Original Article

Significance of Vertebral Foramen of Fully Ossified Dry Human Fifth Lumbar Vertebrae.

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Abstract

Background: *One of the most prevalent signs of lumbar canal stenosis is low back pain, which has sparked an interest in the osteological study of the lumbar canal among anatomists. The current study's objective was to build a morphometric database of lumbar canal dimensions about their practical clinical applications.*

Material and Methods: *A cross-sectional, analytical type of study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka from January 2022 to December 2022. Measurement of cephalic and caudal anteroposterior diameter and maximum transverse diameter of vertebral foramen was done using a digital vernier caliper.*

Results: *The mean (± SD) of the maximum transverse diameter of vertebral foramen was greater in males than females and statistically highly significant (p = 0.000). The mean (± SD) of the cephalic and caudal anteroposterior diameter was higher in males than females and showed no statistical difference (p= 0.186 and p= 0.253).*

Conclusion: *All the measured values of different variables of the fifth lumbar vertebra were greater in males than females. The value of maximum transverse diameter showed a statistically significant difference (p<0.001) except for the cephalic and caudal anteroposterior diameter of the vertebral foramen which were statistically non-significant (p> 0.05) when compared between males and females. This morphometric baseline information can be used to help surgically treat low back pain brought on by lumbar canal stenosis.*

Keywords: *Cephalic and caudal anteroposterior diameter, the maximum transverse diameter of the vertebral foramen, fifth lumbar vertebra*

Introduction

Pressure at the vertebral column is often a result of modern-day life combined with the evolution of the human erect posture and stride of a biped. The fifth lumbar vertebra is where this strain is maximum regularly expressed as neuropathy. Changes in the morphology of bones with age and loss in spinal muscular activity influence the mobility of the vertebra. The triangular vertebral foramen of the fifth lumbar vertebra incorporates cauda equina and spinal meninges[1].

The vertebral foramen is narrowing, which compresses the structure inside and results in a spread of low backache signs and symptoms, including aches or unusual sensations in the lower leg and other neurological abnormalities. All social classes experience low back pain frequently. Narrowing of the vertebral foramen is one reason for lower back pain. One of the uncomfortable age-associated lumbar vertebral column manifestations is lumbar canal stenosis (LCS) [2].

Clinical manifestations of LCS can include neurogenic claudication due to compression of the vertebral foramen. Symptomatology and a radical scientific examination are essential in diagnosing LCS, but anatomical expertise is required for proper therapy[3].

The possibility of various causes for lumbar canal narrowing sparked an interest in morphometry among anatomists. The primary goal of the current study was to examine the morphometry of the fifth lumbar vertebral foramen considering its practical clinical significance.

Material and Methods

A total number of 140 dry fully ossified fifth lumbar vertebrae of unknown sex were collected from the Anatomy Department of Dhaka Medical College. The sex of the collected human dry fully ossified fifth lumbar vertebra was determined by morphological criteria and discriminant function analysis formula according to Ostrofsky and Churchill[4].

To obtain the cephalic anteroposterior diameter of the vertebral foramen of the fifth lumbar vertebra one dot was placed at the posterior aspect of the upper border of the vertebral body at the midsagittal plane marked by A and another dot was placed at the meeting point of the upper border of two laminae at midsagittal plane marked by B. For this measurement, the fixed jaw of the vernier caliper was placed on marked point A and the sliding jaw was adjusted to meet marked point B. The distance between A and B was taken as the cephalic anteroposterior diameter of the vertebral foramen which was measured by the digital vernier caliper in millimeters.

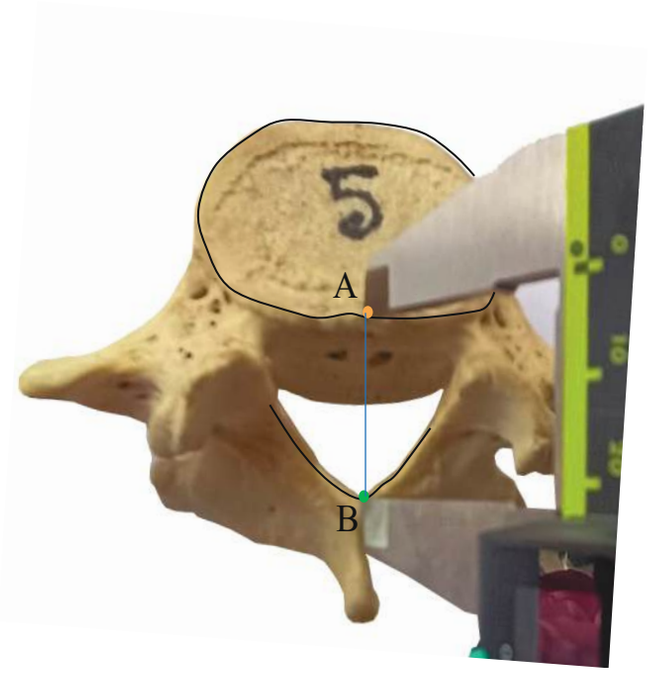

Figure 1: Photograph showing the AB line which represents the cephalic anteroposterior diameter of the vertebral foramen.

To obtain the caudal anteroposterior diameter of the vertebral foramen of the fifth lumbar vertebra one dot was placed at the posterior aspect of the lower border of the vertebral body at the midsagittal plane marked by A and another dot was placed at the meeting point of the lower border of two laminae at midsagittal plane marked by B. Then the fixed jaw of vernier caliper was placed on marked point A and the sliding jaw was adjusted to meet the marked point B. The distance between A and B was taken as the caudal anteroposterior diameter of the vertebral foramen of the fifth lumbar vertebra which was measured by the digital vernier caliper in millimeters.

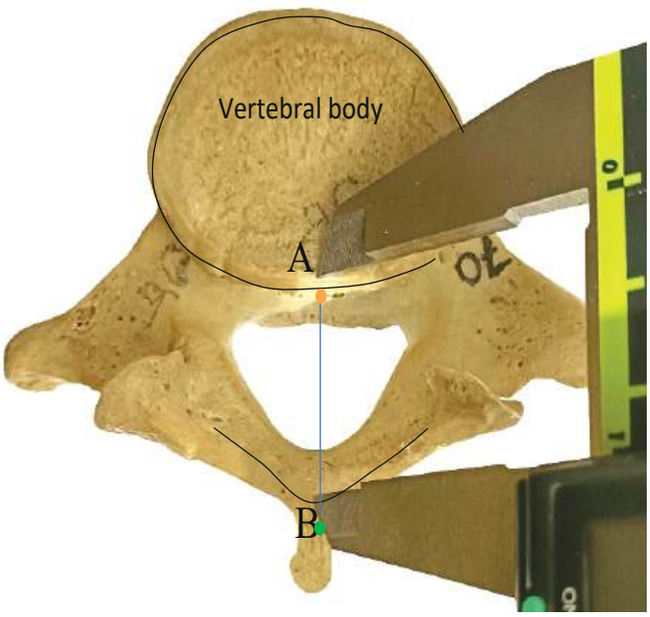

Figure 2: Photograph showing the AB line which represents the caudal anteroposterior diameter of the vertebral foramen.

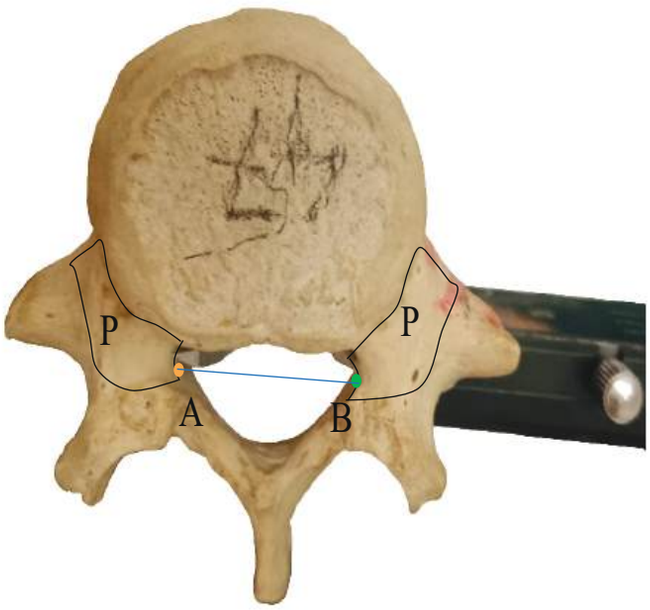

Figure 3: Photograph showing the AB line which represents the maximum transverse diameter of the vertebral foramen.

To measure the maximum transverse diameter of the fifth lumbar vertebral foramen, one dot was placed at the medial surface of the left pedicle marked by A and another dot was placed at the medial surface of the right pedicle of the same vertebra marked by B. Holding the fifth lumbar vertebra in anatomical position, the fixed jaw of vernier caliper was placed on marked point A and the sliding jaw was adjusted to meet the marked point B. The maximum distance between A and B was taken as the maximum transverse diameter of the fifth lumbar vertebral foramen which was measured by a digital vernier caliper in millimeters. Consecutive three times was measured and the highest value was taken.

Ethical Clearance:

The study was carried out after approval of the Research Review Committee (RRC) and Ethical Review Committee (ERC) of Dhaka Medical College, Dhaka.

Data processing and analysis:

The data collected from morphological studies were processed to get mean values and standard deviations as applicable. The statistical analysis was done by unpaired Student's t-test for comparison between variables between males and females by using computer-based software, Statistical Package for Social Science (SPSS) version 26.0. Statistical analysis was accepted at a p-value equivalent to or less than 0.05 ($p<0.05$).

Results

The result is shown in Tables I, II, and Figure 1

Table I: Cephalic and caudal anteroposterior diameter of the vertebral foramen of fifth lumbar vertebrae in males and females (N = 140)

Variables in mm	Male (n= 76) Mean ± SD	Female (n=64) Mean ± SD	*p-value*
Cephalic anteroposterior diameter of the vertebral foramen	17.94 ± 2.41 (13.22 – 23.76)	17.42 ± 2.14 (13.23 – 22.34)	0.186^{ns}
Cephalic anteroposterior diameter of the vertebral foramen	19.79 ± 2.12 (14.59 – 25.52)	19.37 ± 2.22 (14.25 – 25.68)	0.253^{ns}

Values in parentheses indicate a range.
Comparison of values between males and females was done by Unpaired Student's 't' test.
ns = Not significant
n = Sample size in each group
N = Total number of samples
* = Significant at p< .001
SD = Standard deviation

Table II: Maximum transverse diameter of the vertebral foramen of fifth lumbar vertebrae in males and females (N = 140)

Variable in mm	Male (n= 76) Mean ± SD	Female (n=64) Mean ± SD	*p-value*
Maximum transverse diameter of the vertebral foramen	24.58 ± 2.65 (18.69 – 30.70)	23.02 ± 2.46 (18.31 – 27.94)	.000*

Values in parentheses indicate a range.
Comparison of values between males and females was done by Unpaired Student's 't' test.
* = Significant at p< .001
n = Sample size in each group
N = Total number of samples
SD = Standard deviation

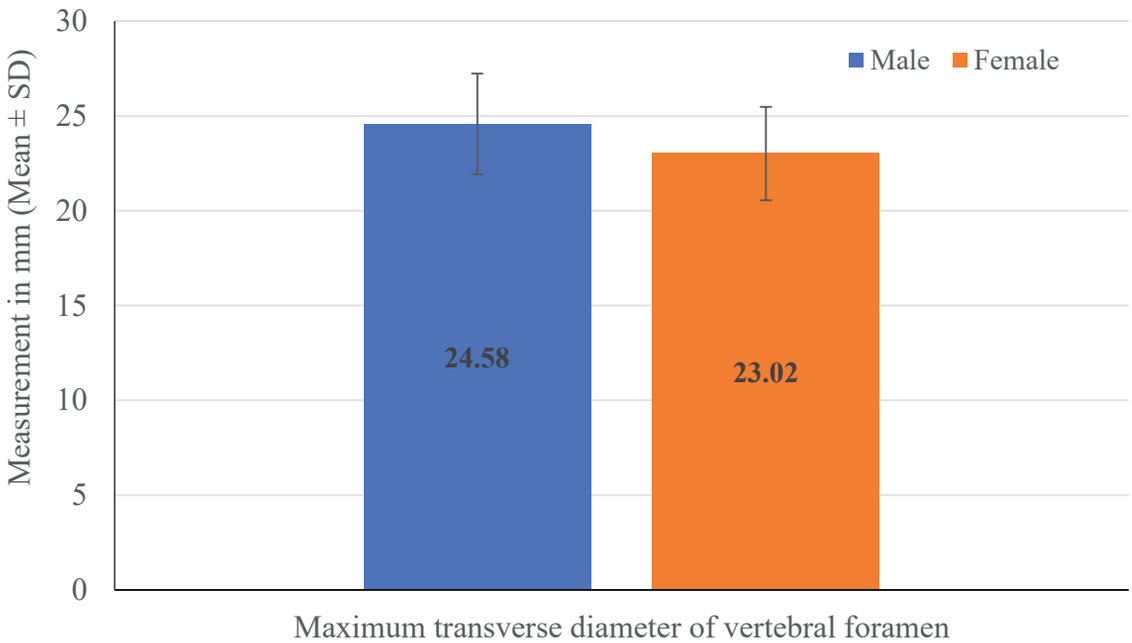

Figure 5: Bar diagram showing the maximum transverse diameter of the vertebral foramen of the fifth lumbar vertebrae.

Discussion

The mean ± SD of cephalic anteroposterior diameter in this study in males and females was 17.94 ± 2.41 mm and 17.42 ± 2.14 mm respectively and when compared, no significant (p= 0.186) difference was observed between males and females. Tyagi and Narayan[5] conducted a study on the Indian population and reported that the mean cephalic anteroposterior diameter of the fifth lumbar vertebra was 21.27 ± 3.12 mm and 18.09 ± 1.32 mm in males and females respectively. The findings of the mean cephalic anteroposterior diameter of vertebral foramen were almost like the present study. The similarity might be due to the same geographical area, socioeconomic condition, and food habits. The measured values of the present study were found almost like the findings reported by Azu[6] who performed a study on the South African population and reported the mean cephalic anteroposterior diameter of vertebral foramen was 18.67 ± 1.49 mm and 18.94 ± 2.76 mm in female and male respectively. No inference could be made regarding this similarity.

The mean ± SD of caudal anteroposterior diameter in this study in males and females was 19.79 ± 2.12 mm and 19.37 ± 2.22 mm respectively and when compared, no significant (p= 0.253) difference was observed between males and females. Gupta and Singla[7] conducted a study on the North Indian population and reported that the mean cephalic anteroposterior diameter was 16.36 ± 3.02 mm. However, the values of the caudal anteroposterior diameter of the vertebral foramen were lower than in the present study. These dissimilarities might be due to variations in skeletal morphology in the different zones of India.

In this study, the mean ± SD maximum transverse diameter of a vertebral foramen in males and females was 24.58 ± 2.65 mm and 23.02 ± 2.46 mm respectively. The maximum transverse diameter of the vertebral foramen of the fifth lumbar vertebra was greater in males than females and it was found statistically significant (p=0.000). Londhe and Garud[2] carried out a study on the Indian population and reported that the mean maximum transverse diameter of the vertebral foramen of the fifth lumbar vertebra was 24.34 ± 2.03 mm. The findings of the mean maximum transverse diameter of vertebral foramen were nearest to the present study. The similarity reported might be due to the same race. The measured values of the present study were found dissimilar to the findings

reported by Scolies[8] who worked on the Ohio population and reported that the mean maximum transverse diameter of the vertebral foramen of the fifth lumbar vertebra was 26.0 ± 2.6 mm and 25.9 ± 2.8 mm in female and male respectively. The dissimilarities can be due to variations in race.

Conclusion

The value of the rest of the maximum transverse diameter of the vertebral foramen of the fifth lumbar vertebra was greater in males than females and it was statistically significant ($p < 0.001$). However, no statistically significant difference was found between males and females in the cephalic and caudal anteroposterior diameter of the vertebral foramen. Measurement of different dimensions of living bones by radiographic study and comparison of them with fully ossified dry bones are suggested. Thus, a morphometric comparison between living and dry bones can be made.

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