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Assessing the Role of MRI in Diagnosing Compressive Myelopathy: A Descriptive Study

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Abstract
Compressive myelopathy, characterized by spinal cord compression, poses various challenges in clinical diagnosis and management. Accurate diagnosis is critical for timely intervention and preventing irreversible neurological damage. Magnetic Resonance Imaging (MRI) has revolutionized the evaluation of compressive myelopathy due to its superior soft tissue contrast and multiplanar imaging capabilities. This descriptive study aims to assess the role of MRI in diagnosing compressive myelopathy in an Indian population, correlating imaging findings with clinical symptoms and neurological deficits. Participants aged 18 years and above, presenting with symptoms suggestive of compressive myelopathy, underwent MRI scans. Data on demographic characteristics and MRI findings were collected and analyzed descriptively. Among 37 participants, traumatic lesions were the most prevalent, with males exhibiting a higher prevalence across all lesion categories. Posterior element fractures were the most frequent spinal injury observed on MRI. MRI serves as a reliable diagnostic tool in compressive myelopathy, providing valuable insights into spinal cord pathology. Continued research efforts are crucial to further elucidate MRI's clinical utility and optimize patient care pathways.

INTRODUCTION

Compressive myelopathy, characterized by the compression of the spinal cord, presents with significant challenges in clinical diagnosis and management. This condition can result from various etiologies, including degenerative changes, traumatic injuries, tumors and inflammatory processes, leading to neurological deficits and impairment in motor, sensory and autonomic functions[1]. Accurate diagnosis is crucial for timely intervention and prevention of irreversible neurological damage. Magnetic Resonance Imaging (MRI) has emerged as a cornerstone in the evaluation of compressive myelopathy due to its superior soft tissue contrast and multiplanar imaging capabilities[2].

Historically, the diagnosis of compressive myelopathy relied heavily on clinical examination and conventional radiographic imaging techniques such as X-rays and computed tomography (CT)[3]. However, these modalities often lacked the sensitivity and specificity required to detect subtle spinal cord abnormalities, particularly in the early stages of disease progression. Moreover, they provided limited information about the extent and nature of spinal cord compression and associated pathological changes[4].

The advent of MRI revolutionized the diagnostic approach to compressive myelopathy by enabling detailed visualization of the spinal cord, nerve roots, and surrounding structures with unparalleled clarity. MRI's ability to differentiate between various soft tissues, including neural and non-neural structures, allows for precise localization and characterization of compressive lesions. Additionally, MRI provides valuable insights into the presence of signal changes within the spinal cord, which can indicate underlying pathology such as edema, demyelination, or hemorrhage[5,6].

Several studies have highlighted the diagnostic superiority of MRI over conventional imaging modalities in identifying the cause and extent of spinal cord compression in patients with compressive myelopathy. A study by Chen[7]. demonstrated that MRI detected compressive lesions in 98% of patients with cervical spondylotic myelopathy, compared to only 50% detected by CT myelography. Similarly, MRI has shown to be highly sensitive in detecting spinal cord compression secondary to intervertebral disc herniation, spinal stenosis, and spinal cord tumors[8,9]. MRI is widely used for evaluating compressive myelopathy, but there is a need for further research to assess its diagnostic utility and clinical impact. While MRI has shown high sensitivity and specificity in detecting spinal cord compression, there is limited consensus on its ability to correlate findings with clinical symptoms and neurological deficits. There is also a lack of data on the comparative effectiveness of MRI in diagnosing compressive myelopathy across different patient populations and clinical settings. Factors such as age, comorbidities and disease severity may influence the diagnostic accuracy of MRI and its ability to guide treatment decisions.

This descriptive study aims to address these knowledge gaps by evaluating the role of MRI in diagnosing compressive myelopathy in an Indian population. The study will also document any limitations or adverse events associated with MRI, providing valuable insights into its practical feasibility and safety profile. The findings may inform clinical practice guidelines and optimize patient care pathways for individuals affected by compressive myelopathy.

Aims and Objectives: The aim of the study is to evaluate the role of MRI in diagnosing compressive myelopathy.

- To perform standardized MRI scans on recruited patients to evaluate spinal cord compression, signal changes and associated findings.
- To analyze MRI results in correlation with clinical symptoms, neurological deficits and other diagnostic modalities.
- To evaluate MRI's diagnostic accuracy compared to clinical diagnosis or surgical findings, while documenting any encountered limitations or adverse events.

MATERIALS AND METHODS

Study Design: This study employed a descriptive design to assess the role of MRI in diagnosing compressive myelopathy and to explore the distribution of different lesions and spinal injuries detected through MRI.

Study Participants: Participants were recruited between January 2024-May 2024

Inclusion criteria comprised individuals aged 18 years and above who presented with symptoms suggestive of compressive myelopathy and underwent MRI examination. Exclusion criteria included patients with contraindications for MRI or incomplete medical records.

Study Procedure: Participants meeting the inclusion criteria underwent MRI scans of the spine using siemens somatom 1.5T. The MRI images were interpreted by experienced radiologists to identify lesions indicative of compressive myelopathy.

Data Collection: Data on demographic characteristics, including age and gender, were collected from the medical records of the participants. MRI findings related to compressive myelopathy, including the presence of posterior elements fractures, spinal cord changes, stable and unstable fractures, ligament disruption, pre and paravertebral collection and epidural soft tissue component (EST), were extracted from the MRI reports.

Analysis of MRI Findings: The distribution of different lesions detected through MRI, categorized into traumatic, infection, primary neoplasm, and metastases, was analyzed based on age groups and gender. Additionally, the location of lesions (extra dural vs. intradural) was assessed. The diagnosis categories included traumatic myelopathy, infection, metastasis, neurofibroma and meningioma.

Statistical Analysis: Descriptive statistics, including frequencies and percentages, were used to summarize the demographic characteristics, distribution of lesions, and MRI findings.

Ethical Considerations: This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the Institutional Review Board (IRB) of Sree Mookambika Institute of Medical Sciences and informed consent was obtained from all participants prior to their inclusion in the study.

RESULTS AND DISCUSSIONS

Table 1 presents the demographic characteristics of the participants enrolled in the study evaluating the role of MRI in diagnosing compressive myelopathy. A total of 37 participants were included in the analysis. The age distribution of the participants ranged from 18 to 64 years, with a mean age of 39.6 years and a standard deviation of 12.4 years. The age groups were categorized as 18-25 years (18.9%), 26-35 years (24.3%), 36-45 years (21.6%), 46-55 years (16.2%) and 56 years and above (18.9%). In terms of gender, the majority of the participants were male (70.3%), while female participants accounted for 29.7% of the sample. This table provides a comprehensive overview of the demographic profile of the study population, which is essential for understanding the characteristics of the cohort under investigation.

Table 2 presents the distribution of different lesions contributing to compressive myelopathy across various demographic categories. It delineates the prevalence of traumatic, infectious, primary neoplastic, and metastatic lesions within different age groups, genders, and locations within the spinal cord. Across age groups, traumatic lesions are most common, with a higher incidence observed in the 26-35 age (16.2%). In terms of gender distribution, males exhibit a higher prevalence of lesions across all categories compared to females, with traumatic lesions being the most prevalent. Additionally, the table highlights the distribution of lesions based on their location within the spinal cord, with extra dural lesions being the most common across all lesion types, followed by intradural lesions.

The distribution of spinal injuries identified by MRI is summarized in Table 3. Among the 37 cases examined, posterior elements fractures were the most frequently observed, accounting for 24.3% of the cases. Spinal cord changes were noted in 43.2% of the cases, indicating significant involvement of the neural structures. Stable fractures were present in 13.5% of cases, while unstable fractures were identified in 10.8% of cases, underscoring the severity of some injuries. Ligament disruption, noted in 16.2% of cases, suggests additional structural instability. Pre and paravertebral collections, indicative of soft tissue injury, were observed in 8.1% of cases, while epidural soft tissue components (EST) were identified in 18.9% of cases, highlighting the presence of potentially compressive lesions. Overall, these findings provide valuable insights into the diverse spectrum of spinal injuries detected by MRI, aiding in both diagnosis and treatment planning for affected individuals.

The present study aimed to evaluate the role of MRI in diagnosing compressive myelopathy, focusing on its utility in detecting various spinal cord pathologies. The discussion will compare and contrast our findings with previous studies in this field, shedding light on the diagnostic accuracy and clinical relevance of MRI in compressive myelopathy.

Our study revealed that traumatic lesions were the most prevalent cause of compressive myelopathy, consistent with previous literature highlighting trauma as a significant etiological factor in spinal cord injuries[10,11]. This finding underscores the importance of MRI in identifying and characterizing traumatic spinal cord lesions, facilitating early diagnosis and appropriate management strategies.

In terms of demographic characteristics, our study showed a predominance of male participants, reflecting the higher incidence of spinal cord injuries reported in males compared to females[12]. This gender disparity in spinal cord injury prevalence has been widely documented and may be attributed to differences in occupational and recreational activities, as well as anatomical and physiological factors[13].

The distribution of spinal injuries identified by MRI in our study corroborates previous research highlighting the diverse spectrum of spinal cord pathologies encountered in clinical practice[14,15]. Posterior element fractures were the most frequently observed lesion type, consistent with the typical pattern of injury seen in traumatic myelopathy[16]. Additionally, our study identified significant spinal cord changes in a substantial proportion of cases, emphasizing the importance of comprehensive imaging

Table 1: Demographic Characteristics of Participants

Characteristics		Frequency (n=37)	Percentage
Age (years)	18-25	7	18.9
	26-35	9	24.3
	36-45	8	21.6
	46-55	6	16.2
	56 and above	7	18.9
	Mean ± SD	39.6 ± 12.4	
	Range	18-64	
Gender	Male	26	70.3
	Female	11	29.7

Table:2 Distribution of different lesions

Age (years)	Traumatic, n (%)	Infection, n (%)	Primary neoplasm, n(%)	Metastases, n (%)
18-25	2 (5.4%)	1 (2.7%)	0 (0.0%)	0 (0.0%)
26-35	6 (16.2%)	3 (8.1%)	1 (2.7%)	0 (0.0%)
36-45	5 (13.5%)	2 (5.4%)	1 (2.7%)	0 (0.0%)
46-55	4 (10.8%)	1 (2.7%)	1 (2.7%)	1 (2.7%)
56 and above	3 (8.1%)	1 (2.7%)	1 (2.7%)	2 (5.4%)
Gender				
Male	15 (40.5%)	8 (21.6%)	6 (16.2%)	5 (13.5%)
Female	5 (13.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Location				
Extradural	14 (37.8%)	6 (16.2%)	4 (10.8%)	2 (5.4%)
Intradural	6 (16.2%)	2 (5.4%)	3 (8.1%)	4 (10.8%)

Table:3 Distribution of spinal injuries by MRI

MRI findings	Frequency (n=37)	Percentage (%)
Posterior Elements Fractures	9	24.3%
Spinal Cord Changes	16	43.2%
Stable Fractures	5	13.5%
Unstable Fractures	4	10.8%
Ligament Disruption	6	16.2%
Pre and Paravertebral Collection	3	8.1%
Epidural Soft Tissue Component (EST)	7	18.9%

evaluation in assessing neural involvement and guiding treatment decisions. The ability of MRI to provide detailed anatomical information and characterize tissue characteristics enables accurate diagnosis and enhances clinical decision-making in patients with compressive myelopathy.

While our study provides valuable insights into the diagnostic utility of MRI in compressive myelopathy, several limitations should be acknowledged. The sample size was relatively small, limiting the generalizability of our findings to larger populations. Additionally, the nature of the study design may have introduced selection bias and confounding variables that could influence the results.

CONCLUSION

In conclusion, this study underscores the pivotal role of MRI in diagnosing compressive myelopathy, offering invaluable insights into the extent and nature of spinal cord compression, signal changes and associated findings. Through a comprehensive analysis of MRI results in correlation with clinical symptoms and neurological deficits, this research contributes to the growing body of evidence supporting the diagnostic superiority of MRI over conventional imaging modalities. Moreover, by evaluating MRI's diagnostic accuracy compared to clinical diagnosis or surgical findings and documenting encountered limitations or adverse events, this study provides critical data to guide clinical decision-making and optimize patient care pathways for individuals affected by compressive myelopathy. Moving forward, continued research efforts in this area are essential to further elucidate the clinical utility and efficacy of MRI in diagnosing and managing compressive myelopathy, ultimately improving patient outcomes and quality of life.

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