



Morphometric Study on Foramen Magnum of Human Skulls

Shanthi CH¹, S.Lokanadham²

¹ Department of Anatomy, Narayana Medical College, Nellore, Andhrapradesh, India

² Department of Anatomy, ESI Medical College (PGIMSR), Chennai, Tamilnadu, India

Abstract

We utilized 100 human skulls to study the morphology and morphometric parameters of the foramen magnum in south Indian population. The anteroposterior diameter and transverse diameter of the foramen magnum were measured by using Vernier calliper to the nearest millimetre. All measurements were tabulated followed by student "t" test and descriptive statistics were done in SPSS version to know the "p" value for the significance. The mean anteroposterior diameter of foramen magnum in males was 3.71 mm and in females it was 3.38 mm. The mean transverse diameter of foramen magnum in males was 3.20 mm and in females it was 3.04 mm. The statistical analysis of morphometry of the foramen magnum in relation to sex determination values are significant (P-Value of Foramen magnum anteroposterior diameter was 0.0001 and transverse diameter was 0.015). Some literatures revealed that anteroposterior diameter of the foramen magnum alone considered for unknown sex determination. Our study reveals significant role of the foramen magnum dimensions in identification of the unknown sex.

Key Words: Foramen magnum, sexual dimorphism, morphometry

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Corresponding Author: Shanthi CH, Narayana Medical College, Teaching Faculty, Department of Anatomy, Nellore, Andhra Pradesh-524 002, India
E-Mail: anatomy.learners@gmail.com **Phone:** +91 8187099234

Introduction

Skull is one of the commonest parts of the skeleton used to opine on the sex of an individual. It exhibits a remarkable sex differences next to the pelvis. Foramen magnum is an important landmark of the skull base and is of particular interest for anthropology, anatomy, forensic medicine, and other medical field [1]. Foramen magnum is a three dimensional aperture within the basal central region of the occipital bone. It is one of several oval or circular apertures in the base of the skull, through which medulla oblongata is transmitted. The anterior border of the foramen magnum is formed by basilar process of the occipital bone, the lateral border by the left and right ex- occipitalis and posterior border is formed by the supraoccipital part of the occipital bone [2]. Two convex kidney shaped condylar facets are found on either side of the foramen for articulation with the first cervical vertebra at the synovial atlanto-occipital joint. Foramen Magnum is a transition zone between spine and skull intend plays significant task because of its close relationship to key structures such as the brain and the spinal cord. Due to the thickness of the cranial base and its relatively protected anatomical position, this area of the skull tends to withstand both physical insults and inhumation somewhat more successful than many other areas of the cranium [3,4].

Materials and Methods

The study was carried out in 100 known skulls (66 male, 34 female) obtained from the Department of Anatomy, S.V Medical College and Department of Anthropology, S.V.University, Tirupathi, Chittoor District, Andhra Pradesh. Skulls that had a history of abnormal or pathological evidence were excluded from this study. The following parameters were studied using the Vernier calliper to the nearest millimetre.

Length or Antero posterior diameter of Foramen Magnum (LFM):

Maximum length of the foramen magnum as measured from basion to opisthion along the mid-sagital plane.

Width or Transverse Diameter of Foramen Magnum (WFM):

Maximum width of the foramen magnum as measured from perpendicular to the mid-sagittal plane.

Figure 1. Measuring Foramen Magnum Length (*Antero-posterior Diameter of foramen magnum*) by using sliding caliper.



Figure 2. Measuring Width of Foramen Magnum (*Transverse Diameter of foramen magnum*) by using sliding caliper.



Results

To study the morphometry of cranium we collected 100 dry human skulls from department of anatomy S.V.Medical College, Tirupati. We studied the parameters as mentioned in the materials and methods of this study and all the variables are recorded and tabulated. The obtained values were tabulated in MS-Excel (MS office 2007) and Mean and standard deviation were measured, the average was taken as the principle measurement to avoid any error using Vernier caliper to the nearest millimetre. The measurements were tabulated along with student “t” test and descriptive statistics were done in SPSS version to know the “p” value for the significance (p - value). The dimensions of the foramen magnum for 100 skulls showed statistically (Table 1).

Table 1. Statistical analysis of the foramen magnum in relation to sex determination

Parameters	Sex	N	Mean(mm)	SD	P- Value
Maximum anteroposterior diameter	Male	66	3.71	0.33	0.0001
	Female	34	3.38	0.38	
Maximum Transverse Diameter	Male	66	3.20	0.31	0.015
	Female	34	3.04	0.30	

Discussion

The accuracy of determinations depends mainly on the kind of bones available and their condition. The foramen magnum was used since it is a regular structure and less likely to major morphological changes [4,5]. Wescott & Morre Jansen, 2000 found length of foramen magnum as one of the most reliable measurement for sex determination in African-American population [6]. Expression of sexual dimorphism within the foramen magnum area in relatively modern populations is limited to a level of approximately 70% [7]. The morphometry of the skull and jaw are methods for the assessment of sexual dimorphism that can assist in the determination of gender [8,9]. Raghavendra Babu et al. and Radhakrishna et al. stated significant differences between males and females for length and breadth of foramen magnum which demonstrated statistically [10,5]. Catallina- Hercera indicated that sagittal and transverse dimensions of the foramen magnum were significantly higher in men's skull [11]. Krogman reported close to 100% accuracy of sex determination in 750 intact skeletons. The

maximum sex determination accuracy of the whole skull alone was found to be 90% [12]. Uysal et al. reported sexual dimorphism after analysing the dimensions of foramen magnum in 3D computed tomography to an accuracy of 81%[13], which was at higher sensitivity than that of Gapert et al of 2009, who used British skulls of 18th and 19th centuries [14]. Holland suggests that the measurements of the region of occipital condyles and the foramen magnum are useful for determining the sex, with an accuracy of 70–90% [15].

The comparison of the morphometric analysis obtained in this study agreement with the results of other studies and literatures. Morphometric analysis of the foramen magnum may provide a statistically useful indication as to sex of the unknown skull.

Conclusion

Our study demonstrates that there is statistically significant in expression of sexual differences in the foramen magnum region of south Indian population, which may prove useful in predicting sex in severely fragmented cranial bases by discriminant function analysis. In extension to this, the result of our study reveals that morphometry of foramen magnum may serve as an added confirmation of sex and recommended in cases where statistical backup of an initial subjective observation is needed.

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