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BENEFIT OF DYNAMIC MR IMAGES IN EVALUATION CERVICAL SPONDYLOTIC MYELOPATHY PATIENTS

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ABSTRACT

Background: cervical spondylotic myelopathy CSM is the most cause of cervical spinal cord dysfunction in people aged over 55 years. even though , our understanding of the etiology of this clinical problem remains incomplete. **Methods**: A total of 30 patients (M:F=11:19, 60.1±10.7 years), The study population consisted of 23(76.7%) patients with signs of cervical myelopathy (M group) and 7(23.3%) patients without signs of myelopathy (NM group). All patients examined clinically and neurologically. the static and dynamic cervical MRI done by using a 1.5-T MR unit (siemens magetom essenza A tim + dot system). The dynamic exam was performed with as much neck flexion and extension the patient could achieve alone. On T2-weigthed MRI each level was assessed and Muhle scale was applied. **Results:** Analysis with extension MR images found an increased number of compression levels posterior position 6 fold than static.Clinical factors for increased compression levels in extension MR images were age (p-value=0.002 , r= 0.4). **Conclusions:** The evaluation of CSM may be better with dynamic MR images. Dynamic MR imaging may be proposed for elderly patients with signs of myelopathy, but an interpretation for asymptomatic cervical spine compressed based exclusively on extension MR image must be done with caution.

KEYWORDS: Dynamic cervical MRI; cervical myelopathy; extension cervical MRI.

INTRODUCTION

Cervical spondylitic myelopathy CSM still the most public disease of the spinal cord occurring in the middle age, the Pathophysiology still unclear. in addition to static factors causing canal encroachment, including congenitally narrowed canal, osteophytes, disk bulging, later studies have showed that vascular compromise lead to the development of cervical spondylitic myelopathy. In addition, dynamic factors, like cervical spinal motion, leading to reduce the functional diameter of the cervical spinal canal.[1] so, the dynamic factor compress the cervical spinal cord during motion, and neutral MR images not fully show the dynamic spinal cord compression occurring in daily life.[2]

MATERIALS AND METHODS

From January 2019 to June 2020, 30 consecutive patients (M:F=11:19; 48±10.7 years; range, 30 – 63) had flexion/ neutral/extension cervical MR images (dynamic MR images, 1.5 T, siemens magetom essenza A tim + dot system) taken at in- or out-patient clinics. The study population included 23 patients (76.7%) with signs of cervical myelopathy (M group) and 7 patients (23.3%) with arm or neck pain without signs of myelopathy (NM group). Signs of cervical myelopathy included (1) increased deeptendon reflex (biceps/supinator/knee/ankle jerk), (2) positive, inverted radial response, (3) positive Hoffmann's sign, and/or (4) positive Babinski sign. depending on Modified Japanese Orthopaedic Association (mJOA) score for severity of deases.[3] All procedures followed were in accordance with the ethical standards of the responsible committee on human, experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

Dynamic MR images

Before undergoing the MR imaging, the patients tested tolerability, active flexion and extension neck posture outside the MR scanner. Then, the dynamic MR images were scanned, respecting direction with pillow support at the head and shoulder. Tolerability was assessed through

a microphone. If the patient felt discomfort during the test, such as increased tingling or pain, scanning was stopped. No adverse effect occurred during the MR scanning.

Image analysis

The number of compression levels was counted from C2—T1 in mid-sagittal, T2-weighted MR images, Complete obliteration of the anterior and posterior subarachnoid space was considered a "compression level", which corresponded to Muhle Grade 2 or greater(Table 1)[4] The diameter of the spinal canal at each compressed level was measured from neutral, flexion and extension, mid-sagittal, T2-weighted MR images, from posterior border of the disk to th anterior border ligamentum flavum.

Table 1: Classification of the grade of cervical spinal stenosis by Muhle 8 Grade Description.

0	Normal width of the spinal canal, no narrowing of the anterior or posterior subarachnoid space (SAS)
1	Partial obliteration of the anterior or posterior SAS
2	Complete obliteration of the anterior and/or posterior SAS
3	Anterior and/or posterior spinal cord impingement

RESULTS

The number of compression levels in each of the two groups of patients was higher in the dynamic MRI extension position compared to the static, where it increased 2 times in the myelopathy group. Figure(1)

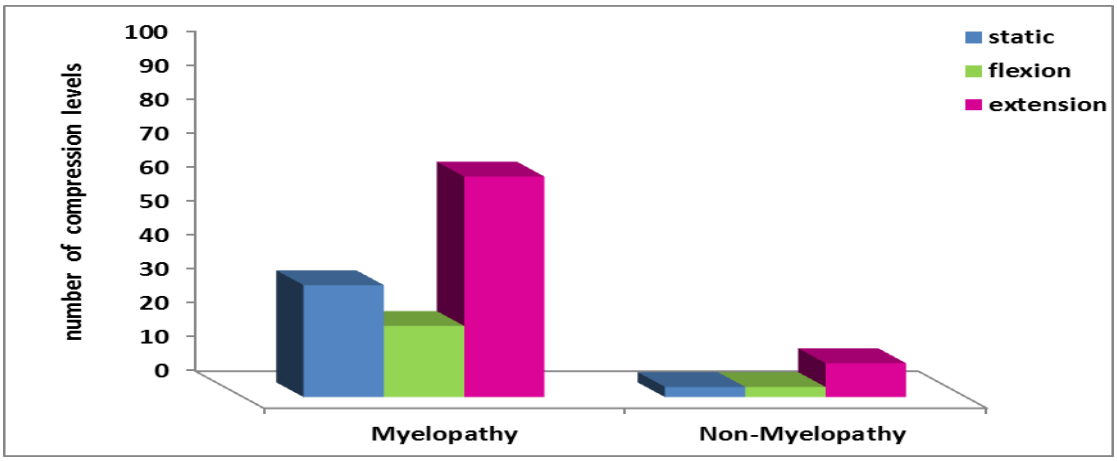

Figure 1: The number of compression levels according to the type of MRI among patients attending the Department of Neurosurgery at Tishreen University Hospital in Latakia during the period 2019-2020.

The number of compression levels in each of the two groups of patients was higher in dynamic MRI extension position in the anterior and posterior sites compared to the static MRI, and in the anterior site the number of compression levels was higher than the posterior site. In the myelopathy group the increase in the extension position anterior sites Twice than static, while the increase in the posterior sites extension position was 6 times higher compared to the static MRI Figure (2)

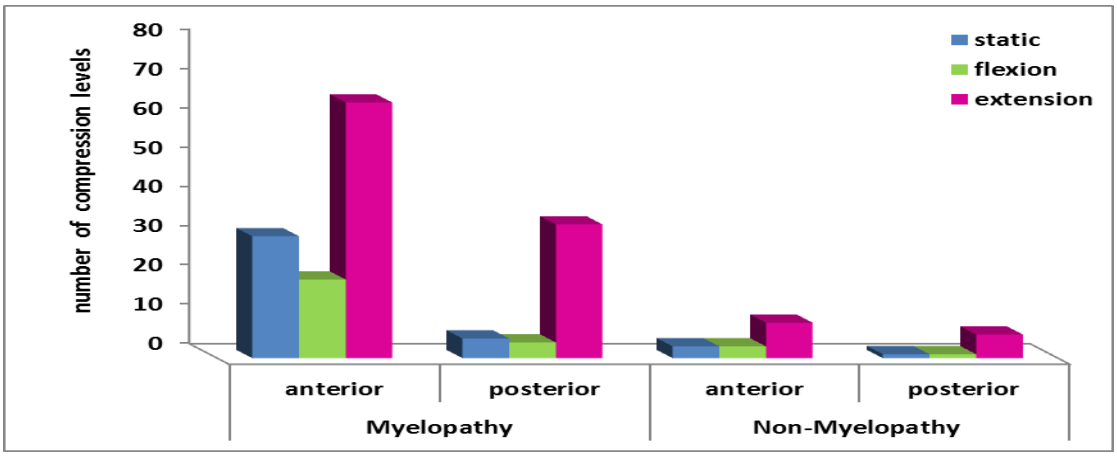

Figure (2): The number of compression levels according to location and according to the type of MRI.

Table 2: Comparing the change in the diameter of the spinal canal in the compression levels between different positions in patients without myelopathy group.

Compression levels	MRI levels		
	static	flexion	extension
C4 – C3	10	12	8.01
C5 – C4	10.2±0.5	11.06±0.5	8.5±0.3
C6 – C5	9±0.8	10.4±0.6	7.9±0.6
C7 – C6	9.3±2.2	9.9±3.2	7.7±1.6

We notice from table [2] a change in the diameter of the spinal canal between the static and the dynamic at all of compression levels, where it was higher in the flexion position compared to the static and the increase ranged between 6.4% to 20% while in the case of extension position there was a decrease in the diameter of the canal compared to the Static position and the decline ranged between 12.2% to 20% and the highest increase and decrease was at the level C3 - C4 with a difference of statistical value at all levels between the different positions with p-value <0.05.

Table 3: Comparing the change in the diameter of the spinal canal in the compression levels between different positions in patients with myelopathy group.

Compression levels	MRI type		
	static	flexion	extension
C4 – C3	9.6±1.3	10.07±1.3	7.5±1.4
C5 – C4	9.04±1.7	9.7±1.7	7.2±1.5
C6 – C5	8.4±1.1	9.1±1.4	6.8±1.2
C7 – C6	9.05±1.4	9.4±1.3	7.6±1.1
t1 - C7	10.1	11.4	9.16

We notice from table [3] a change in the diameter of the spinal canal between the static and the dynamic at all of compression levels where it was higher in the flexion position compared to the static and the increase ranged between 3.8% to 12.8% while in the case of extension there was a decrease in the diameter of the canal compared to the static position and the decline ranged between 9.3% to 21.8% and the highest increase was at the level t1 – C7 while the decrease was more at the level C4 - C3 with a difference of statistical value at all levels between different modes with p-value <0.05.

The relationship between age and number of compression levels in the extension position

The relationship between age and the number of compression levels was studied using the correlation coefficient (Spearman Correlation). The value of the correlation coefficient r = 0.4 with p-value = 0.002, and therefore a positive correlation between the two variables studied, i.e. with age, the number of compression levels increases with a difference of value Statistic Figure (3)

The relationship between the MJOA classification and the number of compression levels in the extension

The relationship between the MJOA classification and the number of compression levels was studied using the correlation coefficient (Spearman Correlation). The correlation coefficient value r = 0.08 with p-value = 0.7 and therefore we did not notice a correlation relationship between the two studied variables and there were no statistical differences.

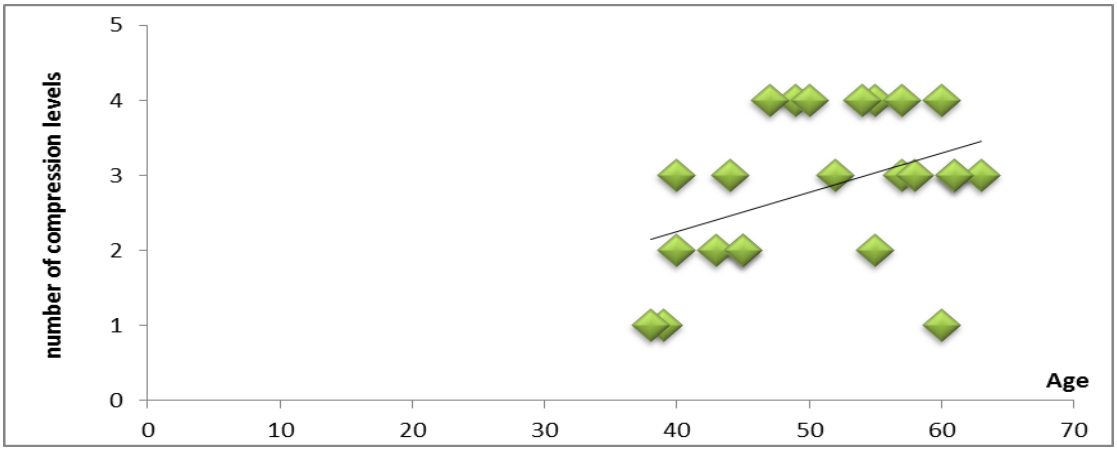

Figure (3): The relationship between age and the number of levels of compression in extension.

Case 1

A 54-year old male with mJOA=10, tingling sensation in four extremities, Deep-tendon reflexes were increased, Hoffmann's sign was positive neutral MRI did not show compression level according to muhle just two level C5-C6 and C6-C7 muhle=1 anterior, but extension MRI showed three compression levels obliteration of the anterior and posterior subarachnoid space C4-C5\ C5-C6 and C6-C7, and one level obliteration of the anterior subarachnoid space at C3-C4 Figure (4).

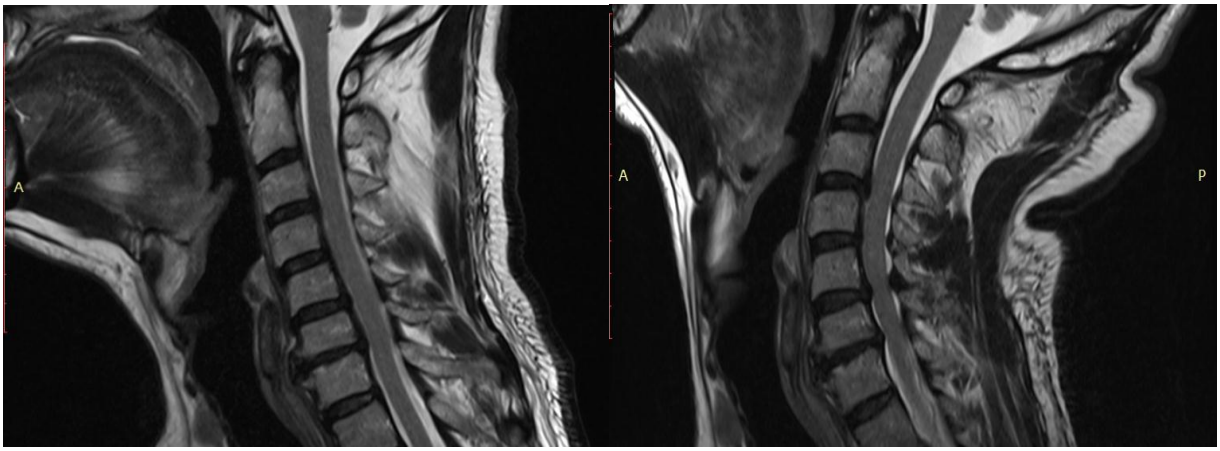

Figure (4): Increased number and degree of compression levels and aggravated spinal cord impingement based on extension magnetic resonance images.

Case 2

A 61-year-old female presented with decreased sensation in four extremities. with mJOA=9 Deep-tendon reflexes were increased. definitive spinal cord compression was not detected. However, extension MR images showed obliteration of the anterior and posterior subarachnoid space at C4-C5\C5-C6 (Figure. 5).

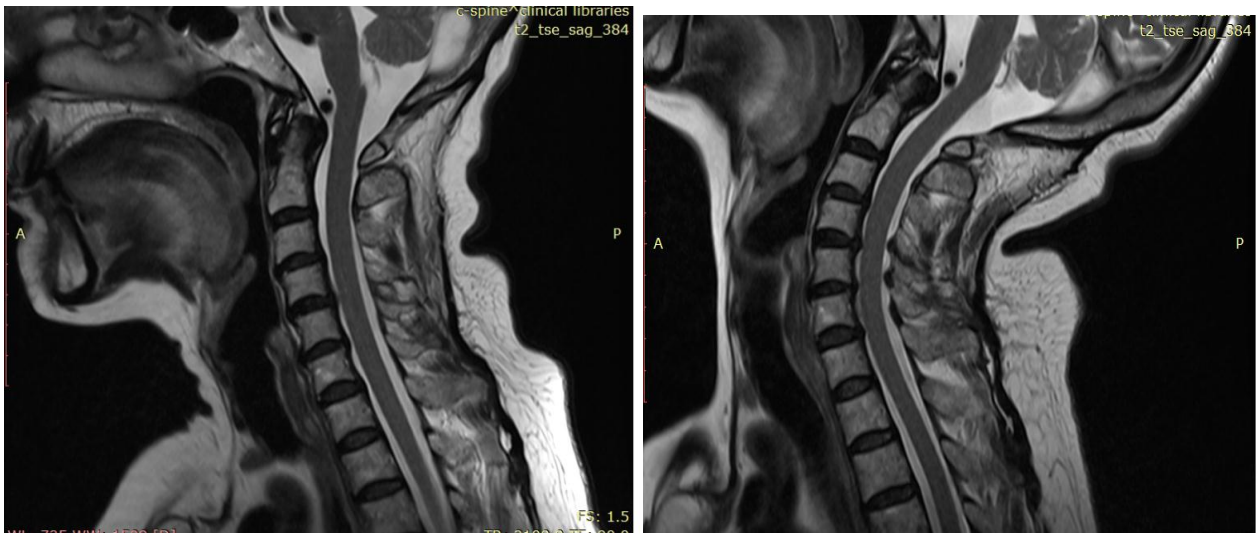

Figure (5): Cervical compressive myelopathy was interpreted using extension magnetic resonance (MR) imaging.

DISCUSSION

Diagnosis of cervical spondylotic myelopathy was improved in (72%) of patients depending on comparisons of extension MR images to neutral MR images. Intellectual compatibility between clinicians in interpreting the images was improved with extension MR images. Dynamic MR considered when evaluating elderly patients with symptoms and signs of myelopathy.[2] Dynamic cervical MRI reveals a great number of findings compared to static MRI with a predilection of posterior ones, which are in 57.14% with complete obliteration of subarachnoid space. Its use in combination with static MRI may be effective in patients suffering from cervical myelopathy in order to plan the operation.[5] Dynamic MRI with extension images is an useful and non-invasive procedure study for the evaluate of spinal canal stenosis and compression used preoperatively, and should be added in addition to neutral images MRI as it is able to show more levels of spinal cord compression. MRI with flexion positions is useful in showing hyperintense intramedullary lesions that are not visualized on neutral MRI. Although the significance of these lesions are Not specified at this

time, may be prognostic importance associated. This data has significance in the estimating of patients with CSM and the preoperative evaluation before to decompression of the spinal cord. Use of dynamic MRI may impact surgical strategy and modify later standards in the evaluation of cervical myelopathy.[6] Using baseline measurements for changes in the ligamentum flavum LF on DMRI in the flexed and extended positions. matching what many clinicians thought occurs with the LF with motion—thickening in extension. the presence of millimetric changes may affect of findings, and the impact of these changes on the spinal canal and the clinical importance.[7] the sagittal and axial dynamic MR during flexion and extension, the Relationship between the transverse area measurements must be considered, and surgical planning should be based on this. The changes in spinal cord compression and the transverse area of the cord, are the most effective prognostic indicators in spinal diseases, and the area of the cord and subarachnoid space detected via dynamic axial sections of MRI. Dynamic MRI may helpful in the decision-making regarding the surgical planning of CSM.[8]

CONCLUSIONS

dynamic MRI shows useful radiological information to the surgical plan. This technical procedure can be particularly helpful for the diagnosis and treatment of patients affected by cervical myelopathy, since their neurological examination does not give information about the level to decompress and a lot of surgical options are available. The high amount of radiological findings in extension images suggests its caution evaluation and integration with flexion position.

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