

MORPHOMETRIC ANALYSIS OF FORAMEN MAGNUM AND VARIATIONS IN ITS SHAPE IN DRIED HUMAN ADULT SKULLS

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ABSTRACT

Background: The foramen magnum is an important landmark in posterior part of cranial base formed by occipital bone. The purpose of the study was to measure the antero-posterior and transverse diameters of foramen magnum in dried human skulls. Variation in its shape, area and index of foramen magnum were also studied. The dimensions of foramen magnum are clinically important because vital structures are passing through it may lead to compression such as in cases of brain stem herniation and foramen magnum meningiomas.

Materials and methods: A total of 35 dried human adult skull of unknown age and sex were collected from the Department of Anatomy, Coimbatore Medical College, Coimbatore were used for this study. The antero-posterior diameter, transverse diameter, shape were measured by using digital vernier caliper. The area and index of foramen magnum were also calculated.

RESULTS: In our study the mean antero-posterior diameter was 34.80mm. The maximum antero-posterior diameter was 42.18mm and minimum antero-posterior diameter was 31.10mm. The mean transverse diameter was 28.5mm. The maximum transverse diameter was 32.10mm and minimum transverse diameter was 25.20mm. The most common shape of foramen magnum were rounded in 26%, irregular in 22%, oval shaped in 18%, egg shaped in 14%, tetragonal in 11%, pentagonal in 6%, hexagonal in 6%. The mean area of foramen magnum was 820.53mm². The mean index for foramen magnum was 82.54. In 6 % the occipital condyles were observed to protrude into the foramen magnum.

CONCLUSION: Knowledge about the dimensions of foramen magnum is clinically important for neurosurgeons while performing transcondylar and inferior suboccipital approach for foramen magnum meningiomas.

KEYWORDS: Foramen magnum, Antero-posterior diameter, Transverse diameter, Foramen magnum area, Foramen magnum index.

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INTRODUCTION

The posterior part of cranial base is largely occupied by occipital bone. The most prominent feature here is foramen magnum. Foramen

magnum lies in an anteromedian position and leads to posterior cranial fossa. It is oval and wider behind with its greater diameter being the antero-posterior diameter. Foramen magnum

contains lower end of medulla oblongata, meninges, vertebral arteries and spinal accessory nerve. The apical ligament of dens and tectorial membrane pass through the foramen magnum [1]. The morphometric measurement of foramen magnum is important because most of the vital structures are passing through it may lead to compression such as in cases of brain stem herniation and foramen magnum meningiomas. Knowledge about the dimensions is clinically important for neurosurgeons in performing surgeries for foramen magnum meningiomas. The transverse diameter is more in Arnold Chiari Syndrome.

MATERIALS AND METHODS

The study was conducted in 35 dried adult skulls of unknown age and sex in Department of Anatomy, Coimbatore Medical College, Coimbatore. The different shapes of foramen magnum were studied macroscopically. The antero-posterior and transverse diameters were studied by using manual vernier calliper. The antero-posterior diameter was measured from end of anterior border to the end of posterior border of foramen magnum. The transverse diameter was measured from point of maximum concavity on the right margin and point of maximum concavity on the left margin. Area of foramen magnum was measured by Radinsky formula: $\frac{1}{4} \times 3.14 \times \text{foramen magnum length} \times \text{foramen magnum width}$. Foramen magnum index was calculated by $\text{Foramen magnum width} \times 100 / \text{Foramen magnum length}$.

RESULTS

In our study the mean antero-posterior diameter was 34.80mm. The maximum antero-posterior diameter was 42.18mm and minimum antero-posterior diameter was 31.10mm. The mean transverse diameter was 28.5mm. The maximum transverse diameter was 32.10mm and minimum transverse diameter was 25.20mm. The most common shape of foramen magnum were rounded in 26%(Fig-1), irregular in 22%(Fig-2), oval shaped in 18%(Fig-3), egg shaped in 14%(Fig-4), tetragonal in 11%(Fig-5), pentagonal in 6%(Fig-6), hexagonal in 6%(Fig-7). The mean area of foramen magnum was 820.53mm² The mean index for foramen magnum was 82.54. In

6 % (Fig-8) the occipital condyles were observed to protrude into the foramen magnum.

Fig. 1: Showing round shaped foramen magnum.



Fig. 2: Showing irregular shaped foramen magnum.



Fig. 3: Showing oval shaped foramen magnum.



Fig. 4: Showing egg shaped foramen magnum



Fig. 5: Showing tetragonal shaped foramen magnum.



Fig. 6: Showing pentagonal shaped foramen magnum.



Fig. 7 : Showing hexagonal shaped foramen magnum.



Fig. 8: Showing encroached occipital condyle.



Table 1: Showing the % and different shapes of Foramen Magnum (n=35).

	Present Study	Shikha Sharma et al. 2015 [2]
Morphological variants of foramen magnum	Percentage and number	Percentage and number
Round shape	26%(9)	22%(11)
Irregular shape	22%(8)	18%(9)
Oval shape	18%(6)	16%(8)
Egg shape	14%(5)	16%(8)
Tetragonal shape	11%(4)	12%(6)
Pentagonal shape	6%(2)	8%(4)
Hexagonal shape	6%(2)	8%(4)

Table 2: Showing the comparison of Morphometric Data of Foramen Magnum with the previous reports.

AUTHORS	ANTERO-POSTERIOR DIAMETER	TRANSVERSE DIAMETER
Shikha Sharma et al (2015) [2]	38.76mm	33.44mm
Muralidhar et al (2014) [6]	Male – 33.4mm Female – 33.1mm	Male – 28.5mm Female – 27.3mm
Murshed et al (2003) [4]	35.9 mm	30.4mm
Jain et al (2013) [3]	Male – 36.9mm Female – 32.9mm	Male – 31.5mm Female – 29.5mm
Osunwoke et al (2012) [5]	36.11mm	29.56mm
Present study (2016)	34.8mm	28.5mm

DISCUSSION

According to Shika et al, in 50 dried human skulls of unknown sex studied the mean antero posterior and transverse diameter of foramen magnum were 38.76mm and 33.44mm respectively. The most common shape of foramen magnum was round shaped 22%. The foramen magnum index was 87.68. In 4% of the skulls the occipital condyle was protruded into the foramen magnum. The mean area of foramen magnum was 970.57mm²[2].

Jain et al stated that in 68 dried human skulls of known sex the mean antero-posterior and transverse diameters of foramen magnum in male were 36.9mm and 31.5mm respectively. The mean antero-posterior and transverse diameter of foramen magnum in female were 32.9mm and 29.5mm respectively [3].

According to Murshed et al, in 110 CT images of known sex studied the mean antero-posterior and transverse diameters of foramen magnum in male were 37.2mm and 31.6mm respectively. The mean antero-posterior and transverse

diameter of foramen magnum in female were 34.6mm and 29.3mm respectively. The area of foramen magnum was 931.7mm² in male and in female was 795mm² [4].

Osunwoke et al, stated that in 120 dried human skulls of unknown sex the mean antero posterior and transverse diameters of foramen magnum were 36.11mm and 29.56mm respectively [5].

According to Muralidhar et al, in 150 dried human skulls of known sex the mean antero-posterior and transverse diameters of foramen magnum in male were 33.40mm and 26.70mm respectively. The mean antero posterior and transverse diameter of foramen magnum in female were 33.6mm and 28.00mm respectively. The area of foramen magnum was 748.60mm² in male and in female was 711.10mm²[6].

In our present study the mean antero-posterior diameter was 34.80mm. The mean transverse diameter was 28.5mm. The most common shape of foramen magnum was rounded in 26% of skulls. The mean area of foramen magnum was 820.53mm². The mean index for foramen magnum was 82.54. In 6 % the occipital condyles were observed to protrude into the foramen magnum. In 6% of the skulls the occipital condyle was protruded into the foramen magnum which was coinciding with earlier studies.

CONCLUSION

The mean antero-posterior and transverse diameters were 34.80mm and 28.50mm respectively. The dimensions are clinically important because vital structures are passing through foramen magnum. The knowledge about the morphometric analysis is important for anatomists, anaesthetists, radiologists and neurosurgeons. The knowledge about the diameters is necessary while performing surgeries for foramen magnum meningiomas or posterior cranial fossa lesions and also in determining Arnold Chiari Syndrome.

Conflicts of Interests: None

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