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Clinical Study

Is level- and side-specific multifidus asymmetry a marker for lumbar disc pathology?

Michele C. Battié, PhD[a,*], Riikka Niemelainen, PhD[a], Laura E. Gibbons, PhD[b], Sukhvinder Dhillon, MD[c]

[a]*Department of Physical Therapy, Faculty of Rehabilitation Medicine, University of Alberta, 2-50 Corbett Hall, Edmonton, Alberta T6G 2G4, Canada*
[b]*Department of Internal Medicine, University of Washington, Seattle, WA 98195, USA*
[c]*Department of Radiology, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta T6G 2G4, Canada*

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Abstract

BACKGROUND CONTEXT: Several reports suggest that level- and side-specific multifidus atrophy or fat infiltration may be related to localized spinal pathology and symptoms. In particular, a study using a porcine model reported rapid level- and side-specific multifidus atrophy and adipocyte enlargement resulting from anterolateral disc or nerve root lesions.

PURPOSE: To investigate asymmetry in cross-sectional area (CSA) and fat infiltration in multifidus and other paraspinal muscles in patients with acute or subacute unilateral symptoms of radiculopathy and concordant posterolateral disc herniation. If multifidus asymmetry is indeed related to local pathology, this may serve as a marker for helping to target the search for less clearly identifiable pathology responsible for low back–related symptoms, which currently remains elusive in approximately 85% of those seeking care.

STUDY DESIGN: Cross-sectional observational study.

PATIENT SAMPLE: Subjects were patients referred to magnetic resonance imaging (MRI) with unilateral leg symptoms of less than 6 weeks onset suggestive of radiculopathy, with a consistent posterolateral lumbar disc herniation verified on imaging.

METHODS: Using T2-weighted axial MRI, measurements were obtained for total muscle CSA and signal intensity, functional (fat-free) CSA, and the ratio of functional CSA to total CSA.

RESULTS: Forty-three subjects met the inclusion criteria. The ratio of functional CSA to total muscle CSA was smaller on the side of the herniation than on the unaffected side, both below (mean 0.69 vs. 0.72, p=.007) and at the level of herniation (mean 0.78 vs. 0.80, p=.031). Multifidus signal intensity (fat infiltration) was greater on the side of the herniation at the level below the herniation (p=.014). Contrary to expectation, greater total multifidus CSA was found ipsilateral to the pathology at the level of herniation (p=.033). No asymmetries were found at the level above the herniation or in any other paraspinal muscles, with the exception of higher signal in the erector spinae at the level and side of herniation.

CONCLUSIONS: Multifidus may be particularly responsive to, or indicative of, localized lumbar disc or nerve root pathology within the first 6 weeks of symptoms as expressed through fat infiltration, but not through CSA asymmetry on MRI. However, such measurements are not reliable markers of lumbar pathology on an individual basis for use in clinical or research settings.

Keywords: Disc herniation; Radiculopathy; Multifidus; Paraspinal muscles; Fatty infiltration

FDA device/drug status: Not applicable.

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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* Corresponding author. Department of Physical Therapy, Faculty of Rehabilitation Medicine, 2-50 Corbett Hall, University of Alberta, Edmonton, Alberta T6G 2G4, Canada. Tel.: (780) 492-5968; fax: (780) 492-1626.

E-mail address: mc.battie@ualberta.ca (M.C. Battié)

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Introduction

There have been a number of reports of paraspinal muscle atrophy and fat infiltration associated with back pain problems [1–5]. Whether these changes represent a risk factor for or consequence of low back pain continues to be debated [3]. Most intriguing, however, have been reports of multifidus atrophy that appears to be level- and side-specific in relation to symptoms and localized spinal pathology. These findings come from studies of disc herniation [6,7], experimentally inflicted disc or nerve root lesions [8] and nerve root avulsion [9], as well as symptoms of radiculopathy or unilateral acute or chronic low back pain [10–13]. The level- and side-specificity of multifidus atrophy suggests that such variations may represent a marker for localizing the site of painful lumbar pathology. The apparent specificity of variations in multifidus, as compared with other paraspinal muscles, is thought to stem from its unique unisegmental innervation [14,15], although this has been questioned by some [9,16,17].

Multifidus atrophy has been studied specifically in relation to disc lesions, with or without nerve root involvement, in several studies. In a 2006 ISSLS Prize study by Hodges et al. [8], which provided the motivation for this study, level- and side-specific multifidus atrophy and multilevel side-specific enlarged adipocytes were observed within days after experimentally inflicted anterolateral disc lesions, without suspected denervation, using a porcine model. It was hypothesized that the rapid, level-specific changes after a disc lesion may have been caused by reflex inhibitory mechanisms. This suggests that multifidus asymmetry could be an early indicator for acute, painful disc lesions without clear nerve root involvement and related denervation and, thus, possibly a marker to help localize painful lumbar disc-related pathology. More widespread side-specific atrophy spanning several levels was found in the case of nerve root lesions [8]. A year later, Hyun et al [6] reported on a study of 39 patients with herniated lumbar discs and chronic unilateral leg pain suggestive of radiculopathy. They found significantly more multifidus asymmetry in patients with radiculopathy verified on electromyography, as compared with patients with nonconfirmatory electromyography or a control group. Level-specific asymmetry was not investigated [6]. More recently, a study of multifidus asymmetry in 20 patients scheduled to undergo microdiscectomy at the L4–L5 disc revealed the presence of a smaller multifidus in 17 of the patients on the side of the herniation or when the herniation was deemed to be central [7]. In another study of symptomatic disc herniations, neurogenic changes in multifidus were observed as judged through histology of biopsy samples, but muscle asymmetry was not studied [18].

Further study is needed to clarify whether level- and side-specific multifidus muscle atrophy is a marker for disc pathology in humans. A marker for localizing such pathology could have significant implications for clinical investigations and research focused on identifying the pathology underlying back-related symptoms, which has to date remained elusive. It is estimated that the underlying pathology is unknown in approximately 85% of individuals seeking care for back problems, an estimate that has remained relatively unchanged for decades [19]. If multifidus asymmetry is indeed related to local pathology, this marker could represent a substantial advance in helping to target the search for the pathology responsible for low back–related symptoms.

The objective of this study was to determine the presence of level- and side-specific multifidus atrophy or fat infiltration in patients within 6 weeks of onset of unilateral radicular symptoms associated with posterolateral disc herniation confirmed on magnetic resonance imaging (MRI). Although some investigators have reported multifidus asymmetry at the suspected level of the pathology in patients with acute, unilateral low back symptoms and at the level of certain degenerative findings on MRI [12,20], we were most interested in the level below the pathology. Asymmetry at this level has been found within days after experimentally inflicting anterolateral disc lesions, when multifidus denervation was not suspected [8]. Asymmetry at the levels below the herniation also would be consistent with denervation related to nerve root involvement. No asymmetry was expected at the level above the pathology. A strong association of localized multifidus asymmetry with the relatively well-defined spinal pathology of disc herniation with concordant unilateral symptoms of radiculopathy would support multifidus asymmetry as a possible marker for localizing the search for other less well-

EVIDENCE & METHODS

Context
Previous studies suggest that changes in the multifidus muscles might be indicative of local disc/nerve pathology, perhaps as a secondary effect of disuse or a primary driver of other pathologic changes. This study further explores this concept.

Contribution
The authors found that fatty infiltration of multifidus muscles could be observed within 6-week sciatica duration at the level below a disc herniation.

Implication
The authors themselves point out significant limitations of the study. While the findings are interesting, they are likely nonspecific. It remains unclear if these findings could predate or predispose the disc herniation, or possibly play an independent role in recovery potential or recurrence risk.

—The Editors