

Clinical Study

# Association of postoperative outcomes with preoperative magnetic resonance imaging for patients with concurrent multiple sclerosis and cervical stenosis

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## Abstract

**BACKGROUND CONTEXT:** Differentiating between multiple sclerosis (MS) and cervical stenosis (CS) can be difficult because of their overlapping symptoms. Although studies have shown preoperative imaging criteria that are predictive of outcomes in either MS or CS individually, no studies have investigated these factors in patients that have concurrent MS and CS.

**PURPOSE:** To investigate the associations between preoperative magnetic resonance imaging (MRI) findings and postoperative outcomes in patients with concurrent MS and CS with myelopathy.

**STUDY DESIGN:** A retrospective review.

**PATIENT SAMPLE:** All patients presenting with myelopathy who underwent cervical decompression surgery at a single tertiary-care institution between January 1996 and July 2011, diagnosed with concurrent MS and CS.

**OUTCOME MEASURES:** Pre- and postoperative severity of myelopathy was assessed using the modified Japanese Orthopaedic Association (mJOA) scale.

**METHODS:** Preoperative imaging was assessed for stenosis, lesions, signal intensity (graded low, intermediate, or high), extent of lesion (focal or diffuse), and cord atrophy. Imaging was then correlated with postoperative myelopathy outcomes.

**RESULTS:** Forty-eight patients with MS and CS were reviewed for an average follow-up of 53 months. In the short term after surgery, there were 24 patients (50%) who showed improvement in the mJOA myelopathy score and 24 (50%) who did not improve. Significantly greater percentage of patients in the improvement group had high-intensity lesions on preoperative MRI as compared with the no-improvement group ( $p=.03$ ). At long-term follow-up, there were 18 patients (37.5%) who showed postoperative improvement and 30 patients (62.5%) with no improvement. No

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significant differences were identified on preoperative imaging between those who improved postoperatively and those who did not.

**CONCLUSIONS:** Although certain characteristic preoperative MRI findings are associated with postoperative outcomes in cohorts of either MS or CS patients, we did not find this to be the case in patients with concurrent MS and CS. Accordingly, the treatment of the MS/CS patient population should be unique as their outcomes may not be as good as those with CS but no MS. © 2015 Elsevier Inc. All rights reserved.

**Keywords:** Multiple sclerosis; Cervical stenosis with myelopathy; Cervical decompression; Magnetic resonance imaging; mJOA; Outcomes

## Introduction

Multiple sclerosis (MS) is a chronic demyelinating autoimmune disease that affects the central nervous system. Differentiating between MS and cervical stenosis (CS) with myelopathy can be difficult because of their overlapping symptoms, such as spasticity, sensory disturbances, gait ataxia, and weakness. Accordingly, diagnosis and monitoring of MS has traditionally relied on magnetic resonance imaging (MRI) [1]. Quantification of the MRI evidence of fluid-attenuated inversion recovery and gadolinium (Gd) enhancement representing inflammation and edema have been shown to be predictive of long-term outcomes in patients with MS [2].

Similar preoperative MRI findings have been shown to be predictive of outcome in patients with CS. In a blinded, prospective study of patients with cervical spondylotic myelopathy, Arvin et al. [3] reported that focal high preoperative T2-signal intensity was associated with poor postoperative myelopathy score outcome. They also reported that preoperative cord compromise was associated with poor outcomes on Short Form-36. Numerous other studies have reported association of high preoperative T2-signal intensity with poor postoperative outcomes in patients with CS [3–9].

Although studies have shown preoperative imaging criteria that are predictive of outcomes in either MS or CS individually, no studies have investigated these factors in patients who have concurrent MS and CS. When these pathologies occur together, the diagnosis and treatment are complicated as the natural histories and medical/surgical therapies are vastly different. In these patients, it is difficult to determine which disease process is causative of the symptoms. Accordingly, the preoperative imaging criteria that may predict outcomes for either MS or CS alone, can be different with concomitant MS/CS. In the present study, we retrospectively reviewed patients with concurrent MS and CS to investigate the association between preoperative MRI and postoperative outcomes in this unique patient population. The hypothesis was that the traditional predictive measures for patients undergoing cervical decompression for CS would be applicable, in the short term, for patients with concurrent MS and CS. In the long term, however, we hypothesized that because of MS

progression, the postoperative course would be different for MS/CS patients, and therefore, the same predictive factors would not be useful.

## Methods

### Database and study sample

A retrospective review was performed of all patients presenting with myelopathy who underwent cervical decompression surgery at the Cleveland Clinic between January 1996 and July 2011, diagnosed with concurrent MS and CS. Only patients with available preoperative MRIs were included. After approval by the institutional review board, the electronic medical record was used to retrieve patient data that fit our criteria.

T2-weighted images of axial and sagittal views of the cervical cord were obtained for all patients. Preoperative imaging was assessed for stenosis, lesions, signal intensity, extent of lesion, and cord atrophy. Lesion intensity was classified from Grade 0 to Grade 2 using the well-described grading system, initially reported by Chen et al. [8–14]. This classification is based on signal intensity and border, where Grade 0 represents no change, Grade 1 represents faint intensity and fuzzy border, and Grade 2 represents strong intensity and well-defined border (Figs. 1–3). Strong intensity was defined as similar to the intensity of the cerebrospinal fluid. Extent of lesion was defined as either focal or diffuse. Lesions could be identified anywhere in the cervical spine, either at the site of the stenosis or elsewhere. Cord atrophy was determined via measurements of the spinal cord circumference at the sites of narrowing as previously described [15]. Two independent assessors (ATH and MPS) were blinded to the patient outcome to ensure objectivity in measurements. The concordance between the two assessors in evaluating the signal intensity was a kappa of 0.88 ( $p < .0001$ ), for extent of lesion was a kappa of 0.77 ( $p < .0001$ ), and for presence or absence of atrophy was a kappa of 0.96 ( $p < .0001$ ). The two observers established the final classification by consensus. Any relationships between the level of stenosis, level of cord atrophy, and the regions with signal intense lesions were recorded (atrophy was found at the level of the stenosis in five patients [10.4%] and atrophy was

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