of foramen magnum is also important prior to the cutting off of the foramen magnum lesions, because larger antero-posterior diameter is associated with greater contralateral surgical exposure6. The diameters and area of foramen magnum are more in males compared to females. So the dimensions are important for determination of sex in medicolegal cases5,7. It's obvious that the dimensions of foramen magnum are highly valuable in neurosurgery, radiology and forensic medicine. So the present study was carried out to determine the dimensions of foramen magnum.

MATERIALS AND METHODS:

The study was carried out on fifty dried human skulls of unknown age and sex available in the Departmental Museum of Anatomy in a Medical College in Bhubaneswar. Broken and deformed skulls were excluded from the study. The diameters of foramen magnum were measured with the help of digital Vernier callipers. The antero-posterior (sagittal) diameter was measured as the distance between basion and opisthion (Figure- 1). The transverse diameter was measured between the points of maximum concavity on right and left margins (Figure- 2).

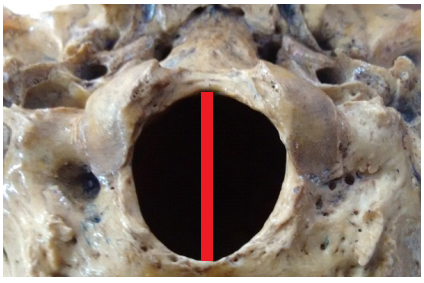

Figure 1: Photograph showing the distance measured as the antero-posterior diameter of foramen magnum.

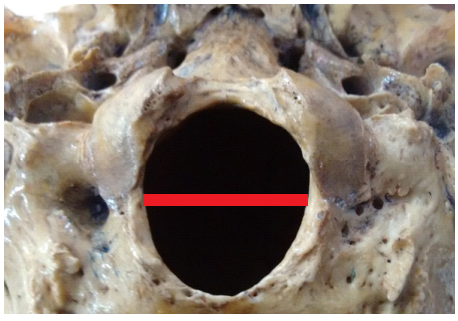

Figure 2: Photograph showing the distance measured as the transverse diameter of foramen magnum

The measurements were repeated twice to eliminate observer bias. The data was compiled and analysed using Microsoft Excel software.

The area of foramen magnum was calculated using the following formula.

$$A = \prod \times (a/2) \times (t/2)$$

Where A= area of foramen magnum
a= antero-posterior diameter
t= transverse diameter
$\prod$ = Mathematical constant (3.14)

Mean and standard deviation were calculated for antero-posterior diameter, transverse diameter and area of foramen magnum.

RESULTS:

The antero-posterior and transverse diameters of foramen magnum were found to be 3.4 ± 0.3 cm and 2.79 ± 0.21 cm respectively. The area was calculated to be 7.49 ± 1.11 cm^2. The results are displayed in Table 1.

TABLE- 1 (Dimensions of foramen magnum)

Parameters	Mean	Standard Deviation
Antero-posterior diameter	3.4 cm	0.3 cm
Transverse diameter	2.79 cm	0.21 cm
Area	7.49 cm^2	1.11 cm^2

DISCUSSION:

Our findings are comparable to various authors.

Patel et al[8] found average antero-posterior diameter to be 3.37 cm and average transverse diameter to be 2.83 cm. They found mean area as

7.55 cm^2. Muthukumar et al[5] observed the average anteroposterior diameter as 3.33 cm and average transverse diameter as 2.79 cm. In Catalina- Herrera's[9] study the average sagittal diameter was established as 3.52 cm and average transverse diameter was found to be 3.03 cm. The average area was found to be 8.88 cm^2 in male and 8.01 cm^2 in female. Tubbs et al[10] found the mean sagittal diameter as 3.1 cm and mean transverse diameter to be 2.7 cm. The mean area was reported to be 5.58 cm^2. Wanebo and Chicoine[11] found sagittal diameter as 3.6 ± 0.2 cm , transverse diameter as 3.2 ± 0.2 cm and area as 8.2 ± 1 cm^2. Berge and Bergmann[12] reported mean antero-posterior diameter as 3.4 cm and mean transverse diameter as 2.9 cm. Gruber et al[13] has reported mean sagittal diameter of 3.66 cm and mean transverse diameter of 3.11 cm. Erdil[14] has found the mean antero-posterior diameter as 3.55 cm and mean transverse diameter as 2.98 cm.

Foramen magnum includes many neuroanatomic structures. Lesions of these vital structures need special microsurgical intervention. So selecting the most suitable surgical technique requires meticulous planning mainly based on the foramen magnum size to refrain from any neurological impairment[15].

CONCLUSION:

The dimensions of foramen magnum are needed to determine malformation (Arnold Chiari's syndrome) and prior to cutting off of foramen magnum in posterior cranial fossa lesions and sex determination from skulls. So findings of the present study are important for neurosurgeons, radiologists and forensic scientists.

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