RESEARCH

A MORPHOMETRIC STUDY TO EVALUATE THE STRUCTURAL DIFFERENCE IN THE DIMENSION OF FORAMEN MAGNUM AMONGST GENDER

Virwar Kumar Jha[1], Nafees Fatima[2], Saif Omar[3], Pramita Kumari[1]

[1]Senior Resident, Department of Anatomy, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India.
[2]Assistant Professor, Department of Anatomy, Patna Medical College and Hospital, Patna, Bihar, India.
[3]Professor and HOD, Department of Anatomy, ESICMCH, Bihta, Patna, Bihar, India.

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Corresponding Author:
Dr. Pramıta Kumarı,
Email. pramita2002@gmail.com
ORCID: 0000-0001-9536- 0217

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Abstract

Background: Skull remained the interest for anthropologist an anatomist and sex determination using skull also is of utmost importance in medico legal cases. To evaluate the structural difference in the dimension of foramen magnum amongst gender. **Materials and Methods:** The study sample consisted of 48 human adult skulls (25 males and 23 females). The study samples were visually confirmed for the gender of the skull using non-metric parameters. The study samples were also examined to classify the foramen magnum aperture shape, i.e oval / round / tetragonal / pentagonal. The Anterioposterior & Transverse diameter of foramen magnum was measured using a digital Vernier Caliper. All the measurement were taken in millimeters. **Result:** The most commonly found shape was Oval followed by round and tetragonal while pentagonal shape was least common. Overall the foramen magnum length varied from 25.84 cm to 35.26 cm with a mean value of 30.55 ± 2.28 cm. The overall foramen magnum width varied from 24.89 cm to 29.93 cm with a mean value of 27.41 ± 1.53 cm. These dimensional difference of the aperture showed its round to oval shape. The values for male skull foramen magnum length varied from 34.1 cm to 35.26 cm with a mean value of 34.68 ± 0.27 cm. The male skull values for foramen magnum width varied from 28.41 cm to 28.98 cm with a mean value of 28.69 ± 0.2 cm. In female skull, the values for foramen magnum length varied from 25.84 cm to 35.06 cm with a mean value of 30.45 ± 2.08 cm. The female skull values for foramen magnum width varied from 24.89 cm to 29.93 cm with a mean value of 27.41 ± 1.72 cm. **Conclusion:** The current study could not establish any gender difference statistically for the foramen magnum dimensions, but the values were different metrically, with values being higher for males.

INTRODUCTION

In osteology there are two prime methods to define and differentiate the gender of on individual. E first and fore most is visual and the other is metric, where the measurement of the skeletal osteological landmarks suggests gender differentiation. The metric technique is less subjective and highly reproducible and comparatively more reliable, but requires bone preservation with well-defined landmarks.[1]

Skull remained the interest for anthropologist an anatomist and sex determination using skull also is of utmost importance in medico legal cases. The skeleton remains incomplete in the forensic examination without skull, and also this makes gender differentiation cumbersome. The foramen magnum is located inferior to the sagittal suture on the cranial base and is primary centers of ossification. It is a three-dimensional, circular and/or oval structure in the basilar part of occipital bone. This important and stable landmark in the cranial base fetches interest of researchers of osteological science and other related researchers. The foramen magnum dimensions is reported to vary amongst gender.[2] The foramen magnum dimensions also varies significantly with geographical regions.[3] this variation in the structure and dimension of foramen magnum has clinical radiological diagnostic and research implications.[4] The detailed knowledge of foramen magnum is also important for surgeries in these areas.[5]

Therefore this study was designed to evaluate the structural difference in the dimension of foramen magnum and to establish a normative value for the population and for sex differentiation.

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MATERIALS AND METHODS

Study Setting: The study was conducted in the department of Anatomy, at ESIC Medical College and Hospital, Bihta. The study was conducted over a period of 05 months from January 2022 to May 2022.
Study sample: The study sample consisted of 48 human adult skulls. The study sample skull bones, of known gender (25 males and 23 females) was collected from anatomy department of our institute and also were taken on loan from the nearby institutes.

Inclusion Criteria
Skull with full cranial base including intact foramen magnum.
Exclusion Criteria
Damaged bones and bones with anomalous feature.

Visual Examination
The study samples were visually confirmed for the gender of the skull using non-metric parameters. The study samples were also examined to classify the foramen magnum aperture shape, i.e oval / round / tetragonal / pentagonal.

Morphometry
The Anterioposterior & Transverse diameter of foramen magnum was measured using a digital Vernier Caliper. All the measurement were taken in millimeters.

Anterioposterior Diameter (= Length of foramen magnum): The Anterioposterior diameter of foramen magnum was considered as the maximum internal length along the midsagittal plane of foramen magnum, i.e; from opisthion to basion.

Transverse Diameter (= Width of foramen magnum): The Transverse diameter of foramen magnum was considered as the maximum internal width along the transverse plane of foramen magnum.
Statistical Analysis
The data was tabulated in a Microsoft excel spread sheet and was subjected to statistical analysis using SPSS software version 16.0. The descriptive statistics were calculated and the test of significance (t-test) was done for difference in mean values. P <0.001values was considered statistically significant.

RESULTS

48 adult skull with well-defined anatomical landmarks were assessed for foramen magnum to evaluate sexual dimorphism. Overall the most commonly found shape was Oval followed by round and tetragonal while pentagonal shape was least common.
Our study result showed, overall the foramen magnum length varied from 25.84 cm to 35.26 cm with a mean value of 30.55 ± 2.28 cm. The overall foramen magnum width varied from 24.89 cm to 29.93 cm with a mean value of 27.41 ± 1.53 cm. This dimensional difference of the aperture showed its round to oval shape. [Table 1]
The current study result showed that, the values for male skull foramen magnum length varied from 34.1 cm to 35.26 cm with a mean value of 34.68 ± 0.27 cm. The male skull values for foramen magnum width varied from 28.41 cm to 28.98 cm with a mean value of 28.69 ± 0.2 cm. [Table 2]
The present study results also showed that, in female skull values for foramen magnum length varied from 25.84 cm to 35.06 cm with a mean value of 30.45 ± 2.08 cm. The female skull values for foramen magnum width varied from 24.89 cm to 29.93 cm with a mean value of 27.41 ± 1.72 cm. [Table 3]
A Student's t-test showed non-significant difference for the length and width of foramen magnum between the two genders.

Table 1: Overall foramen magnum dimension.

S.N.	Parameter	Min	Max	Mean	SD
1	Foramen magnum length	25.84	35.26	30.55	± 2.28
2	Foramen magnum width	24.89	29.93	27.41	± 1.53

Table 2: Foramen magnum dimension in male skull.

S.N.	Parameter	Min	Max	Mean	SD
1	Foramen magnum length	34.1	35.26	34.68	± 0.27
2	Foramen magnum width	28.41	28.98	28.69	± 0.2

Table 3: Foramen magnum dimension in female skull.

S.N.	Parameter	Min	Max	Mean	SD
1	Foramen magnum length	25.84	35.06	30.45	± 2.08
2	Foramen magnum width	24.89	29.93	27.41	± 1.72

DISCUSSION

Gender determination using skeletal remains has ever been an interesting and tool for the anthropologist, anatomist and researchers. The reliability of this technique depends the structural integrity pf the bony component. The missing and / or fragmented bone makes the gender determination extremely difficult or sometimes impossible.

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Holland suggested, that the foramen magnum and occipital condyles dimensions are valuable for sex identification, with a relatively very high accuracy.[6] In humans, skul remained the most commonly studied bone, after pelvis, for sex identification.[7] The current study found, overall the most commonly found shape was Oval followed by round and tetragonal while pentagonal shape was least common. This shows the wide variation in morphology of the foramen magnum dimension. The foramen magnum shape and dimension was reporting gender differences in Indian population,[8] this was similar previous study report using Brazilian skulls.[9]

The present study found a considerable amount of mean difference clinically, for the foramen magnum length and width. But this difference was not statistically significant amongst gender, for either of the dimension. In contrast, the previously reported study result showed a significant foramen magnum dimension amongst gender, with the values being higher for males compared to females.[10] this difference in study observation may be attributed to the methodological differences and the population difference. Some previous studies have established a sexual dimorphism by direct morphometry on Foramen Magnum dimension.[11,12]

Our study found higher, yet relatively similar values for the length of foramen magnum in comparison to the previous study conducted using south and central Indian population.[13,14,15]

Overall the current study found a clinically significantly higher measurement values for male skull compared to female skull. This was in consonance with the previous study report of Uysal et al.[16]

CONCLUSION

The study provided a normative value for human skull foramen magnum dimensions. The current study could not establish any gender difference statistically for the foramen magnum dimensions, but the values were different metrically, with values being higher for males. A further study is required with larger sample size to achieve a conclusive result.

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