



MORPHOMETRIC ANALYSIS OF FORAMEN MAGNUM IN DRY HUMAN SKULLS IN TELANGANA REGION

Anatomy

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ABSTRACT

INTRODUCTION: Foramen Magnum is an important landmark and is present at the lower part of occipital bone. Diameters of Foramen Magnum are important because vital structures passing through it may endure compression in diseases associated with Foramen Magnum like herniation, meningiomas and achondroplasia and to determine some malformations such as Arnold-Chiari Syndrome, which shows increased transverse diameter.

AIM AND OBJECTIVES: To study the morphology of Foramen Magnum in dry human skulls and to evaluate various morphometric parameters like Antero-Posterior diameter, Transverse diameter, Area of Foramen Magnum, Index of Foramen Magnum and Shape.

MATERIALS AND METHODS: The present cross-sectional study conducted on 40 dry human skulls in the Department of Anatomy. Various morphometric parameters of Foramen Magnum like Antero-Posterior diameter, Transverse diameter, Area and Index of Foramen Magnum were calculated by using Vernier Calipers and were statistically evaluated. Different shapes of Foramen Magnum were assessed macroscopically into Oval, Round, Hexagonal and Diamond shape.

RESULTS: Most common shape of Foramen Magnum was Oval in 22 (55%) skulls followed by Round in 10 (25%), Hexagonal in 6 (15%) and Diamond shape in 2 (5%) skulls. The mean of Antero-Posterior diameter was 35.8 ± 3.0 mm; Transverse diameter was 30 ± 2.8 mm; Area of Foramen Magnum was 841 ± 136.13 mm² and Foramen Magnum Index was 84.35 ± 6.58 .

CONCLUSION: The Anatomical knowledge of Foramen Magnum is clinically important for neurosurgeons in analysing the morphometric anatomy of Cranio-Vertebral junction and in transcondylar approach to make a safe occipital condyle resection. These findings also enlighten the anthropologists, morphologists, radiologists, forensic experts and clinical anatomists.

KEYWORDS

Foramen Magnum, Skull, Index, Shape.

INTRODUCTION

The Foramen Magnum ("Great Hole" in Latin) is an opening in the occipital bone at the base of the skull connecting the Cranial Cavity with the Vertebral Canal.[5] 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 Tonsil of Cerebellum.[4] In most of the subjects it is Oval in shape wider in the posterior part and measuring about $3.5\text{cm} \times 3\text{cm}$. [5] In the midline the Anterior margin is Basion and the Posterior margin is Opisthion.[16] Morphometric parameters of Foramen Magnum are useful in the diagnosis of congenital malformations such as Arnold-Chiari malformation in which transverse diameter is more than antero-posterior diameter and also needed prior to the surgery of posterior crania fossa lesion as greater contralateral exposure is required where antero-posterior diameter is more. [5] The dimensions of Foramen Magnum are more in males than in females which can be used to determine sex in various medicolegal conditions like Explosions, Aircraft accidents, Warfare injuries.[1] Morphometric analysis of Foramen Magnum is highly valuable in Neurosurgery, Radiology, Forensic Medicine, Anthropology [4], so the present study was carried out to determine the dimensions of Foramen Magnum.

AIM AND OBJECTIVES

To study the morphology of Foramen Magnum in dry skulls and to evaluate various morphometric parameters like Antero-Posterior diameter, Transverse diameter, Area of Foramen Magnum, Index of Foramen Magnum and Shape.

MATERIALS AND METHODS

The present study was conducted on 40 dry human skulls in the Department of Anatomy. This study included fully ossified, dried, cleaned skulls only. Broken and deformed skulls were excluded from the study. Various morphometric parameters were measured as follows:

Antero-Posterior diameter = Distance between Basion and Opisthion
Transverse diameter = Maximum distance between two lateral margins

Area = $\frac{1}{4} \times \pi \times$ Antero-Posterior diameter $\times$ Transverse diameter
(Formula given by Routal et al) [3]

Index = Transverse diameter / Antero-Posterior diameter $\times 100$

Shape of Foramen Magnum: Different shapes were macroscopically noted and classified as Oval, Round, hexagonal and Diamond shape.

All dimensions were measured with the help of Vernier Calipers in an accuracy of 0.01mm. All measurements were repeated twice to eliminate observer bias. The data was compiled and analysed statistically using Microsoft Excel Software.

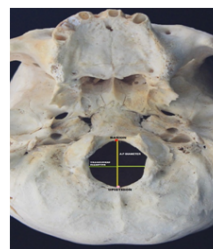


Fig: Showing For A Men Magnum Along With Its Basion Opisthion, An Antero-Posterior Diameter And Transverse Diameter.

OBSERVATIONS AND RESULTS

Morphometric parameters of Foramen Magnum such as Antero-Posterior diameter, Transverse diameter, Area and Index were measured and represented in Table No. 1 and Table No. 2 below:

Table No. 1 Various Diameters Of Foramen Magnum.

Parameter	Minimum	Maximum	Mean	Standard Deviation	P-Value
Antero-Posterior diameter [mm]	28	42	35.8	3.0	0.06
Transverse diameter [mm]	25	35	30.0	2.8	0.05

Area [mm ²]	610	1120	841.2	136.1	0.27
Index	75	100	84.35	6.58	1.34

In the above table, the Mean Antero-Posterior diameter is 35.8±3.0mm ranging from 28-42mm and Mean Transverse diameter is 30.0±2.8mm ranging from 25-35mm. The Mean Area is 841.2±136.1 mm² ranging from 610-1120 mm². Mean Index of Foramen Magnum is 84.35±6.58 ranging from 75-100.

Table No. 2 Frequency Distribution of Shape of Foramen Magnum

Shapes	Number of skulls	Percentage [%]
Oval	22	55
Round	10	25
Hexagonal	6	15
Diamond	2	5

In the present study most common shape of Foramen Magnum is

Table No. 3: Comparison Of Morphometric Parameters Of Foramen Magnum In Various Studies

Author and Year	Number	Antero-Posterior diameter [mm]	Transverse diameter [mm]	Area [mm ²]	Index	Frequency shape [%]
1. Zuberi Hussain Riyaz, et al, 2015 [9]	61	33.4±2.5	28.5±2.2	747.92	--	Oval, 31.14%
2. Faazila Fathima, et al, 2016 [16]	53	38.22	35.15	110.25	--	Egg, 35.8%
3. M. Rohini Devi, et al, 2016 [12]	35	34.80	28.5	820.53	82.54	Round, 26%
4. Berjina Farooq Naqshi, et al, 2017 [15]	25	31.6±2.16	26.5±2.12	66.0±9.0	83.64±5.71	--
5. Kulesh S Chanderkar, et al, 2017 [7]	80	36.23±1.76	29.06±2.54	--	80.19±7.51	Oval, 38.75%
6. Rajkumar, et al, 2017 [11]	298	33.98±2.79	28.16±2.15	754.32±105.16	83.14±6.33	Oval, 66%
7. Anshu Sharma, et al, 2019 [6]	50	34.44	30.46	745.72	88.44	Hexagonal, 45%
8. Archana Singh, et al, 2019 [2]	120	33.79±2.60	28.25±1.83	--	83.91±6.43	Oval, 33.3%
9. Arjun Kumar, et al, 2019 [5]	50	34.08±2.25	28.17±2.88	757.41±115.09	--	Oval, 58%
10. Jalles Dantas, et al, 2019 [10]	159	35.01±3.03	30.12±2.95	833.46±131.34	86.74±8.61	Pentagonal, 11.3%
11. Present Study, 2020	40	35.8±3.0	30±2.8	841.2±136.1	84.35±6.58	Oval, 55%

Study Limitation

The sample size of the present study was small, study was done on dry human skulls and no sexual differentiation was done.

Conflicts Of Interest: None.

CONCLUSION

The present study on morphometric analysis of 40 dry human skulls showed that the Antero-Posterior diameters of Foramen Magnum were more than Transverse diameter and most common shape of Foramen Magnum was Oval in 22 (55%) skulls. The Knowledge of morphometric analysis is clinically important because vital structures are passing through Foramen Magnum and also important for Anatomists, Anaesthetists, Radiologists, Orthopaedicians and Neurosurgeons to achieve the best exposure with appropriate surgical outcome.

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Oval in 22 [55%] skulls followed by Round in 10 [25%], Hexagonal in 6 [15%] and Diamond shape in 2 [5%] skulls.

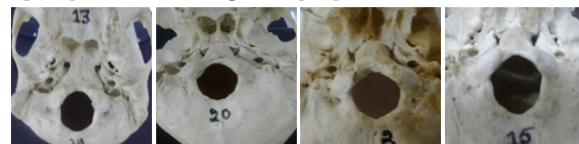


Fig: Oval (55%) Fig: Round (25%) Fig: Hexagonal (15%) Fig: Diamond (5%)

DISCUSSION

Anatomical knowledge of Foramen Magnum is useful in various Craniovertebral diseases.[5], Neurosurgical approaches, Forensic, Radiological evaluations and for Evolutionary studies [2]. Foramen Magnum is a morphologically variable osteological feature in the skull that has undergone evolutionary changes.[10] By understanding the importance of Foramen Magnum, findings of present study has been compared with previous studies and represented in Table No. 3.

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