Relationship of Modic Changes, Disk Herniation Morphology, and Axial Location to Outcomes in Symptomatic Cervical Disk Herniation Patients Treated With High-Velocity, Low-Amplitude Spinal Manipulation: A Prospective Study

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Abstract

Objective: The purpose of this study was to evaluate whether cervical disk herniation (CDH) location, morphology, or Modic changes (MCs) are related to treatment outcomes.

Methods: Magnetic resonance imaging (MRI) and outcome data from 44 patients with CDH treated with spinal manipulative therapy were evaluated. MRI scans were assessed for CDH axial location, morphology, and MCs. Pain (0-10 for neck and arm) and Neck Disability Index (NDI) data were collected at baseline; 2 weeks; 1, 3, and 6 months; and 1 year. The Patient's Global Impression of Change data were collected at all time points and dichotomized into "improved," yes or no. Fischer's exact test compared the proportion improved with MRI abnormalities. Numerical rating scale and NDI scores were compared with MRI abnormalities at baseline and change scores at all time points using the *t* test or Mann-Whitney *U* test.

Results: Patients who were Modic positive had higher baseline NDI scores ($P = .02$); 77.8% of patients who were Modic positive and 53.3% of patients who were Modic negative reported improvement at 2 weeks ($P = .21$). Fifty percent of Modic I and 83.3% of Modic II patients were improved at 2 weeks ($P = .07$). At 3 months and 1 year, all patients with MCs were improved. Patients who were Modic positive had higher NRS and NDI change scores. Patients with central herniations were more likely to improve only at the 2-week time point ($P = .022$).

Conclusions: Although patients who were Modic positive had higher baseline NDI scores, the proportion of these patients improved was higher for all time points up to 6 months. Patients with Modic I changes did worse than patients with Modic II changes at only 2 weeks. (J Manipulative Physiol Ther 2016;39:565-575)

Key Indexing Terms: *Cervical Spine; Disk Herniation; Chiropractic Manipulation; MRI; Outcomes; Modic Changes*

Introduction

After low back pain, neck pain is the second most common complaint of patients presenting to a chiropractic practice.[1-3] A relatively common subgroup of neck pain is cervical radiculopathy (CR), with an annual incidence of about 80 cases per 100 000 people.[4] Patients with CR present with neck pain, arm pain in a dermatomal pattern, and neurologic deficits, including motor weakness, decreased deep tendon reflexes, or dermatomal sensory loss.[5,6] The nerve roots of C6 and C7 are the most commonly affected.[4]

Clinically, the best tests to diagnose CR are[1] the upper limb tension test A,[2] <60° of cervical rotation,[3] positive Spurling test, and[4] pain relief with cervical distraction.[7] These tests seem to have the best diagnostic accuracy. If 3 of the 4 are positive, there is a 65% probability that CR is present; with all 4 tests positive, the probability increases to 90%.[7] For further investigation, magnetic resonance imaging (MRI) is the most commonly used imaging modality to detect CR because it detects neural structures, such as cervical nerve roots, directly.[8] MRI has been

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reported to have better accuracy in the prediction of cervical disk herniation (CDH) causing CR compared with other imaging modalities such as computed tomography or plain films.[9] In addition, MRI can also rule out unusual cases of a pathologic condition as a cause of CR, such as intra- or extradural spinal tumors or epidural abscess.[5]

In unclear cases, for the differentiation of other neurologic conditions that may imitate CR, electrodiagnostic studies have been reported to be very useful as a further investigation method.[8] Thus, it is important to link the clinical findings with the findings on the MRI study because degenerative disk changes, including CDH, are often seen in asymptomatic persons.[10-12]

The exact pathogenesis of CR is still not clear. Some of the causes of CR are degenerative changes such as CDH, spondylotic spurring of the uncovertebral or facet joints, or a combination of these that lead to compression of the nerve root in the intervertebral foramen.[5] In addition to the mechanical compression, inflammatory changes in the nerve root and in the dorsal root ganglion seem to play an important role in pain generation. Neurogenic chemical mediators of pain can be released by the neural cell bodies and nonneurogenic mediators of pain by the disk tissue.[13]

To further complicate matters, recent studies have reported that Modic changes (MCs) are commonly associated with disk herniations in both the lumbar and cervical spine.[14] MCs are specific endplate signal changes in the spine categorized into 3 types: MC type I (bone marrow edema), II (fat), and III (subchondral bone sclerosis).[15] In published reports, they are associated with nonspecific spinal pain syndromes, especially type I.[16,17] There are 2 main theories about the pathophysiology of MCs: a biomechanical theory and an infection theory. The biomechanical theory explains the MC as a result of mechanical stress at the vertebral endplate.[18-20] Because disk degeneration is also a result of improper loading of the disk, published reports support this theory with studies that have identified an increased incidence of MCs in patients with disk degeneration.[21,22] The infection theory implies that the edema in the vertebral endplate is caused by pyogenic infection of the disk and adjacent endplates. However, controversy about this theory exists in the published reports.[23-25]

For disk herniation patients it has been reported that patients with MC have a slower resorption of the discus hernia.[26] In addition, studies often report a poorer outcome with various treatments of individuals who are MC positive.[27-29] However, spinal manipulative therapy (SMT) is not one of the treatments evaluated in patients who are MC positive.

The treatment of CR can be divided into conservative and surgical treatment methods.[30,31] Surgical treatment options contain several different methods and are generally considered in the absence of success with conservative treatment.[32] The pool of conservative treatment methods for CR includes different manual and physical therapies as well as oral or invasive application of anti-inflammatory medication. There is good evidence that many patients with CR benefit, in both short-term and long-term outcomes, from epidural or nerve root infiltration.[29,33,34]

The evidence for SMT as a treatment method for CDH with CR is sparse in the published reports. Murphy et al[31] studied 35 patients with CR who were treated conservatively with an individualized combination of high-velocity, low-amplitude (HVLA) manipulation; muscle energy techniques; neural mobilization techniques; traction treatment; nonsteroidal anti-inflammatory medication; oral corticosteroids; epidural steroid injection; and different types of rehabilitation exercises. They reported a mean self-rated improvement of 88% and a mean reduction in pain of 72% at 3 months after the initial treatment.[31] Although this study used cervical HVLA manipulation as the central part of their treatment, the other modalities were added individually. This means that the outcome cannot be related only to the HVLA manipulation. Peterson et al[35] looked at the effect of HVLA alone for the treatment of patients with MRI-confirmed CDH with radiculopathy. They examined the effect of HVLA manipulation at the level of the symptomatic CDH combined with local ice application. At 3 months after the initial treatment, the patients had a mean reduction in pain scores of 66%. In addition, 93% of the acute patients (symptoms duration <4 weeks) and 76% of the chronic patients (symptoms duration >12 weeks) reported their global impression of change as better or much better.[35]

There is some research evidence supporting the use of HVLA SMT for patients with symptomatic CDHs, but the importance of specific MRI findings relevant to the treatment outcomes has not been studied. Therefore, the purposes of this study were to[1] compare the specific MRI CDH findings of location in the axial plane, morphology, CDH level, and presence or absence and type of MCs to treatment outcomes; and[2] examine the inter-rater reliability of using the accepted nomenclature for CDH as well as for MC.

Methods

Ethics approval was obtained from the hospital and Canton ethics committees before the start of the study (EK 21/2009).

Patients

Inclusion Criteria

This is a retrospective analysis of the MRI scans from patients included in a previous prospective, cohort, outcome study about symptomatic CDH treated by SMT done by Peterson et al in 2013.[35] The patients had been