Manipulation Improves Recruitment of Multifidus Muscles, Reduces Disability

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Our understanding of the elusive subluxation and the effects of spinal manipulation has gradually evolved as the science of articular neurology, biomechanics, and motor programming has matured. New insights are consistently accumulating with the proliferation of research investigating the mysteries of kinematics and neuromotor control. In 2011, two papers made important and original contributions to enhance our understanding of the impact of the high-velocity, low-amplitude thrust of manipulation on multifidus muscle function, and the correlation between this and improved clinical outcomes. Let’s review the latest research and discuss implementation of these findings to improve patient outcomes through appropriate integration of manipulation and appropriate exercise training.

The Multifidus Provides Dynamic Stability to Spinal Joints

There has been increasing evidence for more than a decade documenting the significance of the multifidus muscle in providing essential and immediate dynamic stability to intervertebral joints, the lumbosacral joint and the sacroiliac joints in order to protect them from injury when subjected to stress. The research indicates that the multifidus is the first muscle to contract when there is a change in juxtaposition of vertebral joints, providing stability and reduced risk of injury to spinal ligaments, intervertebral discs and joint capsules.

As stretch receptors in ligaments are stretched reflexively, proprioceptive feedback stimulates the segmental multifidus muscle to contract in order to dampen and share the stress, as well as reduce the risk of damage of collagen fibers in ligaments, joint capsules and discs from occurring. This reflex is known as the "ligamentomuscular reflex." Furthermore, numerous studies document the reflex inhibition of the multifidus in response to tissue damage and nociceptive input from various spinal tissues the muscle overlies.

This reflex inhibition, which has been documented to occur in the contralateral motor cortex, is commonly followed by rapid progressive atrophy and is associated with a delayed onset and reduced contractility of
this muscle. In addition, recent research describes the vulnerability of the multifidus muscle to injury during standard back surgery procedures, due to its monosegmental innervation, the use of retractors, and multiple other factors.

Past Research on Multifidus Function and Dysfunction

In animal studies dating back to the late 1990s, it has been demonstrated that with ligament laxity, the involved ligament’s stretch receptors become desensitized, resulting in a delayed reflex activation of the multifidus muscle. This leaves the joint functionally unstable and at increased risk of injury.

In a recent study involving human subjects, the results document that the onset of multifidus reflex contraction is delayed after an hour of sitting in a slumped, flexed posture. This can impair sensorimotor control and reduce back muscle protection of the spine. In other studies involving human subjects, it has been documented that the normal feed-forward activation of the multifidus is delayed when there is rapid arm movement in flexion, abduction, and extension in recurrent back pain patients, even when they are asymptomatic and in full remission.

The studies indicate that with the onset of back problems, the multifidus is inhibited, has reduced cross-sectional area, and is asymmetrical in patients with a previous history of low back troubles. In addition, the research documents that there is inhibition of contralateral corticomotor neurons, which demonstrate an increased threshold and reduced responsiveness to electrical stimuli on the contralateral side of the brain from the inhibited and progressively atrophying erector spinae and multifidus muscles.

Another recent paper found that in humans, not only do these muscles exhibit reduced cross-sectional area and fibrofatty infiltration; they also display a reduce ability to contract or thicken when activated.

The New Research on Manipulation and Multifidus Recruitment

In the past five years, an increasing number of studies have documented that the high-velocity, low-amplitude thrust (HVLA) used in spinal manipulation and facilitate immediate and, in some studies, sustained improvements in contractility. Some of these papers were published by chiropractors, some by physical therapists who employed HVLA thrust techniques; some multidisciplinary papers included chiropractors, physical therapists and various PhDs. Overall, there is an accumulation of evidence that these primary stabilizing muscles function can be positively influenced by the use of HVLA thrust techniques.
One of the most recent additions to this group of papers is a multidisciplinary study by Koppenhaver, et al.\textsuperscript{16} This is a case series designed to examine the relationship between clinical improvement based on reduced disability scores and changes in muscle thickness of the transverse abdominis (TrA), internal oblique (IO) and lumbar multifidus (LM) muscles.

Diagnostic ultrasound imaging at rest and during submaximal contractions (a prone upper-extremity lifting task) was used in 78 low back pain (LBP) subjects to measure changes in the contracted muscle thickness before and after each of two HVLA thrust manipulations delivered three days apart to the anterior-superior iliac spine in an anterior-to-posterior direction. Subjects were reassessed four days after the second manipulation. For each subject, a total of two manipulations and three assessments were performed within one week.

Outcomes utilized in this study included the \textit{Oswestry Disability Index} (ODI), Fear-Avoidance Beliefs Questionnaire, pain drawings, and 11-point numeric pain rating scale (NPRS). Diagnostic ultrasound imaging was used to measure the diameter of the muscles.

The results of the study demonstrate an increased thickness of the contracted LM muscle at L4-5 after the HVLA thrust. This increase in thickness of the LM was predictive of improved LBP-related disability at one-week follow-up. Larger increases in contracted LM muscle thickness at one week were associated with larger improvements in LBP-related disability.

The authors state that the finding of increased LM, but not TrA and IO contraction associated with improved LBP-related disability after manipulation supports the clinical relevance of the LM muscle in LBP patients. Decreases in TrA and IO muscle thickness were seen immediately post-manipulation, but were transient and unrelated to clinical outcomes.

The paper concludes that the findings provide evidence that clinical improvement after manipulation is associated with increased thickening of the LM during a submaximal task. Furthermore, if the benefits of manipulation are partially mediated by improved contraction of the LM, modification of clinical protocols, including co-interventions such as exercise training, targeting the LM may work synergistically with manipulation to optimally facilitate LM recruitment, possibly resulting in better clinical outcomes.

A second 2011 paper by Fritz, et al.,\textsuperscript{17} is also a case series of 48 LBP patients receiving the same generalized pelvic thrust as in the previous study, to evaluate the associations between spinal stiffness
characteristics, lumbar multifidus (LM) recruitment, and clinical outcome. The LBP patients received two manipulation sessions in one week. Clinical outcome was based on the ODI. Mechanized indentation measures of spinal stiffness and ultrasonic measures of LM recruitment were taken before and after each SM, and after one week.

The study found that significant immediate decreases in stiffness occurred post-manipulation, regardless of outcome. ODI improvement was related to increased thickening of the LM, as well as a greater immediate decrease in global stiffness and less initial terminal stiffness. The results suggest that the clinical outcome of manipulation is mediated by improvements in LM recruitment and immediate decrease in global stiffness.

The authors conclude that the underlying mechanisms explaining the benefits of manipulation are multifactorial. Both spinal stiffness characteristics and LM recruitment changes play a role. Immediate post-manipulation improvements in LM recruitment were highly related to recruitment changes at one-week follow-up, suggesting this facilitation is not transient and not simply a reflex response.

Considering the emerging evidence of the role of LM dysfunction in persistent and/or recurrent LBP, facilitation of LM recruitment may be an important aspect of the mechanism of effect underlying manipulation. This important benefit of manipulation may be enhanced by combining manipulation with exercise interventions designed to promote LM function.

**What This Means to You, the Clinician**

These two papers make an important clinical contribution to the practice of chiropractic care. They clearly document that a major benefit of HVLA manipulation is improvement in the ability of the multifidus muscle to contract, and that this improved contractility still remains one week later. In addition, this sustained recruitment of the LM is significantly associated with reduced disability scores as determined by the ODI at one-week follow-up.

What this means is that the impact of manipulation on the multifidus is not simply a reflex response, which would disappear quickly after delivery of the manipulative thrust, but rather indicates the likelihood that manipulation results in a resetting of the multifidus to a more optimal functional level. How long this sustained improvement of LM recruitment lasts post-manipulation is an important research question to be pursued in future trials.
The finding that lack of significant improvement in multifidus contraction correlates with reduced benefit in terms of disability scores suggests that manipulation’s ability to improve LM function may be an important outcome that contributes to improved functional capacity.

Moreover, the papers state, perhaps for the first time in the scientific literature, that manipulation results in improved contraction of the multifidus and that this benefit may be further enhanced by incorporating other co-interventions, such as exercise training, which also targets the multifidus. Manipulation and exercise training may work synergistically with manipulation to optimize multifidus recruitment and thereby improve patient outcomes.

For the practicing clinician, these new papers offer valuable, practical clinical information, providing the framework for a more effective approach to patient care. Implementing evidence-based patient management that incorporates spinal manipulation and exercise training to improve recruitment and endurance of the multifidus muscles results in greater short-term pain reduction than exercise alone, and greater longer-term changes across multiple outcomes in comparison to manual therapy alone.18-19

References


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