

Morphometric Study of Foramen magnum in East Godavari region of Andhra Pradesh

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Abstract

Foramen magnum dimensions are important clinically because many vital structures like medulla oblongata, the spinal and the vertebral arteries pass through it. Foramen magnum is useful in determining the sex in cases of mass disaster or an accident where it is difficult in identifying the identity of a person/sex. However it is still better to use it as adjunct with other skeletal remains to precisely ascertain the sex of individual.

Keywords: Foramen magnum, Andhra Pradesh, morphometric, study.

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Introduction

Amongst the various primary centres of ossification, foramen magnum is one that is important during growth and development [1]. It is helpful in identifying the sex [2, 3, 4]. Gunay et al (2000) reported that the genetic factors help in determining the morphological differences between the skulls of different gender [5]. Humprey, Dean et al (1999), Prado (2007) concluded that the morphological characters such as ethnicity, age, sex, genetic and dietary factors are helpful in establishing the anthropological alterations [6, 7]. Foramen magnum is now established as an important structure for determining sex in Forensic studies [8, 9]. There exists a considerable amount of difference in the foramen magnum between the genders in a limited territorial area [10]. Foramen magnum has diagnostic and radiological importance [11]. The length, width, surface area of Foramen magnum and its index is useful in craniovertebral and cervical spine surgeries [12]. The findings are helpful for neurosurgeons for performing lateral transcondylar surgical approach for reaching lesions in the middle and posterior part of cranial base. The largest anteroposterior diameter will help in greater contralateral surgical exposure as part of transcondylar approach in condylar resection [13]. The larger width of foramen magnum will help in greater grade in cerebellar tonsillar herniation [14, 15, 16]. The understanding of morphological shape is helpful for surgeons since in ovoid shape of foramen magnum, it is difficult to traverse its anterior portion. The variation in the anatomy of foramen magnum may influence surgeries such as repair of posterior inferior cerebellar artery aneurysm, decompression of the foramen magnum and resection of meningiomas in foramen magnum [17]. So, the present study is carried out in East Godavari region in Andhra Pradesh to know about the different parameters of foramen magnum and its importance in sexing. It will be of surgical, neurosurgical and of diagnostic importance for this region. It is of anthropological, anatomical and forensic importance as well.

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Review of literature

Manoel C et al who conducted a quantitative analysis study on the foramen magnum in Brazil found that the FML in males was 35.7±0.29 mm and in females it was 35.1±0.33mm while the FMW in males was 30.3±0.2mm and in females 29.4±0.23mm. He found that the FMI is higher in males than in females.

He further says that to determine morphological differences between sexes, morphometric linear method of FMW is useful and be used as adjunct with various anthropological techniques [18]. Anil Kumar et al conducted a study on morphometric variation of foramen magnum in dry human skulls in Oman Medical College, Sohar, Oman. He found that Oval type FM as most morphologically variant. T.D of FM in males was between 25.75-34.25 mm and in females between 26-31.75mm. The APD of FM was between 35-39.75mm in males while in females it was between 29.5-34.75mm. The mean area of foramen magnum in males was 876.88±88.83mm². The Foramen magnum index (FMI) in females was 89.01±6.84mm while in males it was 81.75±5.99mm², the difference was statistically significant [12].

Aim and objective

1. To study the length and width of foramen magnum.
2. To study the surface area and index of foramen magnum
3. To study the gender difference in foramen magnum.
4. To study the different shapes in foramen magnum.

Methodology

Study type: It is a morphological study that determines the anteroposterior diameter and transverse diameter of the foramen magnum. The surface area and the index of foramen magnum is also calculated from the above said parameters.

Site of the study: The foramen magnum on the posterior aspect of the base of skull.

Sample size: The sample size includes 40 adult dry human skulls. (30 male, 10 female).

Inclusion criteria: Only adult dry skulls of age 18-70 years in good condition were selected for study.

Exclusion criteria: 1. The skull which were damaged and incomplete
2. The skulls belonging to children.

Study design: The study sample included indiscriminate collection of 40 human skulls (30 male and 10 female). Morphological study of foramen magnum were carried out in the Anatomy department of G S L Medical College, Rajahmundry, Andhra Pradesh. The determination of sex was done contemplating the definitive anatomical features [19, 20]. All the parameters were independently

measured by two observers to prevent error. Measurements were taken by Vernier calipers. The parameters included the following

- Length of Foramen Magnum (Antero-posterior diameter): From mid- point on the anterior brim of the foramen magnum (basion) to mid- point on the posterior brim of the foramen magnum (opisthion).

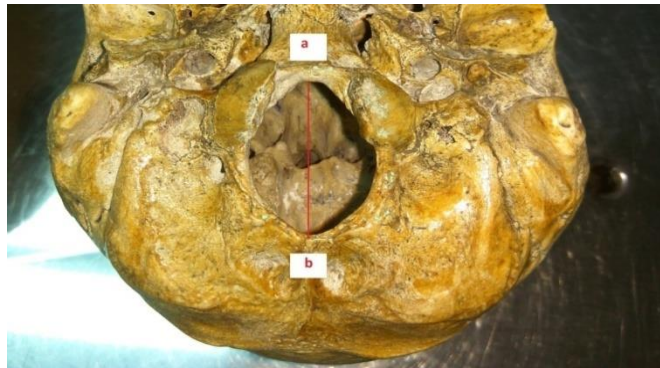


Fig 1: Showing 'a'(basion) and 'b'(opisthion) points – Foramen magnum length (FML)

- Width of Foramen Magnum (Transverse diameter): It was measured between the two points placed on the most lateral edges of the foramen magnum .The prongs of the calipers were kept over the said critical points, manually fixed with the screw and measurements were taken.

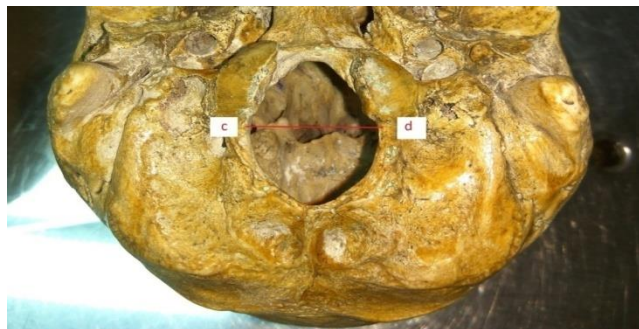


Fig 2: Showing 'c' and 'd' points (most laterally placed points) – Foramen magnum Width (FMW)

- Area of foramen magnum (FMA): It was calculated using
- Radinsky’s formula (FMA) [21]: $1/4 \times \pi \times FML \times FMW$ Where, π (mathematical constant) = 22/7, FML =Length of foramen magnum and FMW =Width of foramen magnum.
- Foramen magnum Index (FMI): Calculated by:foramen magnum width \times 100 / foramen magnum length.

Shape of the foramen magnum – The different shapes of the foramen magnum were noted and classified accordingly.

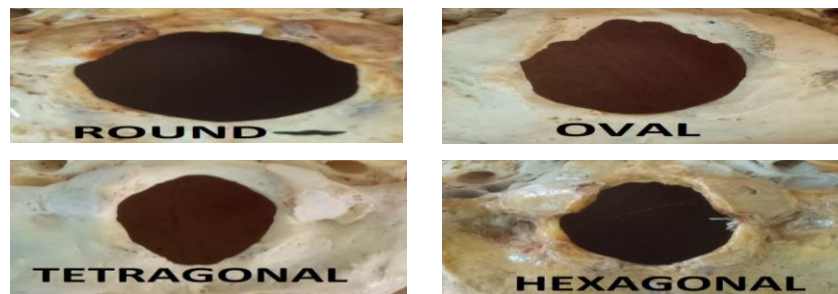


Fig 3:Different shapes of foramen magnum

Statistical analysis

1. The results were statistically analysed
2. P<0.05 is considered significant.
3. The data is analyzed using SPSS software.

Observations and result
Table 1: Different shapes of Foramen magnum and their percentage

	Shape of Foramen Magnum	Present Study
1.	Round	13 (32.5%)
2.	Oval	14 (35%)
3.	Tetragonal	10 (25%)
4.	Hexagonal	3(7.5%)

Table 1 shows that the Foramen Magnum are of different shapes like round, oval, tetragonal and hexagonal. In the study conducted, it was found that the round shape of the foramen Magnum was common (32.5%).

Table 2: Different parameters of Foramen magnum and their range in male and female.

Parameters	Males			Females		
	Range		Mean(+/-) S.D.	Range		Mean(+/-) S.D.
	Minimum value	Maximum value		Minimum value	Maximum value	
Transverse Diameter (mm)	23	29	26.1(+/-) 2.13177	21	29	25.03333(+/-) 1.847334
Anteroposterior Diameter (mm)	27	34	30(+/-) 2.357023	24	33	29.43333(+/-) 2.699723
Foramen Magnum Area(mm) ²	509.14	774.71	616.3929(+/-) 82.20493	414.86	726	580.4857(+/-) 80.23429
Foramen Magnum Index	75	100	87.33288(+/-) 8.205586	70.97	96.55	85.54397(+/-) 7.886254

Table 2 shows that the transverse diameter in male is 26.1(+/-) 2.13177 mm while it is 25.03333(+/-) 1.847334 mm in female. The anteroposterior diameter in male is 30(+/-) 2.357023 mm while it is 29.43333(+/-) 2.699723 mm in female. The Foramen Magnum Area is 616.3929(+/-) 82.20493(mm)² in male while in female it is 580.4857(+/-) 80.23429 (mm)². The Foramen magnum Index in male is 87.33288(+/-) 8.205586 while in female it is 85.54397(+/-) 7.886254.

Discussion

Table 3: Study by other Authors and Present study

Study by other authors along with year	Transverse diameter (mm)	Anteroposterior diameter(mm)
Tubbs et al [22] (2010)	27	31
Chetan et al [11] (2011)	25.2	31
Radhakrishna et al [1] (2012)	28.63	34.04
Singh and Talwar et al [23] (2013)	27.77	33.54
Radhika P.M et al [27] (2014)	29.4	35.3
Howale et al [24] (2014)	26.9	31.2
Anil Kumar et al [12] (2015)	30.05	36.78

The conducted study is identical to Tubbs et al[22] (2010), Chetan et al[11] (2011) and Howale et al[24] (2014) while Radhakrishna et al[1] (2012), Singh and Talwar[23] (2013), Radhika P.M et al[27] (2014) and Anil Kumar et al[12] (2015) slightly differ from the present study.

Table 4: Study by other Authors and Present Study

Study By Other Authors Along With Year	Foramen Magnum Area [FMA] (Mm) ²	Foramen Magnum Index [Fmi] (Mm)
Tubbs et al [22] (2010)	558	_____
Raghavendra et al [25] (2012)	811.67	_____
Burdan et al [26] (2012)	877.4	89.34
Singh & Talwar [23] (2013)	733	_____
Anil Kumar et al [12] (2015)	876.88	81.75
Present Study	Male : 616.3929 Female: 580.4857	Male: 87.33288 Female: 85.54397

Conclusion

Foramen magnum dimensions are important clinically because many vital structures like medulla oblongata, the spinal and the vertebral arteries pass through it. Foramen magnum is useful in determining the sex in cases of mass disaster or an accident where it is difficult in identifying the identity of a person/sex. However it is still better to use it as adjunct with other skeletal remains to precisely ascertain the sex of individual. The present study will help the neurosurgeons,

orthopaedic surgeons and radiologists in a great deal. The findings of the present study will help the neurosurgeon in determining the feasibility of transcondylar approach in brainstem lesions and in planning craniovertebral and cervical spine surgeries appropriately.

Summary

The study was carried out to know whether there is sexual dimorphism. The study revealed that there exists sexual dimorphism in foramen magnum but it is better to use it as adjunct to other skeletal remains to accurately tell the sex of individual skeleton. The

study is helpful for the Clinicians and radiologists in East Godavari region.

Acknowledgement

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Limitations

Though our study is by no means exhaustive, it does provide a glimpse into the morphometry of foramen magnum which can serve as a tool for surgeons and neurosurgeons.

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