Original Article

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Morphometric Study of Foramen Magnum in Adult Indian Skulls

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Abstract

Introduction: The dimensions of the foramen magnum are clinically important because vital structures passing through it may endure compression such as in cases of foramen magnum herniation, foramen magnum meningiomas and foramen magnum achondroplasia.The current studyamined to measure the anteroposterior diameter, transverse diameter, area and index of foramen magnum in adult Indian skulls. *Materials and Method:* The present study was carried out on foramen magnum of 55 dry adult skulls of known sex (36 male skulls and 19 female skulls) from bone library of department of Anatomy, GMC Aurangabad. The anteroposterior diameter and transverse diameter of foramen magnum were measured using digital vernier caliper. Area and index of foramen magnum were calculated using both diameters. *Results:* The mean value of anteroposterior diameter in males was 34.99 mm whereas that in females was 33.75mm.Also, The mean value of transverse diameter in males was 28.53 mm whereas that in females was 27.41mm.The mean area of foramen magnum was 765 Sq.mm.in males and 728 Sq mm. in females. The index of foramen magnum was 81.79 in males and 81.39 in females. *Conclusion:* The anteroposterior and transverse diameters, area and index of foramen magnum of male skulls were greater than females. This study of the morphometric analysis of foramen magnum will be helpful to anatomists, anaesthetists, radiologists and neurosurgeons and anthropologists.

Keywords: Foramen Magnum; Skulls; Morphometric analysis.

Introduction

Foramen magnum is the largest foramen in the skull. It is formed by the four portions of the occipital bone (two lateral, one squamous, and one basal) and can present different shapes [1].

It lies in an anteromedian position and leads into the posterior cranial fossa. It is oval, wider behind, with its greatest diameter being anteroposterior. It contains the lower end of the medulla oblongata, meninges, vertebral arteries and spinal accessory nerve [2].

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The foramen magnum dimensions are clinically very important because the above mentioned vital structures passing through it may endure compression such as in cases of foramen magnum herniation, foramen magnum meningiomas and foramen magnum achondroplasia [3].

Concerning its site, measures of the occipital region seems to be an alternative to determinate certain characteristics of cadaveric remains in cases where human fragments are greatly damaged by insults (fire, explosions, and mutuliations), as the basicranium is protected by large and strong tissues, such as muscle, tendons and ligaments [4,5].

The knowledge of foramen magnum diameters is needed to determine some malformations such as Arnold Chiari syndrome, which shows expansion of transverse diameter [6].

The diameters and area of the foramen magnum are greater in males than in females, hence its dimensions can be used to determine sex in the medicolegal conditions, especially in the following

circumstances, such as explosions, aircraft accidents and war fare injuries [6,7].

Materials and Methods

Skulls were collected from bone library of department of Anatomy GMC Aurangabad Maharashtra. The present study was carried out on foramen magnum of of 55 dry adult skulls of known sex (36 male skulls and 19 female skulls). The skulls with pathological lesions and damage when excluded. Measurements were taken using digital vernier caliper. Readings were taken twice and mean of two readings was taken to avoid error.

The following parameters of foramen magnum were measured-

1. Anteroposterior Diameter of Foramen Magnum (APFM)

It is the maximumanteroposterior diameter of foramen magnum. It was measured from the basion (the midpoint of the anterior margin of the FM) to the opisthion(the midpoint of the posterior margin of the FM) [Figure 1].

2.Transverse Diameter of Foramen Magnum (TFM)

The maximum transverse diameter was measured as maximum internal width of foramen magnum along the transverse plane [Fig. 2].

The APFM and TFM were measured with digital vernier caliper.

The area of the FM was calculated using different formulas based on the study byRoutalet al[8]. formula based on the height and width of the foramen magnum:

$A = ¼ \times ð \times w \times h$

Foramen magnum index was calculated using the formula:

Transverse diameter / Anteroposteriordiameter × 100.

The Statistical Methods: Results were expressed as mean ± standard deviation. Unpaired 't' test was used to compare between males and females. P value of 0.05 or less was considered for statistical significance.

Observation and Results

The following table depicts mean values of different parameters of foramen magnum in present study.

All mean values of parameters in males were slightly higher than those in females. However when

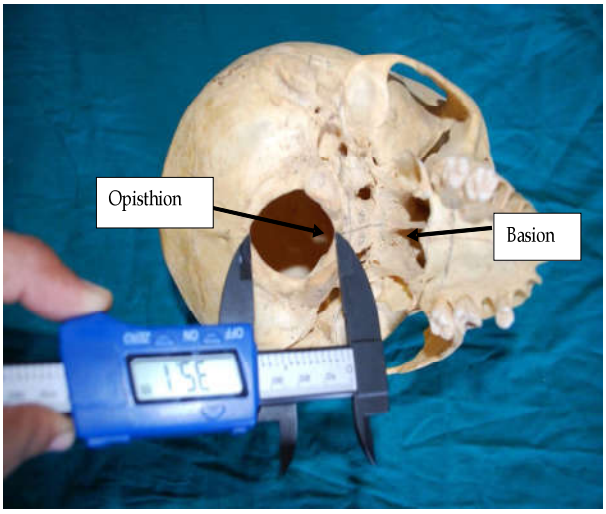

Fig. 1: Illustrating measurement of APFM

Fig. 2: Illustrating Measurement of Transverse Diameter of Foramen Magnum

Table 1: Mean and standard deviation of different parameters of foramen magnum observed in present study

Sr. No.	Parameters	Females (Mean±SD)	Males (Mean ± SD)	Total (Mean ± SD)
1.	APFM (mm)	33.75 ± 2.55	34.99 ± 2.19	34.13±2.17
2.	TFM (mm)	27.41 ±1.93	28.53 ± 1.58	28.02±1.94
3.	Area of FM (Sq. mm)	728.96 ± 96.65	765 ± 98.81	753.44±98.72
4.	Index Of FM	81.39 ± 5.00	81.79 ± 6.04	82.37±6.16

unpaied "t" test was applied, the mean anteroposterior diameter and mean tranverse diameter and Index of foramen magnum in male skulls were notsignificantly higher than in female skulls.

Discussion

The mean anteroposterior diameter of the foramen magnum of male skulls (34.9 mm) of present study was similar to the observations of Sayee [9] on male skulls of Karnataka (34.2 mm), however it was lower than the observations made by Routal [8] on Gujarati male skulls (35.5mm) and Suazo [10] on Brazilian male skulls (36.5 mm).

In female skulls the mean longitudinal diameter of the foramen magnum of present study was correlated with the observations of Sayee [9] on Karnataka female skulls (33.5mm) and Wantanabe [11] on Japanese female skulls (33.7mm), but it was lower than reported Suazo [10] on Brazilian female skulls (35.6 mm). However the mean longitudinal diameter of the foramen magnum of female skulls of present study was higher than values reported by Routal [8] on Gujarati female skulls.

The following table depicts the comparison of previous studies-

Also, genderwise mean values of morphometric study of foramen magnum by Murlidharet al [15] and Jain et al [16] are compared with current study in the below tables.

Table 2: Comparison of various Parameters of foramen magnum in previous studies with the current study

Sr. No.	Studies	APFM (mm)	TFM (mm)	AREA OF FM (Sq. mm)
1.	Gapert et al[4]	34.71±1.91	29.36±1.96	801.78±85.43
2.	Maculasco et al[12]	34.90±2.26	29.40±2.93	807.86±107.58
3.	BabuRaghuvendra et al[13]	32.57± 2.08	28.91±1.76	722.66±78.20
4.	Vismutha SP et al[14]	29.72±1.89	24.73±2.05	577.52±64.36
5.	Present study	34.13±2.71	28.02±1.94	753.44±98.72

Table 3: Gender wise comparison of APFM and TFM in previous studies with the current study

Authors	APFM (mm)		TFM (mm)	
	Males	Females	Males	Females
Muralidhar et al [15]	33.4	33.1	28.5	27.3
Jain et al [16]	36.9	32.9	31.5	29.5
Present study	34.99	33.75	28.53	27.41

Conclusion

It can be concluded from the present study that the several anatomical parameters such as anteroposterior diameter, transverse diameter, area and index of foramen magnum should be taken into consideration during surgeries involving the craniovertebral junction like while performing surgeries for foramen magnum meningiomas or posterior cranial fossa lesions and also in determining Arnold Chiari Syndrome. It can also be of immense importance in forensic and anthropological investigation.

This study of the morphometric analysis of foramen magnum will be helpful to anatomists, anaesthetists, radiologists and neurosurgeons and anthropologists.

Abbrevations Used

APFM- Anteroposterior diameter of foramen magnum

TFM- Transverse diameter of foramen magnum

FM- Foramen magnum

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