

Computed tomographic evaluation of C5 root exit foramen in patients with cervical spondylotic myelopathy

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Abstract

Background: Narrowing of the intervertebral foramen for C5 root and a larger superior articular process in myelopathic patients with postlaminoplasty motor dominant C5 radiculopathy has been reported. We investigated whether the C4-5 foraminal dimensions and surface area in patients with cervical spondylotic myelopathy are universally smaller than the intervertebral foramina at other cervical levels.

Methods: The study population consisted of 44 consecutive patients (sex: 24 males and 20 females), averaging 55.7 years of age (range 42-84) years who presented with clinical features suggestive of cervical spondylotic myelopathy. Using computed tomography (CT) imaging, we prospectively compared height, transverse diameter, and surface area of the C4-5 foramen to those of C3-4, C5-6 and C6-7 foramina of the same side in the whole study population as well as in male and female patients.

Results: In the whole study population at C4-5 intervertebral foramen the mean foraminal height was 8.37 ± 1.3 mm on the right and 8.85 ± 1.16 mm on the left; and the mean foraminal transverse diameter on the right was 4.97 ± 1.35 mm and 5.14 ± 1.16 mm on the left. No statistically significant difference was found between the measurements in the whole study population at various levels, between or within male and female patient groups.

Conclusion: C4-5 intervertebral foramen is not uniformly smaller in patients with cervical spondylotic myelopathy.

Key Words: C5 root, cervical, foramen, intervertebral, myelopathy, spondylosis

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INTRODUCTION

Among the well known complications of cervical laminoplasty is motor dominant C5 root palsy,^[4,5] which may also complicate anterior cervical decompressive surgery.^[7] Much divergence of opinions exists concerning the risk factors for this type of complication as well as its prevention.^[8] There is no reliable evidence to verify any of the proposed hypothetical mechanisms of postdecompression C5 root palsy.^[1]

Some investigators have shown a statistically significant narrowing of the intervertebral foramen for C5 root and a larger superior articular process in their patients with postlaminoplasty C5 radiculopathy when compared with those without postlaminoplasty C5 radiculopathy.^[2] In this study we investigated whether the C4-5 foraminal dimensions and surface area in patients with cervical spondylotic myelopathy are smaller than the intervertebral foramina at other cervical levels.

Table 1: Cervical foraminal dimensions in the whole study population

Level	Transverse diameter (Mean±SD) (mm)		Height (Mean±SD) (mm)		Surface area (Mean±SD) (mm ²)	
	Right	Left	Right	Left	Right	Left
C 3-4	5.11±1.53	4.72±1.38	7.89±1.22	8.06±1.27	64.80±25.36	60.46±23.50
C 4-5	4.97±1.35	5.14±1.16	8.37±1.38	8.55±1.16	66.26±24.07	70.00±21.74
C 5-6	4.61±1.14	4.61±1.24	8.09±1.28	8.35±1.30	60.37±20.52	61.63±23.58
C 6-7	5.20±1.35	5.19±1.47	8.37±1.59	8.36±1.75	70.58±57.80	71.54±29.34

SD: Standard deviation

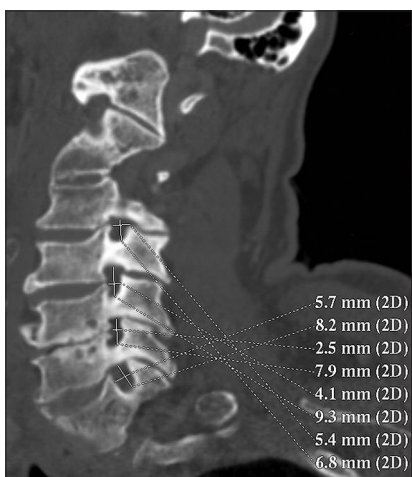


Figure 1: Computed tomography image with measurements

Methods

In a prospective series of 44 consecutive patients (sex: 24 males and 20 females), averaging 55.7 years of age (range 42-84) years with cervical spondylotic myelopathy, computed tomography (CT) imaging was used to compare height, transverse diameter, and surface area of the C4-5 foramen to those of C3-4, C5-6 and C6-7 foramina of the same side in the whole study population as well as in male and female patients. Student's *t*-test for paired samples was used to determine statistical significance ($P < 0.001$) of differences between measurements. SPSS® software version 16.0.1 was used. Helical CT scanning parallel each disk space was performed and measurements of the neural exit foramina from C3-4 to C6-7 were performed with axial images reformatted and rotated to 45 degrees from the sagittal plane. Two perpendicular measurements were taken for each foramen; craniocaudal (height) and anteroposterior (transverse diameter) [Figure 1]. Foraminal heights and transverse diameters were used to calculate the foraminal area using the ellipse area formula: $\pi ab/2$ where *a* and *b* are the major and minor axes of the ellipse, respectively.

RESULTS

No statistically significant difference was found between the measurements in the whole study population at various

levels, between or within male and female patient groups. In the whole study population, the surface area of C4-5 intervertebral foramen was $66.26 \pm 24.0 \text{ mm}^2$ on the right and $70.00 \pm 21.74 \text{ mm}^2$ on the left. Table 1 demonstrates the cervical foraminal height, transverse diameter, and surface area in the whole study population.

DISCUSSION

Imagama *et al.* were the first to correlate impairment of the C5 nerve root with a C5 palsy; they have shown a statistically significant narrowing of the intervertebral foramen of C5 root and a larger superior articular process in their patients with postlaminoplasty C5 radiculopathy.^[2] Katsumi *et al.* reported a significant difference in the diameter of the C4-5 foramen between patients with and without C5 palsy after cervical open-door laminoplasty, and suggested preexisting C4-5 foraminal stenosis to be the main etiology of C5 palsy.^[3] Furthermore, it has been reported that C5 radiculopathy may be avoided by performing selective foraminotomy in addition to posterior central canal decompression.^[4,6] Narrowing the width of anterior decompression has been proposed to decrease the anterior shift of the spinal cord and the traction on the roots, and thus to prevent the development of radiculopathy after corpectomy.^[7]

In this study we found no statistically significant difference between the surface area or dimensions of C4-5 foramen and those of C3-4, C5-6, and C6-7 in patients with cervical spondylotic myelopathy before surgery [Table 1]. The C4-5 foraminal stenosis reported in other studies to contribute to postoperative C-5 palsy in the affected patients is probably present at this specific level in these very patients who develop such a complication and is likely to be postoperatively set in interplay with other factors, like spinal cord shift, leading to C5 root affection.

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