

# ROLE OF MAGNETIC RESONANCE IMAGING (MRI) IN EVALUATION OF NON-TRAUMATIC COMPRESSIVE MYELOPATHY WITH HISTOPATHOLOGICAL CORRELATION

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### Abstract:

**Background:** Compressive diseases of the spinal cord are divided into acute and chronic, including degenerative changes, trauma, tumor infiltration, vascular malformations, infections with abscess formation, and syringomyelia. Compressive disease is the main cause of myelopathy in older patients. It has a chronic course and usually does not recur.

**Method:** The Present study is a descriptive study aimed to evaluate role of MRI in evaluation of non-traumatic compressive myelopathy with histopathological correlation (wherever necessary) on 30 patients in the Department of Radiodiagnosis & Pathology of NSCB Medical College Jabalpur MP.

**Results:** Most common causes of compressive myelopathy (Non traumatic) in the present study are extradural compression from degenerative compressive myelopathy (30%) and Metastasis (20%). Degenerative compressive myelopathy were found to be more common in the higher age group (above 55Yrs) and in females. Most commonly (77.78%) involve lower cervical area (C3-C7). Metastatic disease of the spine (83%) was seen in multiple level of vertebral column. In the present study most common site of involvement was the dorsal spine. Primary neoplasm like spinal ependymoma is more common than other intramedullary spinal neoplasms in adult age group.

**Conclusion:** MRI is very definitive, sensitive, accurate, though costly but very specific, non invasive, radiation free modality for evaluation of Compressive myelopathy. MRI is the definitive modality in assessing soft tissues of the spine and spinal cord abnormalities, to evaluate cord edema/contusion and integrity of the intervertebral discs and ligaments. MR techniques play an indispensable role in the management of compressive non traumatic spondylotic myelopathy patients and have evolved primarily from a diagnostic modality to a method that can potentially predict patient outcome following surgical intervention.

**Keywords:** Compressive Myelopathy, MRI, Non-Traumatic, Spinal tumors

## Introduction

Term Compressive Myelopathy describes pathologic conditions that cause spinal cord, meningeal or perimeningeal space damage or dysfunction by spinal cord compression either from outside of

within the cord itself. Vascular diseases, infections and inflammatory, traumatic injuries, or autoimmune processes may affect the spinal cord<sup>1</sup> due to its confinement in a very small space.

Compressive diseases of the spinal cord

are divided into acute and chronic, including degenerative changes, trauma, tumor infiltration, vascular malformations, infections with abscess formation, and syringomyelia. Compressive disease is the main cause of myelopathy in older patients. It has a chronic course and usually does not recur.<sup>2</sup>

Magnetic resonance (MR) has become the primary imaging modality for evaluation of degenerative disorders of the cervical, dorsal, and lumbosacral spine. The intervertebral disc, vertebrae, ligaments, spinal canal, and neural foramen may all be evaluated using MR techniques. Paramagnetic contrast agents are valuable for differentiating scar and recurrent disc herniation in the postoperative setting and occasionally are used preoperatively for detecting annular tears and inflammatory processes that may accompany acute disc herniation, facet joint synovitis, and radiculitis.

Atlanto-axial instability is the primary cause of degenerative compressive myelopathy.<sup>3</sup>

Epidural abscesses -Tubercle bacillus infections are more insidious than pyogenic infections of the spine.

MRI is the study of choice to detect the characteristic signs of granulomatous spondylitis: the disk space is usually spared, and vertebral osteomyelitis may be accompanied by soft tissue fibrosis.

Tumors of the spine are important due to their potentially devastating clinical effects and challenging radiographic appearance. In establishing the differential diagnosis for a spinal lesion, location is the most important feature, but the clinical presentation and the patient's age and gender are also important. Magnetic resonance (MR) imaging plays a central role in the imaging of spinal tumors, allowing tumors to be classified as extradural, intradural-extramedullary or intramedullary, which is very useful in tumor characterization.

Myelopathy is a broad term that refers to spinal cord involvement of multiple etiologies. Spinal cord diseases often have devastating consequences, ranging from quadriplegia and paraplegia to severe sensory deficits due to its confinement in a very small area. Many of these diseases are potentially reversible if they are recognized on time, hence the importance of recognizing the significance of magnetic resonance imaging when approaching a multifactorial disease considered as one of the most critical

neurological emergencies, where prognosis depends on an early and accurate diagnosis.<sup>4</sup>

## **Material & Methods**

In Present intended study is a descriptive study carried out on 30 patients visiting the OPD/IPD referred to MRI scan to the Department of Radiodiagnosis NSCB Medical College Jabalpur MP.

### **Case selection:**

The patients who are clinically suspected as a case of compressive myelopathy will be investigated with MRI & Histopathology (wherever necessary). The study group will include a sample size of 30 patients. The data will be analyzed by a descriptive analysis.

### **Inclusion Criteria :**

- All age groups
- Both sexes
- All cases of Non-traumatic compressive myelopathy.

### **Exclusion Criteria :**

- Cases of Non-Compressive myelopathy.
- Cases of Traumatic myelopathy cases

### **Patient preparation:**

The procedure will be briefly explained to the patient and consent will be taken. Detail history for contraindication of MRI will be specifically taken.

### **Equipment:**

GE 1.5 TESLA permanent magnet ,Standard surface coils and body coils were used for cervical, thoracic and lumbar spine for acquisition of images.

**Sequences:**

The imaging protocol consisted of sagittal T1-weighted turbo spin-echo (TSE) sequences [echo train length (ETL), 3], with repetition times (TRs) varying from 450 to 700 ms, and an echo time (TE) of 14ms.

- Sagittal T2-weighted imaging was performed and a T2-weighted TSE sequence (ETL, 5) with TRs varying from 2500 to 3200 ms and TEs from 23 to 180 ms, respectively.
- Axial imaging consisted of T2\*-weighted MERGE (Multiple Echo Recombined Gradient Echo) imaging using TRs of 1500-1700 ms, depending on the number of axial images, and a TE of 27 ms.
- Axial T1 imaging consisted of a T1-weighted TSE (ETL, 3) sequence with a TR/TE combination of 600/15 ms.
- The sagittal and axial T1-weighted sequences were repeated after administration of DTPA-gadolinium (A dose of 0.1mmol/kg body weight) Wherever necessary.

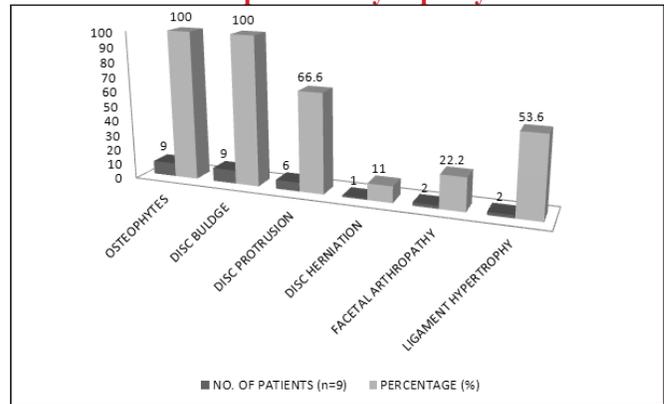
**Results**

**Table (1):- Evaluation Of Various Causes Of Non Traumatic Compressive Myelopathy**

MRI Diagnosis	No. Of Patients (N=30)	Percentage (%)
Degenerative Compressive Myelopathy (DCM)	9	30
Metastases	6	20
Primary Neoplasm	5	16.67
Tuberculous Spondylosis	5	16.67
Pyogenic Spondylosis	3	10
Congenital Lesions Os Odontonium	1	3.3
Epidural Hematoma	1	3.3

The most common cause of non-traumatic compressive myelopathy in this study is degenerative compressive myelopathy followed by metastasis.

**Chart No. (1):- Characterisation Of Degenerative Compressive Myelopathy**



Disc buldge and osteophytes were seen in all cases of degenerative compressive myelopathy follow et by disc protrusion and ligament hypertrophy

**Table No. (2):- Most Common Site Of Metastasis In Spine**

Vertebral Levels	No. Of Patients (N=6)	Percentage (%)
D10-D12 & L4-L5	1	16.6
D1-D2 & L1-L2	1	16.6
WHOLE DL SPINE	1	16.6
D10-D12	1	16.6
D8 & S1-S2	1	16.6
D4-D6	1	16.6

Most common site of vertebral metastasis is in dorsal spine

**Table No. (3):- Spinal Level Of Involvement In Spondylotic Myelopathy**

Spinal Level	No. Of Cases (N=9)
Upper Cervical (C1-C2)	2
Lower Cervical (C3-C7)	7
Upper Dorsal (Above D6)	0
Lower Dorsal (Below D6-L1)	1

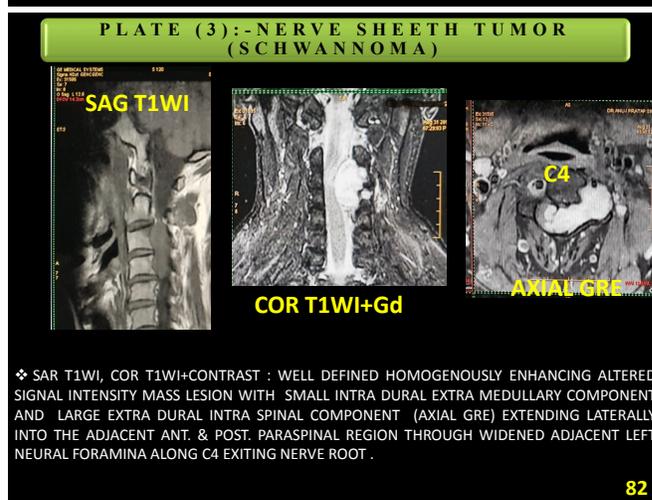
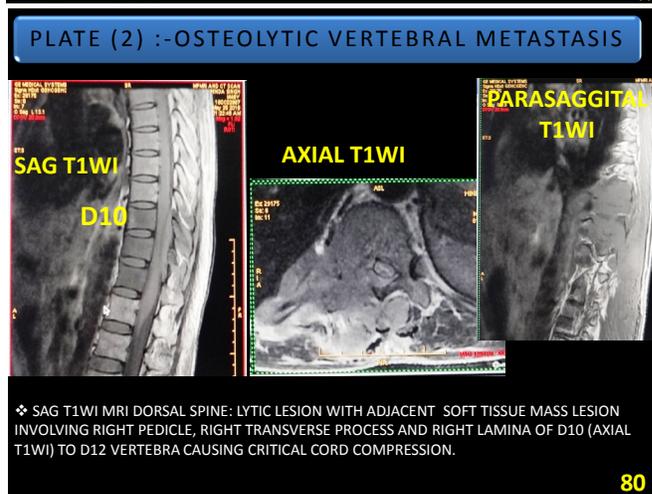
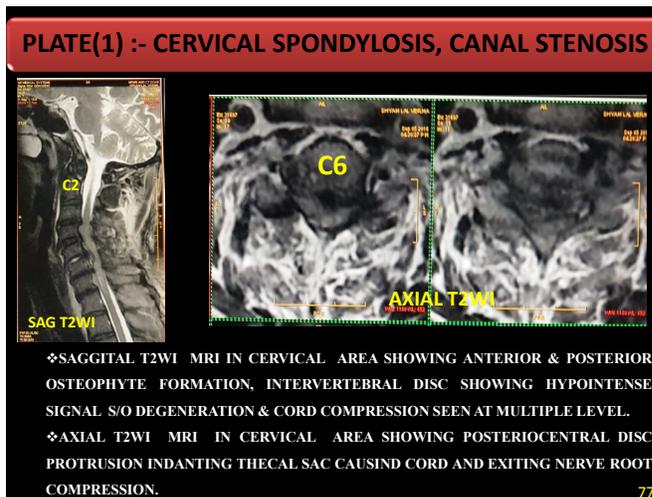
Degenerative Compressive Myelopathy Commonly Involve Lower Cervical Region With Involvement Of Multiple Levels Noted

**Table No. (4):- MRI Findings Of Tuberculous Spondylitis And Pyogenic Spondylitis**

MRI Findings	(No. Of Cases)	
	Tuberculous Spondylitis (N=5)	Pyogenic Spondylitis (N=3)
Well-Defined Paraspinal Abnormal Signal	4	-
ILL-Defined Paraspinal Abnormal Signal	-	3
Thin And Smooth Abscess Wall	4	-
Presence Of Paraspinal Or Intraosseous Abscess	4	-
Absence Of Paraspinal Or Intraosseous Abscess	-	2
Subligamentous Spread ≥ Three Vertebral Levels	4	-
Subligamentous Spread < Three Vertebral Levels Or Without Subligamentous Spread	-	3
Thick And Irregular Abscess Wall	-	3
Multiple Body Involvement	5	2
Involvement ≤ Two Vertebral Bodies	-	1
Thoracic Spine Involvement	4	-

**Table No. (5):- MRI Diagnosis Of Primary Spinal Neoplasm & Histopathology Correlation**

MRI Diagnosis	Compartment	No. Of Patients (N=5)	Histopath. Diagnosis
Meningioma	ID EM	1	Meningioma
Ependymoma	IM	2	Ependymoma
Nerve Sheath Tumor	ID EM	1	Schwannoma
Intramedullary Neoplasm	IM	1	Ependymoma



**Discussion**

Initially radiological evaluation of compressive myelopathy was done by contrast myelography then later it was supported by computed tomography and CT myelography and now a day’s MRI is the modality of choice to image spine and spinal cord pathologies because of its ability to depict cross sectional anatomy in multiple planes without ionizing radiation, exquisite soft tissue delineation and

non invasiveness. The present study of 30 cases of non traumatic compressive myelopathy, it was various different causes for compression were observed. Among these are degenerative compressive myelopathy (9), primary neoplasms (5) and secondary neoplasm (Metastasis) (6), pyogenic spondylitis (3), tuberculous spondylitis (5), one case of congenital lesions (OS Odontonium) and a case of epidural hematoma. Out of 30 cases of non traumatic compressive myelopathy, we had 9 (30%) cases of degenerative compressive myelopathy. In all 9 patients the lesions are located extra durally with 55.6% predominance is seen in female patients. With 77.8% cases found in above 55 years old patients and mean age is 59.2 years. The similar findings were also seen in a study conducted by Lindsay Tetreault et al<sup>5</sup>. The spinal cord abnormalities demonstrated by MR imaging were cord compression and abnormal signal intensities within the spinal cord. Spinal cord compression was observed in all the 9 cases. Posterior osteophytes and disc buldge is seen in all 9 cases where disc protrusion is noted in 6 cases (66.67%).

In the present study of 30 cases, 6 (20%) are of metastatic disease of the spine as a cause of compressive myelopathy. Intraspinal extradural masses that caused cord compression extended from an abnormal part of the vertebra in all the 6 patients. This is substantiated by a study conducted by Lien et al<sup>6</sup> in which 90% showed extradural masses extended from an abnormal part of a vertebra. Out of 6 patients, 5 (83%) showed more than one lesions. This is in comparison to study done by Lien et al<sup>6</sup> in which 78% had more than one lesions which include vertebral metastases in addition to those compressing the cord. In the present study most common site of involvement was the dorsal spine. This is in comparison to the study done by Livingston et al<sup>7</sup> where site of epidural tumor in dorsal spine was 68%. The three most common primary tumors with metastases to the spine and extradural space were lung carcinoma (33%), breast (carcinoma 33%). In the present study we had 2 patients with primary carcinoma lung, 2 patients had breast carcinoma, 1 carcinoma prostate, and 1 patients with thyroid malignancy. We used T1WI, T2WI and STIR sequence and post contrast to image spinal metastases. T1WI was useful in the detection of bone marrow metastases and STIR helped in picking up more marrow lesions. Observation has shown that post- contrast MRI does not improve the detection of extradural spinal metastases even though it has great value in intradural disease.<sup>8</sup>

In the present study 5 cases of primary spinal neoplasms,

among which 2 lesions were located intradural extramedullary and 3 lesions are located inside cord (intramedullary). All the 5 cases caused spinal cord compression. Intradural extramedullary lesions are 1 case of meningioma and 1 case of nerve sheath tumor (schwannoma) and intramedullary lesions were ependymomas. All lesions were histological proven cases. Nerve sheath tumors were iso to hypointense on T1WI and hyperintense on T2WI and showed intense heterogenous enhancement on post contrast showed extension into the neural foramina and causing widening of neural foramina. Studies done by Dorsi et al<sup>9</sup> showed that on T1WI the signal varied from hypo to isointense to the cord and on T2WI they are hyperintense in signal and also may show decreased signal in the central portion consistent with necrosis. Nerve sheath tumors showed marked enhancement which was heterogeneous. Of the 2 intradural extramedullary neoplasm<sup>10</sup>, one case of meningioma and one were nerve sheath tumors which were histopathologically proved. Those lesions which showed intense homogenous enhancement on post contrast images were given meningioma as primary differential and in those which showed areas of T2 hyperintensities and heterogenous contrast enhancement on post contrast images were given as nerve sheath tumors as primary differential. Above findings coincided with the pathological diagnosis of intradural extramedullary neoplasms.

Spinal ependymomas are the most common intramedullary neoplasm in adults, comprising 60% of all glial spinal cord tumours. They are the second most common intramedullary neoplasm in the pediatric population, representing 30% of pediatric intramedullary spinal neoplasms. Ependymomas can occur anywhere along the spinal cord, however in the present study all cases were seen in dorsal spinal cord. Spinal cord ependymomas are iso- or hypointense relative to the spinal cord on T1-weighted MR images<sup>11</sup>. In rare cases, they may manifest as a hyperintense mass, usually secondary to the effects of hemorrhage. On T2-weighted images, the lesions are typically hyperintense relative to the spinal cord, although in the single largest review of spinal ependymomas, isointense tumors were as common as hyperintense tumors<sup>12</sup> About 20%–33% of ependymomas demonstrated the “cap sign,” a rim of extreme hypointensity ( hemosiderin) seen at the poles of the tumor on T2-weighted images. This finding is thought to be secondary to hemorrhage, which is common in ependymomas and other highly vascular tumors (eg, paraganglioma, hemangioblastoma).<sup>13</sup>

In the present study, 8 cases of infective spondylitis were associated with compressive myelopathy. 5 cases were in the thoracic region all of them being known cases of tubercular infection and 3 in the lumbar region all of them being histopathological proven cases of pyogenic spondylitis. MRI showed vertebral body destruction with pre and para vertebral abnormal MRI signal in 4 cases. Epidural component compressing the cord was seen in all the 9 cases which were hypointense on T1WI, hyperintense on T2WI and STIR images suggestive of cord edema. Cord edema was associated with all the 9 cases. Study by Weaver P et al<sup>13</sup> showed thoraco lumbar junction as the most common affected site as in our cases. They showed rim enhancement around the intra – osseous and paraspinal soft tissues abscess in 4 cases. It was observed, contrast study was done in some cases due to various reasons though provisional diagnosis of tubercular etiology was given. Ideally contrast study should have been done to increase the specificity of MRI. Follow up MRI after course of proper prescribed treatment (ATT) was done in a case showed complete resolution of epidural component confirming the tuberculous etiology of lesion. Multiple vertebral body involvement is seen in 5 cases of tuberculous and 2 case of pyogenic spondylitis (87.5%), which corresponds to the findings in earlier studies including that by Prateek S. Gehlot et al.<sup>14</sup>

The present study there is a case of 20 year old male patient in which there is acute onset of paraplegia since two days with no history of trauma, fever of any other obvious lesion. On MRI cord opposite to C5 to C7 is not visualized there is T1 & T2 hypointence epidural lesion causing cord compression. This is a case of spontaneous epidural hematoma in cervical spine. Drainage of hematoma was done in orthopedic department and patient recovered on post operative day 1. MRI findings correspond with previously done study by Fukui MB et al.<sup>15</sup>

In the present study there is a case of orthotopic subtype of Os Odontonium were seen. Patient is one year old male child with complaint of not able to stand and hold his neck. On MRI increase atlanto-dental distance were seen measuring up to 6mm (n-<sup><</sup>5 mm in children) with resultant retropulsion of the dens and compression of upper cervical cord between dens and posterior arch of atlas. Which caused cervical canal stenosis (diameter up to 7mm), which leads to hyper intensity on T2 and STIR, suppressed on FLAIR. On post contrast it shows mild irregular enhancement suggestive of developing myelomalacia-subacute ischemic

changes secondary to compressive myelopathy. Above mentioned MRI findings corresponds with reference articles.<sup>16</sup>

## Summary

The Present study is a descriptive study aimed to evaluate role of MRI in evaluation of non-traumatic compressive myelopathy with histopathological correlation (wherever necessary) on 30 patients in the Department of Radiodiagnosis & Pathology of NSCB Medical College Jabalpur MP.

Patients with suspected case of compressive myelopathy (Non traumatic) were evaluated with MRI to characterize the lesion into extradural, intradural extramedullary, and intramedullary location.

Most common causes of compressive myelopathy (Non traumatic) in the present study are extradural compression from degenerative compressive myelopathy (30%) and Metastasis (20%).

Degenerative compressive myelopathy were found to be more common in the higher age group (above 55Yrs) and in females. Most commonly (77.78%) involve lower cervical area (C3-C7).

Metastatic disease of the spine (83%) was seen in multiple level of vertebral column. In the present study most common site of involvement was the dorsal spine.

Primary neoplasm like spinal ependymoma is more common than other intramedullary spinal neoplasms in adult age group.

Involvement of multiple levels with epidural component and involvement of dorsal spine was common findings in cases of Tuberculous spondylitis.

## Conclusion

MRI is very definitive, sensitive, accurate, though costly but very specific, non invasive, radiation free modality for evaluation of Compressive myelopathy. MRI is the definitive modality in assessing soft tissues of the spine and spinal cord abnormalities, to evaluate cord edema/

contusion and integrity of the intervertebral discs and ligaments. MR techniques play an indispensable role in the management of compressive non traumatic spondylotic myelopathy patients and have evolved primarily from a diagnostic modality to a method that can potentially predict patient outcome following surgical intervention.

MRI is very sensitive and considered the imaging modality of choice to detect and characterize the spinal tumors and spinal infections. The final diagnosis for suspicious primary neoplastic lesions still relies on biopsy and histopathological examination. Till date, MRI is the widely used modality of choice to visualize the spinal cord and its pathology. Finally, we conclude that MRI is useful in differentiating between various causes of cord compression like neoplastic, spondylotic and infective lesions. Neoplastic lesions may be subcategorized according to their compartment of origin. Clinical and imaging evaluation of patients varies according to different regions.

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