Clinical implications morphometric study of the cervical spine on MRI

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ABSTRACT

Degenerative changes, history of trauma or inflammation usually progressed to cervical spinal canal stenosis. This condition leads to cervical spondylosis neuropraxia and cervical spondylotic myelopathy (CSM). SAC (space available for the cord) value is important to understand the symptoms of spinal cord compression in cervical canal stenosis. The aim of our study is to establish cervical spinal canal morphometry in Western Maharashtra population observed by MRI of cervical region. 70 subjects aged between 18-70 years. The sagittal vertebral body diameter, the sagittal spinal canal diameter and the sagittal spinal-cord diameter were measured at the C3 - C7 level. The SAC was determined. For each variable a two-way ANOVA was performed, sagittal canal diameter, sagittal spinal cord diameter and SAC were significant with p-value P < 0.0001**. Mean vertebral body diameters observed were 1.49-1.51. Values of SAC observed were C3-1.5 cm, C4-1.51cm, C5- 1.49cm, C6- 1.5cm, C7 - 1.49cm. Average sagittal spinal canal diameter from C3-C7 was 14.1± 1.3 mm. The range of SAC was between 6.4-9.5mm, least at the C5 level. We conclude that subjects in our study do not have an increased risk of spinal cord compression.

INTRODUCTION

At large complaint of neck pain pertaining to adult population is common. Such presentation is accompanied by pain radiating to the upper limb. A predisposing factor for such clinical presentation is cervical spinal canal stenosis. Cervical spinal canal contains spinal cord along with meninges if the diameter of the spinal canal is reduced it is labelled as cervical canal stenosis (Amonoo-Kuofi HS et al., 1990). Degenerative changes, history of trauma or inflammation usually progressed to cervical spinal canal stenosis. This condition leads to cervical spondylosis neuropraxia and cervical spondylotic myelopathy (CSM) (Chhabra S et al., 1991; Edwards WC, La Rocca H 1983; Gore DR 2001). The Previous study done on radiograms was showed degenerative changes of the cervical spine to a high tune of 82% with an average age of 54 years. (Hayashi H et al., 1997) Review of literature mentions different spinal canal morphological values. This is a result of variations in magnification of plane radiographs. In 1987 scientist Pavlov and Torg (Herzog RJ et al., 1991) described the ratio "Torg’s ratio" as a suitable indicator of cervical canal stenosis. Previous studies commented that reliable indicator for cervical canal stenosis was the value of the sagittal diameter of the spinal canal less than 13mm (Jones ET, Mayer P. 1994, Lee MJ et al., 2007, and Maitreyee Kar et al., 2017) with the era of MRI, they are superior to plane radiographs for accurately measuring different morphological measurements. If we need to calculate space available for the spinal cord from the sagittal diameter of the spinal canal. (Meyer SA et al., 1994, Pavlov H et al., 1987) SAC value is important to understand the
MATERIAL AND METHODS

A retrospective study done in D.Y. Patil Medical College, Kolhapur included 70 subjects aged between 18-70 years. All individuals who underwent MRI of the cervical region during period 21 August 2018 to 30 September 2018. Care was taken to exclude individuals with congenital anomalies of the vertebral column and cervical region.

MRI was done with the help of 1.5 Tesla MRI machine (Avanto, Siemens, Germany), using a spinal coil and standardized neutral head position. T1-weighted and T2-weighted images were taken for the MR imaging study. Sagittal T1-weighted Fast Spin Echo sequence (FSE) (repetition time msec/echo time msec, 700/11; section thickness, 3 mm; field of view, 250 mm x 250 mm; matrix, 384 x 288), sagittal T2-weighted turbo-spin echo sequence (2920/101; section thickness, 3 mm; insertion gap, 1 mm;) and a transverse T2-weighted Fast Recovery Fast Spin Echo (FSE) sequence at one or multiple levels (3960/88; section thickness, 3 mm; insertion gap, 0.5 mm; field of view, 200mm x 200 mm; matrix, 384 x214) was used for this purpose. All measurements were made by using Osirix DICOM viewer 64-bit software, and a mean value of three measurements was considered as the final measurement. All the measurements were made midsagittal at each spinal level from C3 to C7 vertebra.

RESULTS

In our study data was collected from 70 subjects, with an average age of 48.53 years. Mean vertebral body diameters observed were 1.49-1.51 as shown in Table 1. Sagittal canal diameter and sagittal spinal cord diameter were analysed, showed a significant difference as shown in Table 1. SAC value was calculated by using formula sagittal canal diameter minus sagittal spinal cord diameter at different vertebral levels. Values of SAC observed were C3-1.5 cm, C4- 1.51cm, C5- 1.49cm, C6-1.5cm, C7- 1.49cm. Different cervical vertebral levels as shown in Table 2. Statistically, SAC value was strongly significant showing p-value, P<0.0001** as shown in Table 1.

DISCUSSION

On comparison of studies done on morphometric measurements of the vertebral canal they have reported variations on bases of races and ethnicity. Studies performed on Indian population conclude that canal size is definitely smaller than others. (Standring S 2016, Tierney RT et al., 2002a, Tierney TR et al., 2002b)

A couple of authors have shown differences in spinal canal diameter at different levels; our study also shows the difference in mean value at different levels. Tierney et al. used MRI and reported average spinal canal diameter 13.28 mm ± 1.47 and average sagittal vertebral body diameter 17.7 mm ± 2.18. The reported average sagittal cervical canal diameter (C3-C7) by Lee (18) was 14.1 ± 1.6 mm. In our study, we reported an average sagittal spinal canal diameter from C3 to C7 as 14.1±1.3 mm which is comparable with previous studies (Torg J et al., 1986; Torg JS et al., 1987; Torg JS et al., 1997).


### Table 1: Statistical analysis of variables

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<th></th>
<th>C3</th>
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<th>C6</th>
<th>C7</th>
<th>P' value</th>
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<tr>
<td>Vertebral bodies</td>
<td>MEAN</td>
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<td>1.51</td>
<td>1.49</td>
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<td>1.49</td>
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<td>diameter (cm)</td>
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<td>Sagittal canal</td>
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<td>diameter (cm)</td>
<td>SD</td>
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<td>0.14</td>
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<tr>
<td>Sagittal Spinal cord</td>
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<td>diameter (cm)</td>
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<td>SAC value (cm)</td>
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<td>0.677</td>
<td>0.638</td>
<td>0.692</td>
<td>0.757</td>
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<tr>
<td></td>
<td>SD</td>
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### Table 2: Mean of variables

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<tbody>
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<td>1.51</td>
<td>1.49</td>
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<tr>
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C- Cervical; SAC- Space Available for Cord

### Acknowledgement

The authors gratefully acknowledge the valuable input provided by Dr J.K. Patil, Eureka diagnostic centre, Kolhapur over the course of this study.

### REFERENCES


CONCLUSION

Calculation of morphometric parameters of cervical region is superior with MRI as compared to plain Radiograms. Our study was performed on Indian population; average sagittal spinal canal diameter from C3-C7 was 14.1± 1.3 mm. A range of SAC was between 6.4-9.5mm, least at C5 level. We conclude that subjects in our study do not fit into the criteria of cervical spinal canal stenosis. So they do not have increased risk of spinal cord compression.


