

**Original article:**

## Role of flexion-extension MRI in assessing the severity of cervical spondylotic canal stenosis

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### Abstract:

**Introduction:** Cervical spondylotic canal stenosis is a degenerative condition of the spine that commonly affects the elderly population.

**Material and methods:** The study was conducted over a period of 18 months at Bapuji Hospital and Chigateri General Hospital, which are affiliated with the Department of Radiology, J J M Medical College, Davangere. The sampling technique used in this study was purposive sampling.

**Results :** Out of 50 patients included in the study, majority of them were aged more than 50 years with the incidence of 18 (36%) followed by 41 to 50 years with the incidence of 16 (32%). 11 (22%) and 5 (10%) were aged between 30 to 40 years and less than 30 years respectively. Out of 50 patients included in the study, 26 (52%) were males and the rest 48% were females.

**Conclusion:** In conclusion, flexion-extension MRI plays a valuable role in assessing the severity of cervical spondylotic canal stenosis. By capturing dynamic images of the cervical spine during different neck positions, it provides essential information on spinal cord compression and helps determine the appropriate treatment approach.

**Keywords:** cervical spondylotic canal stenosis , MRI , flexion-extension

### Introduction:

Cervical spondylotic canal stenosis is a degenerative condition of the spine that commonly affects the elderly population. It is characterized by the narrowing of the spinal canal in the neck region, which can lead to compression of the spinal cord and nerve roots, resulting in various neurological symptoms. Accurate assessment of the severity of cervical spondylotic canal stenosis is crucial for determining the appropriate treatment strategy.

Magnetic resonance imaging (MRI) is widely used as a diagnostic tool for evaluating cervical spine pathologies, including cervical spondylotic canal stenosis. Traditionally, conventional MRI in the neutral position has been the standard imaging modality for assessing this condition. However, the neutral position MRI may not always capture the full extent of spinal cord compression, particularly in cases where symptoms are triggered or worsened by neck movements.

Flexion-extension MRI is a specialized imaging technique that allows dynamic assessment of the cervical spine by capturing images in different neck positions, specifically during flexion and extension. This dynamic imaging provides valuable information on the mobility and positional changes of the spinal cord and nerve roots, which can be crucial in assessing the severity of cervical spondylotic canal stenosis.

The role of flexion-extension MRI in the assessment of cervical spondylotic canal stenosis lies in its ability to visualize the dynamic changes in spinal cord compression that occur during neck movements. By comparing the images obtained in the neutral, flexed, and extended positions, clinicians can better understand the extent of spinal cord compression and its relationship to symptoms experienced by the patient.

Furthermore, flexion-extension MRI can help differentiate between stable and unstable forms of cervical spondylotic canal stenosis. Instability refers to abnormal movement or excessive motion between the vertebrae, which can lead to further compression of the spinal cord or nerve roots. The dynamic imaging provided by flexion-extension MRI can reveal any abnormal movement patterns or excessive translation between the vertebrae, aiding in the identification of instability.

#### **Material and methods:**

The study was conducted over a period of 18 months at Bapuji Hospital and Chigateri General Hospital, which are affiliated with the Department of Radiology, J J M Medical College, Davangere. The sampling technique used in this study was purposive sampling.

The study population consisted of individuals of either gender, aged more than 18 years, who were referred to the hospitals with a clinical diagnosis of cervical spondylosis. These patients presented with complaints of neck pain with or without neurogenic symptoms, such as radiating pain to the upper limb, tingling sensation of the upper limb, numbness, or decreased sensation. The inclusion criteria also required the patients to have a Nurick grade of 0, 1, or 2. The Nurick grading system assesses the severity of neurological impairment in patients with cervical spondylosis, with grade 0 indicating no signs or symptoms and grade 1 or 2 indicating mild to moderate symptoms.

Patients who met the inclusion criteria and were willing to participate in the study by providing written informed consent were included as study samples. On the other hand, patients with a history of trauma, tumor, infection, prior cervical surgery, or claustrophobia, as well as those with a Nurick grade greater than 3, were excluded from the study.

#### **Results:**

Based on the sample size formula, the minimum study population obtained was 33 although we observed that a greater number of cases were presenting fulfilling the inclusion criteria during our study period. Hence the study was conducted with study population of 50 cases.

Out of 50 patients included in the study, majority of them were aged more than 50 years with the incidence of 18 (36%) followed by 41 to 50 years with the incidence of 16 (32%).

11 (22%) and 5 (10%) were aged between 30 to 40 years and less than 30 years respectively.

Out of 50 patients included in the study, 26 (52%) were males and the rest 48% were females.

**Table 1: Cervical canal dimensions**

	<b>C2-3</b>	<b>C3-4</b>	<b>C4-5</b>	<b>C5-6</b>	<b>C6-7</b>
Flexion	1.2	1.02	1.02	1	0.99
Extension	1.17	0.97	0.92	0.86	0.89
Neutral	1.16	1.03	0.99	0.94	0.97

On analysing the MRIs for cervical canal stenosis, the mean dimensions were found as the above. On flexion, the dimensions at C2-3, C3-4, C5-6 and C6-7 were 1.2, 1.02, 1.02, 1 and 0.99 respectively. On extension, it was 1.17, 0.97, 0.92, 0.86 and 0.89 at C2-3, C3-4, C5-6 and C6-7 respectively. At neutral position, they were 1.16, 1.03, 0.99, 0.94 and 0.97 at C2-3, C3-4, C5-6 and C6-7 respectively.

**Table 2: Ligamentum flavum hypertrophy**

	<b>C2-3</b>	<b>C3-4</b>	<b>C4-5</b>	<b>C5-6</b>	<b>C6-7</b>
Flexion					
0	50 (100%)	48 (96%)	47 (94%)	45 (95%)	43 (86%)
1	0	2 (4%)	3 (6%)	5 (10%)	7 (14%)
Extension					
0	50 (100%)	48 (96%)	44 (88%)	43 (86%)	41 (82%)
1	0	2 (4%)	6 (12%)	7 (14%)	9 (18%)
Neutral					
0	50 (100%)	47 (94%)	46 (92%)	45 (90%)	44 (88%)
1	0	3 (6%)	4 (8%)	5 (10%)	6 (12%)

Thickening of ligamentum flavum increased from the C2-3 to 6-7 level. Also, there was no significant difference observed at flexion, extension and the neutral position.

**Table 3: FACET JOINT ARTHROPATHY**

	<b>C2-3</b>	<b>C3-4</b>	<b>C4-5</b>	<b>C5-6</b>	<b>C6-7</b>
<b>Flexion</b>					
0	50 (100%)	50 (100%)	47 (94%)	45 (90%)	46 (92%)
1	0	0	3 (6%)	5 (10%)	4 (8%)
<b>Extension</b>					
0	50 (100%)	49 (98%)	46 (92%)	44 (88%)	45 (90%)
1	0	1 (2%)	4 (8%)	6 (12%)	5 (10%)
<b>Neutral</b>					
0	50 (100%)	49 (98%)	47 (94%)	46 (92%)	46 (92%)
1	0	1 (2%)	3 (6%)	4 (8%)	4 (8%)

Incidence of Facet joint arthropathy was also increased as the cervical level was lowered from C2-3 to 6-7. No significant difference observed in flexion, extension and the neutral positions.

**Table 4: Distribution of the study parameters based on the age**

<b>Position</b>	<b>Grading</b>	<b>Age group</b>			<b>p value</b>
		<b>20 to 35 N = 11</b>	<b>36 to 50 N = 20</b>	<b>&gt;50 N = 18</b>	
<b>Flexion</b>	<b>0</b>	9 (81.8%)	2 (10%)	0	<b>0.031</b>
	<b>1</b>	3 (18.2%)	18 (90%)	18 (100%)	
<b>Extension</b>	<b>0</b>	3 (18.2%)	1 (5%)	0	<b>&lt;0.01</b>
	<b>1</b>	9 (81.8%)	19 (95%)	18 (100%)	
<b>Neutral</b>	<b>0</b>	9 (81.8%)	2 (10%)	0	<b>&lt;0.01</b>
	<b>1</b>	3 (18.2%)	18 (90%)	18 (100%)	

We observed that as the age progressed. Degree of bulging also increased significantly.

### **Discussion:**

The present study aimed to assess the severity of cervical spondylotic canal stenosis using flexion-extension MRI in a study population of 50 cases. The results revealed interesting findings regarding the age distribution, cervical canal dimensions, ligamentum flavum hypertrophy, and facet joint arthropathy.

Regarding the age distribution of the study population, it was observed that the majority of patients with cervical spondylotic canal stenosis were aged over 50 years (36%). The incidence decreased in the age groups of 41 to 50 years (32%), 30 to 40 years (22%), and less than 30 years (10%). This finding aligns with the well-established fact that cervical spondylosis predominantly affects the elderly population due to degenerative changes in the spine over time.

The analysis of cervical canal dimensions in different neck positions provided valuable insights into the severity of canal stenosis. The mean dimensions at various levels (C2-3, C3-4, C4-5, C5-6, and C6-7) during flexion, extension, and neutral positions were recorded. It was observed that the dimensions were slightly increased during flexion compared to extension and neutral positions. This suggests that flexion of the neck may contribute to increased compression of the spinal cord and nerve roots, potentially exacerbating the symptoms experienced by patients.

Ligamentum flavum hypertrophy, which is a common feature of cervical spondylotic canal stenosis, was also assessed in the study. The results indicated an increasing trend of thickening from the C2-3 to C6-7 levels, indicating a progressive nature of the condition. However, no significant difference was observed between flexion, extension, and the neutral position in terms of ligamentum flavum hypertrophy. This suggests that ligamentum flavum thickening remains consistent across different neck positions.

Facet joint arthropathy, another important aspect of cervical spondylotic canal stenosis, was evaluated in the study. The incidence of facet joint arthropathy also increased as the cervical level was lowered from C2-3 to C6-7. Similar to ligamentum flavum hypertrophy, no significant difference was observed in flexion, extension, and the neutral position in terms of facet joint arthropathy. This indicates that facet joint arthropathy remains a consistent finding regardless of neck position.

Furthermore, the study analyzed the association between age and disc bulge, which is a common finding in cervical spondylotic canal stenosis. The results revealed a significant increase in disc bulge with age, indicating a progressive nature of disc degeneration as individuals get older. This finding emphasizes the importance of age as a contributing factor to the severity of cervical spondylotic canal stenosis.

Overall, the findings of this study contribute to a better understanding of cervical spondylotic canal stenosis and its associated features. The age distribution highlights the increased susceptibility of the elderly population to this condition. The analysis of cervical canal dimensions, ligamentum flavum hypertrophy, facet joint arthropathy, and disc bulge provides valuable insights into the severity and progression of cervical spondylotic canal stenosis. These findings can aid clinicians in diagnosing and managing patients with this condition, ultimately leading to improved patient outcomes. However, it is important to note that further research with larger sample sizes and longitudinal follow-up is needed to validate and generalize the findings of this study.

### **Conclusion:**

In conclusion, flexion-extension MRI plays a valuable role in assessing the severity of cervical spondylotic canal stenosis. By capturing dynamic images of the cervical spine during different neck positions, it provides essential information on spinal cord compression and helps determine the appropriate treatment approach. Its

ability to identify instability also contributes to the comprehensive evaluation of the condition. Flexion-extension MRI offers an improved understanding of the pathology, leading to more accurate diagnoses and better-informed treatment decisions for patients with cervical spondylotic canal stenosis.

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