Original articles

Lumbar magnetic resonance imaging hypolordosis in symptomatic patients: association with paraspinal muscle spasms[☆]

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Abstract

Objective: This study examined a set of patients who were symptomatic for low back pain and who had significant lumbar hypolordosis as assessed by visual evaluation of magnetic resonance images to investigate the frequency of comorbid paraspinal muscle spasms as determined via history or physical examination.

Methods: A retrospective chart review was performed on 50 patients who had significant hypolordosis on magnetic resonance imaging (MRI) (Cobb angle $<20^\circ$) to determine whether they were positive for paraspinal muscle spasms by either history or physical examination.

Results: Of the 50 patients with significant hypolordosis on MRI, 66% (33) had a history of paraspinal muscle spasms, 76% (38) had a positive physical examination for palpation of paraspinal muscle spasms, and 48% (24) were positive for both history and physical examination.

Conclusions: This retrospective study suggests that most symptomatic patients with significant hypolordosis on lumbar MRI have a positive history or physical examination for paraspinal muscle spasm. Thus, MRI finding of significant hypolordosis (Cobb angle $<20^\circ$) could potentially be a valuable tool in addition to medical history and physical examination in aiding clinicians in diagnosing paraspinal muscle spasms in symptomatic patients and in helping them to formulate appropriate and effective treatments.

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Introduction

Lumbar paraspinal muscle spasms are most often clinically diagnosed via a patient history of paraspinal cramps or “knots,” or a finding of splinting, tightness, or decreased range of motion on physical examination. Some spasms are inferred from loss of lordosis on neuroimaging examination such as radiography or magnetic resonance imaging (MRI).

Fortunately, most patients with a clinical diagnosis of paraspinal muscle spasms, lumbar strain/sprain, lumbar disk rupture, or nerve root contusion improve with nonsteroidal anti-inflammatory drugs, muscle relaxants, or other conservative modalities such as physical, chiropractic, or osteopathic manipulative therapy. If these modalities fail or the patient worsens, spinal injections can often produce clinical improvement and relaxation of muscle splinting.¹

Lumbar lordosis is frequently evaluated by visual assessment or physical examination, with assessment results tending to vary between clinicians.^{2,3} Research findings are inconsistent about the association of low back pain and range of lordosis. Using radiographic examination, one study found that the range of lordosis does not vary between cohorts with acute or chronic low back pain or those cohorts that are asymptomatic.⁴ Another study of lumbar lordosis using MRI in patients with and without low back pain suggests that “reduced lumbar lordosis” is a very weak clinical sign for low back pain.⁵ However, other studies have found that patients have measurably greater stiffness when they have low back pain than when they have little or no pain⁶ and that chronic low back pain limits the maximal range of lumbar extension more than acute low back pain.⁷

Paraspinal muscle spasms are commonly used as a clinical sign in the diagnosis of hypolordosis; however, the association between muscle spasms and reduced lordotic curve is not well documented in the literature. For this reason, we examined a set of patients who were symptomatic for low back pain and who had significant lumbar hypolordosis as assessed by visual evaluation of MR images to investigate the frequency of comorbid paraspinal muscle spasms as determined via history or physical examination. Should a positive association exist between significant hypolordosis on MRI and a positive history of or physical examination for paraspinal muscle spasm, the clinician could potentially be offered a third tool (ie, MRI) for use in clinically diagnosing paraspinal muscle spasm.

Methods

We conducted a retrospective study of 50 serial patients referred to our multispecialty neuroscience practice for low back pain in 2007. Patients included in the study were 18 years or older, had low back pain, and had significant hypolordosis on lumbar MRI (ie, Cobb angle $<20^\circ$). No other inclusion or exclusion criteria were used. All patients provided written consent to have personal health information published without divulging personal identifiers.

Each patient had a medical history taken and physical examination performed by one or more of our physicians at 1 of our 5 private office locations in central and eastern Kentucky. All of our offices are accredited by the Academy of Pain Management. This voluntary pain program accreditation demonstrates compliance with rigorous, peer-reviewed standards. Accreditation involves review of policies and procedures demonstrating accountability and distinct organizational practices to ensure that patients receive proper assessment and management of their pain.⁸

To optimize the quality of their care, patients with chronic pain (the most common type of pain) were subjected to universal precautions and pain program accreditation guidelines.^{9,10} The universal precautions include continuing medical education for physicians so that they can be aware of the best treatment options available; consultation between the pain specialist and the primary care physician; comprehensive history including the CAGE-AID questionnaire¹¹; confirmatory physical and imaging examinations; treatment agreement (contract or consent for treatment); alternative measures beginning with combinations of noncontrolled medications, physical therapy, and exercise and using opiates in a slow stepped care approach; compliance measures such as urine drug screens and prescription tracking programs, control of prescriptions with drug logs, and no-early-refill rules; call blocks to prohibit calling in any prescription for any controlled substance; and, last but not perhaps most important, compassion.¹⁰

Three of our 5 offices are each equipped with a midfield (0.6 T) open Upright MRI (Fonar Corp, Melville, NY), which allows imaging of the patient in the weight-bearing, sitting position. The other 2 offices are each equipped with an Airis II (Hitachi Medical Systems, Twinsburg, OH) low-field (0.3 T)

open recumbent MRI scanner. Requests for MRI imaging were based on current, evidence-based guidelines.¹² Routine lumbar pulse parameters set by the neuroimaging physicians included sagittal, axial, and coronal T1- and T2-weighted images. All offices are accredited by the American College of Radiology.¹³

All offices are connected via intranet using secure 200-bit encrypted HIPAA-compliant T lines and electronic medical records. Over a period of several weeks, all lumbar MR images were reviewed by the primary author, who regularly reviews and interprets neuroimages for each of the 5 office locations via telehealth, that is, teleneuroimaging/teleradiology using the same secure intranet and RadWorks (GE Healthcare, Buckinghamshire, United Kingdom) technology.

Although alternative methods for measuring curvature exist and intraobserver variability may range from a few degrees to 10°, the 4-line Cobb method was chosen to determine the angle of lordosis in the sagittal plane by drawing lines along the top of the vertebral body of L1 and a line parallel to the bottom of vertebral body L5 and then bisecting these lines at 90°. The bisecting lines were extended until they intersected; the acute angle formed by their intersection was measured. Disagreement regarding the range of normal lordosis exists; for this study, a *normal range* was defined as a Cobb angle from 35° to 40°. *Significant hypolordosis* was defined by a Cobb

angle less than 20°. ¹⁴⁻¹⁶ Although it is known that disk pressures are greater in the sitting position than in the standing position, ¹⁷⁻²⁰ a positive MRI for significant hypolordosis in either weight-bearing or recumbent positions was an inclusion criterion for this study under the assumption that this Cobb angle was sufficiently small to trigger muscle dysfunction in the symptomatic patients studied.

Over a period of several weeks, charts of symptomatic patients with chronic low back pain, sciatica, other signs and symptoms, and MR images of the lumbar spine were reviewed by a neuroradiologist or neuroimagist for significant loss of lordosis on T2 sagittal imaging. A series of 50 patients were noted to have significant loss of normal lumbar lordosis on T2 sagittal imaging. Thirty of these patients had been scanned in the sitting position using the Fonar Upright MRI; the other 20 patients had been scanned in the recumbent position using the Airis II MRI. For all patients, retrospective electronic medical record charts were reviewed. No cancer patients were identified. A history was considered positive for paraspinal lumbar muscle spasm if the patient reported to the physician a complaint of paraspinal muscle spasms, cramps, or swelling in the paraspinal lumbar location; physical examination was considered positive if the physician palpated paraspinal muscle spasms on physical examination. Physical findings of tenderness, decreased range of

Fig 1. Single midline T2 sagittal lumbar MR images showing the following clinical diagnoses representative of patients in this study: (A) lumbar strain/sprain, (B) lumbar fracture at L4, (C) L5-S1 grade I spondylolisthesis, (D) L4-5 disk protrusion, and (E) postlaminectomy.

Table 1 Medical history and physical examination for muscle spasms from 50 symptomatic patients with hypolordosis on MRI

	Positive Medical History	Positive Physical Examination	Positive Medical History and Physical Examination	Positive History and Negative Physical Examination	Negative History and Positive Physical Examination	Negative Medical History and Negative Physical Examination
Patients (n)	33	38	24	9	14	3
Patients (%)	66	76	48	18	28	6

motion, or splinting were not considered positive for muscle spasm in this study.

Results

Fig 1 provides 5 midline T2 sagittal lumbar MR images that are representative of the clinical diagnoses after neuroimaging or neuroradiological diagnoses in the study population: lumbar strain/sprain, lumbar fracture at L4, L5-S1 grade I spondylolisthesis, L4-5 disk protrusion, and postlaminectomy.

Of the 50 patients studied with lumbar MRI evidence of significant hypolordosis, the majority had a positive medical history (66%), positive physical examination (76%), or both positive medical history and positive physical examination (48%) (Table 1).

Discussion

The point of this study was to look only at symptomatic neuroscience patients with significant hypolordosis on MRI and to determine whether a correlation exists with a history or physical finding of paraspinal muscle spasm. Indeed, our results suggest that MRI finding of significant hypolordosis may be a valuable tool in addition to medical history and physical examination in aiding the clinician in diagnosing paraspinal muscle spasms in symptomatic patients and in helping them to formulate appropriate and effective treatment. Thus, MRI may be a valuable tool to complement the history and physical examination in diagnosing muscle spasm. Already, MRI is recognized as the preferred imaging study for evaluation of lumbar disk lesions because it involves no ionizing radiation and offers advantages over computed tomographic imaging such as excellent delineation of soft tissue structures, direct multiplanar imaging, and excellent characterization of medullary bone.²¹

It is well known that most asymptomatic individuals have some degree of disk degeneration and spondylosis that increases with age and that, among asymptomatic individuals, 20% to 30% can be expected to have disk protrusions.²² Hypothetically, symptomatic patients with pain would be expected to have an increased likelihood of muscle spasms and/or symptomatic disk protrusions. For symptomatic patients, clinicians are called upon to integrate history, physical examination, and other diagnostics to determine the underlying pain generator.

Research supports the possibility that low back pain can trigger spasms of the paraspinal muscles associated with intervertebral dysfunction.^{23,24} Such spasms are thought to act as a protective mechanism, splinting injured areas of the spine. Injuries may be superficial such as strain/sprain or more serious such as disk protrusion, spondylosis, or fracture. A study of the behavior and muscle function of patients with low back pain showed that this muscle guarding (ie, absence of flexion-relaxation response) should receive more attention by clinicians as part of routine physical examinations because this muscle dysfunction can restrict range of motion and possibly lead to the development of maladaptive postures and movements secondary to persistent pain.²⁵ In fact, kyphotic angulation and straightening or reversal of cervical lordosis are commonly seen after trauma. Although these may indeed be normal variants, muscle spasms are widely used to explain these variations between patients with pain.²⁶

Previous studies comparing lumbar hypolordosis between back pain patients and healthy subjects have been inconclusive. One study performed when back pain patients had little or no pain showed that lumbar lordosis may not be the measure that distinguishes them from asymptomatic subjects.²⁷ In fact, in the presence of certain physical conditions, such as tethered spinal cord, a change in lordotic curve may even predate the onset of back pain.²⁸ Obesity has been found to reduce the lumbar lordotic curve.²⁹ It is

generally thought that individuals with strong paraspinal musculature and normal weight are more likely to have a normally aligned spine, although little research has confirmed these assumptions.^{30,31} More research is needed in this area. For example, differences in loss of lordosis as detected via MRI of the lumbar spine in the recumbent vs weight-bearing positions may be clinically relevant. Future studies might also be designed to examine the severity of hypolordosis vs other clinical diagnostic parameters for paraspinal muscle spasm.

Conclusion

This retrospective study suggests that most symptomatic patients with significant hypolordosis (Cobb angle $<20^\circ$) on lumbar MRI have a positive history or physical examination for paraspinal muscle spasm. Thus, MRI finding of significant hypolordosis could potentially be a valuable tool in addition to medical history and physical examination in aiding clinicians in diagnosing paraspinal muscle spasms in symptomatic patients and in helping them to formulate appropriate and effective treatments.

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