

ORIGINAL RESEARCH

Normative Cervical Spinal Canal and Spinal Cord Dimensions on MRI in Kashmiri Adults

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ABSTRACT

Introduction: Stenosis or narrowing of spinal canal is a common cause of cervical pain and a risk factor for development of spondylotic myelopathy. The aim of the present study was to determine the normal values of the cervical spinal canal and spinal cord in antero-posterior dimensions on MRI in Kashmiri adults of Kashmiri ethnicity

Materials and Methods: The measurements were made on 100 MRI scans (mid-sagittal T2 Weighted images) from C3 to C7 levels. Patients ages ranged from 19-38 years (average age 32.8 years) and 56 patients were male and remaining 44 were females. All patients were of Kashmiri ethnic origin. The MR study was rejected if there was clinical history of radiculopathy, possible intrinsic spinal cord disease or a degenerative process.

Results: The average antero-posterior (AP) vertebral body dimension in mid sagittal axis was 15.56 mm \pm 1.36 mm (average \pm SD). The average antero-posterior spinal canal dimension in sagittal axis was 14.5 mm \pm 1.02 mm (average \pm SD). The average antero-posterior (AP) spinal cord dimension in sagittal axis was 8.18 mm \pm 0.9 mm (average \pm SD).

Conclusions: In the present study, the antero posterior vertebral body and spinal canal dimensions in mid sagittal axis were 1 to 3 mm less than the measurements reported in various studies. This could be attributed to ethnic differences.

Keywords: antero-posterior dimensions, sagittal axis, ethnic, variation

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INTRODUCTION

Cervical spondylosis is a common clinical problem. The etiology in many of these patients is narrowing of the cervical canal. With the increased use of computers and laptops the incidence and implications of cervical spondylosis are gaining increasing attention. Various authors have used different techniques for measuring the cervical spinal canal.¹⁻⁵ Standard radiographs (lateral view) of the cervical spine are most frequently used for measuring mid sagittal diameter and canal to corpus ratio (Torg ratio).⁴ However, radiographs have inherent magnification issues. Computed tomography (CT) has been used by some authors for measuring antero-posterior diameter and cross sectional area on axial images.³ However, CT scan allows for evaluation of bony structures only. Magnetic resonance imaging (MRI) evaluates soft tissues as well as bony structures and can accurately measure the canal and spinal cord dimensions.⁵ The dimensions of cervical spinal canal and spinal cord are not only different at different levels in individuals of same race but also differ at identical levels in individuals of different races. Studies⁶⁻⁷ performed on white and African-American cadavers showed significant differences in cervical canal dimensions. There is no published data, to the best of our knowledge, regarding the MR measurements of cervical canal and cord in individuals of Kashmiri ethnicity. In the present study, an attempt has been made to establish the normal values of antero-posterior dimensions of cervical vertebra, spinal canal and spinal cord on mid sagittal MRI images in Kashmiri adult population.

MATERIALS AND METHODS

The study included 100 MR scans of the cervical spine done in the department of Radio-diagnosis, Government Medical College, Srinagar between March 2010 and July 2014. Patients ages ranged from 19-38 years (average age 32.8 years) and 56 patients were male and remaining 44 were females. All patients were of Kashmiri ethnic origin. An MR examination was accepted into the study if it was interpreted as normal by two radiologists independently. MR study was rejected if there was clinical history of radiculopathy, possible intrinsic spinal cord disease or a degenerative process. The subject was also rejected if there was MR evidence of any disc herniation, traumatic, infectious or neoplastic spinal disorders or congenital spinal anomalies or if the image quality was subjectively determined to be below our average

Vertebral level	(AP) vertebral body diameter in sagittal axis in males (SD) mm	(AP) vertebral body diameter in sagittal axis in females (SD) mm	(AP) spinal canal diameter in sagittal axis in males (SD) mm	(AP) spinal canal diameter in sagittal axis in females (SD) mm	(AP) spinal cord diameter in sagittal axis in males (SD) mm	(AP) spinal cord diameter in sagittal axis in females (SD) mm
C3	15.7 (1.16)	15.5 (1.13)	14.6 (1.03)	14.5 (1.02)	8.5 (0.9)	8.4 (0.90)
C4	15.9 (1.08)	15.6 (1.06)	14.5 (1.02)	14.3 (1.00)	8.6 (0.9)	8.5 (0.91)
C5	15.4 (1.04)	15.3 (1.04)	14.1 (1.04)	14.0 (1.02)	8.4 (0.8)	8.4 (0.78)
C6	14.8 (1.10)	14.6 (1.09)	14.7 (0.90)	14.5 (0.93)	7.9 (0.8)	7.8 (0.79)
C7	14.5 (1.14)	14.3 (1.12)	14.6 (0.90)	14.3 (0.91)	7.5 (0.9)	7.4 (0.88)

Table-1: Antero-posterior (AP) vertebral body, spinal canal and spinal cord in sagittal axis and standard deviations (SD)



Figure-1: Mid sagittal T2 weighted sequence of cervical spine showing antero-posterior dimensions of the vertebral body, spinal canal and spinal cord in sagittal axis

- 1-1[^], 5[^]-5, 9[^]-9. Antero-posterior dimension of vertebral body, spinal canal and spinal cord in mid sagittal axis at C3 level
- 2-2[^], 6[^]-6, 10[^]-10. Antero-posterior dimension of vertebral body, spinal canal and spinal cord in mid sagittal axis at C4 level.
- 3-3[^], 7[^]-7, 11[^]-11. Antero-posterior dimension of vertebral body, spinal canal and spinal cord in mid sagittal axis at C5 level.
- 4-4[^], 8[^]-8, 12[^]-12. Antero-posterior dimension of vertebral body, spinal canal and spinal cord in mid sagittal axis at C6 level.

standards. The study was approved by institutional ethical committee. All examinations of cervical spine were performed on a 1.5 Tesla MR unit (Seimens) using a dedicated cervical coil and a standardized neutral head position. The imaging sequences and parameters were identical in all the patients and were as follows: repetition time msec/echo time msec;5590/116; matrix 288x512; FOV 260x183 mm; slice thickness 3mm. Saturation pulses were used anteriorly to reduce the breath and vascular artifacts. The images were analyzed on a work station and the antero posterior dimensions of vertebral body (C3 to C7), spinal canal (C3 to C7) and spinal cord (C3 to C7) were measured on mid sagittal T2 weighted images. Antero-posterior dimensions of vertebral body was measured at the midpoints between the superior and inferior endplates in sagittal axis. The antero-posterior spinal canal dimension was measured as the shortest distance from the midpoint between vertebral body superior and inferior endplates to spino-laminar line. The antero-posterior

spinal cord dimension was measured at the midline of the vertebral body (figure 1). All these measurements were made independently by two radiologists in millimeters and mean value of two measurements was calculated for each level to reduce human error.

RESULTS

In 100 subjects of Kashmiri ethnicity (56 males and 44 females) aged 19-38 years (average age 32.8 years),the antero-posterior dimension of vertebral bodies, spinal canal and spinal cord in sagittal axis were obtained from C3 to C7 levels. The data is presented in Table 1.

The average antero-posterior vertebral body dimension in mid sagittal axis was 15.56 mm +/- 1.36 mm (average +/-SD). The average antero-posterior spinal canal dimension in mid sagittal axis was 14.5 mm +/- 1.02 mm (average +/-SD). The average antero-posterior spinal canal dimension was least at C5 level. The average antero-posterior spinal cord dimension in mid sagittal axis was 8.18 mm +/- 0.9 mm (average +/-SD). It was greatest at C3 to C5 levels because of cervical enlargement.

DISCUSSION

Various morphometric studies on the spinal canal and spinal cord have shown considerable racial and ethnic variations in the dimensions, apart from differences due to age and sex.⁸ Chhabra et al⁹ reported that the spinal canal diameter was smaller in Indian population. In the present study, the sagittal vertebral body dimension and spinal canal dimensions were 1 to 3 mm less than the measurements reported in various studies.

These differences could be attributed to the fact that we used MRI in our study, whereas some authors have used radiographs or computed tomography scans¹⁰ and due to ethnic differences.⁹ In a study Tierney et al¹¹ using MRI, reported average spinal canal diameter of 13.28 mm +/-1.47 mm (average +/-SD) and average sagittal vertebral body diameter 17.7 mm +/- 2.18 mm (average +/-SD). The differences are likely due to ethnic variation. Anderson et al,¹² reported the average spinal cord sagittal diameter in adults as approximately 8 mm from C3 to C7 levels which is consistent with our results.

CONCLUSION

The dimensions of cervical spinal canal and spinal cord vary with ethnicity and vertebral level, a prudent use of these normal values should help the radiologists to interpret MRI of cervical spine and serve as morphometric determinants of cervical canal stenosis in adults of Kashmiri ethnic origin.

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