

Low Back Pain on Passive Straight Leg Raising

The Anterior Theca as a Source of Pain

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Study Design. A prospective clinical and radiologic investigation of two groups of patients presenting with either acute back pain only or acute leg pain only, yet similar restriction in straight leg raising (SLR).

Objectives. To highlight a group of patients presenting with acute low back pain only, yet a restricted SLR normally associated with leg pain (sciatica) caused by a posterolateral disc prolapse. To determine the anatomic source of the pain in the low back pain only group.

Summary of Background Data. A restricted SLR is commonly associated with leg pain (sciatica) due to compression of a nerve root by an intervertebral disc prolapse. Previous studies investigating pain patterns on SLR have suggested that central disc prolapses tend to induce back pain whereas the more lateral prolapses induce leg pain. Such research work has involved patients presenting with typical sciatic pain investigated by myelography and undergoing decompressive surgery. There are no studies specifically investigating patients presenting with low back pain only and reduced SLR.

Methods. Two groups of patients, one with acute low back pain only and one with acute leg pain only, yet showing similar restriction in SLR underwent MR imaging. The scans were reviewed “blind” by an experienced spinal radiologist and imaging features recorded according to a detailed protocol. The MR findings were then compared.

Results. Significant disc prolapses were seen equally in both groups. The disc prolapses in the back pain only group were more likely to be central, smaller, to compress the theca only, and to be at a higher lumbar level as compared with the leg pain only group.

Conclusions. Acute low back pain associated with significant restriction in SLR is likely to be caused by a disc prolapse compressing the anterior theca.

Key words: acute low back pain, straight leg raising, central disc prolapse. *Spine* 2005;30:342–345

The mechanism and origin of acute mechanical low back pain remain controversial. Despite careful clinical assessment and highly sophisticated imaging techniques, it is still difficult in most instances to determine, with any

conviction, a likely source of pain. In contrast, patients presenting with acute leg pain due to a posterolateral disc prolapse, often present with characteristic symptoms and clinical signs that allow a reasonably confident preliminary diagnosis to be made, which can subsequently be correlated with appropriate imaging.

A key physical sign in the diagnosis of acute leg pain due to a disc prolapse is the demonstration of nerve root tension signs. Passive straight leg raising (SLR) will cause traction on the lower lumbar nerve roots, pulling them caudally between 1.4 and 4 mm,¹ and will usually cause an increase in leg pain. After SLR, with the leg still in the raised position, dorsiflexion of the foot or flexion of the knee will increase and decrease the tension in the nerve root, respectively, resulting in a corresponding alteration in the intensity of leg pain.

In contrast, an increase in back pain rather than leg pain during SLR is not generally considered to be due to nerve root tensioning, but it is commonly elicited in patients with low back pain and has been variously attributed to lumbar spinal movement,² movement of the sacroiliac joint,³ or referred pain from the posterior primary ramus.⁴

Edgar and Park⁵ and Shiqing *et al*,⁶ using myelography, compared pain patterns on passive SLR in patients with sciatica who subsequently underwent discectomy. They found that the more central disc protrusions tended to cause back pain, and lateral protrusions, leg pain, on passive SLR.

However, these patients presented primarily with sciatica and not back pain, and none had CT or MR imaging. Edgar and Park⁵ concluded that compression of the anterior dura by the disc was the cause of the back pain on passive SLR.

We report 12 patients with acute and severe low back pain with no leg pain, who demonstrated increased back pain on passive SLR associated with a further increase in pain on dorsiflexion of the foot and resolution of back pain on flexion of the knee. We attempt to explain these findings by comparing the MRI scan appearances of the lumbar spine in these patients with the MRI scans of a similar group of patients with acute leg pain clinically considered to be due to a posterolateral disc prolapse and who demonstrated similar root tension signs.

We know of no other paper that has specifically highlighted this particular presentation of signs and symptoms in patients with acute back pain.

Materials and Methods

This was a prospective investigation involving two groups of patients with distinct and different clinical presentations of spi-

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nal pain. None of the patients was considered on clinical grounds to have “serious” pathology such as malignancy, infection, or trauma, and no patient had previously undergone spinal surgery.

These patients had been referred to the senior author (B.S.) for assessment and treatment as part of an acute spinal service.

Acute Back Pain Only Group. Twelve patients were referred for clinical assessment with the following characteristics.

1. Low back pain of less than 4 months’ duration
2. No leg pain
3. An SLR of 45° or less in either one or both legs aggravating existing low back pain. The limit of SLR was measured when the patient first started to complain of increasing back pain.
4. The back pain was increased by dorsiflexion of the foot and decreased by knee flexion when the leg was in the passively raised position.

There were eight men and four women with an average age of 35 years (range, 25–41 years).

Acute Leg Pain Only Group. Twelve patients were referred for clinical assessment with the following characteristics:

1. Unilateral leg pain of less than 4 months’ duration
2. No back pain
3. An SLR of 45° or less in the affected leg aggravating existing leg pain. The limit of SLR was measured when the patient first started to complain of increasing leg pain.
4. The leg pain was increased by dorsiflexion of the foot and decreased by flexion of the knee when the leg was still in the passively raised position.

There were 10 men and 2 women. The average age was 40 years (range, 20–58 years).

All patients underwent MRI scans of the lumbar spine. The same 0.5 Tesla IGE Sigma Contour scanner was used for all patients. Sagittal T1 and T2 images and axial T1 and T2 at affected disc levels were accessed. All scans were performed within 3 weeks from the time of the initial consultation.

The MRI films were reported “blind” by an experienced orthopedic radiologist (V.C.-P.) who, at the time of reporting, was unaware of the clinical details of the patients or the purpose of the research paper.

Imaging Features Reported on All Patients

Disc Morphology. (1) Bulge—circumferential symmetric extension of the disc beyond the interspace; (2) Protrusion—focal or asymmetric extension of the disc beyond the interspace with the base against the disc of broader origin than any other dimension of the disc; (3) Extrusion—more extreme extension of the disc with the base narrower than the diameter of the extruding material itself or with no connection between the material and the disc.

For the purposes of this paper, disc bulges were not considered to be clinically relevant. Disc protrusions were considered to represent focal disc extensions bounded by an intact annulus. Disc extrusions were considered to be focal disc extensions breaching the outer annulus. Disc extrusions included such discs that might be considered sequestered.

Classification of disc position in spinal canal

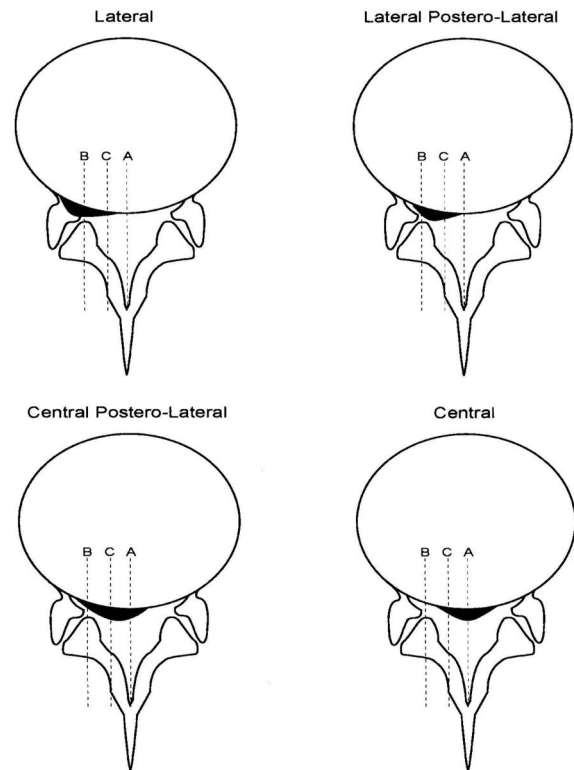


Figure 1. Classification of position of disc prolapse in spinal canal.

Disc protrusions and extrusions are referred to collectively as prolapses in this paper.

Size of Disc Prolapse. (1) Small—disc material occupying area of the spinal canal within one third of the diameter of the canal measured at the mid sagittal level; (2) Large—disc material occupying area of the spinal canal greater than one third the distance of the diameter of the spinal canal measured at the mid sagittal level

Position of Disc Prolapse in Spinal Canal. Each half of the spinal canal in the axial plane was divided into three segments by three anteroposterior lines, creating three zones (Figure 1). The anteroposterior lines are as follows:

1. Line a: midsagittal line
2. Line b: a line parallel to this passing through the most medial aspect of the articular surface of the facet joint
3. Line c: a line parallel to and half way between lines a and b

Central prolapse—symmetric prolapse with apex on line a
Central/posterolateral prolapse—asymmetric prolapse with apex between line a and c

Lateral/posterolateral prolapse—asymmetric prolapse with the apex between line c and b

Lateral prolapse—asymmetric prolapse with apex lateral to line b

Thecal or Nerve Root Compression. Contact of the disc prolapse to thecal sac or nerve root or both was noted.

■ Results

The results are given in the Tables 1 to 5 and are self-explanatory.

Table 1. Disc Morphology

	Normal	Protrusions	Extrusions	Total Disc Prolapses
Back pain group	1	8 in 7 patients	4 in 4 patients	12 in 11 patients
Leg pain group	1	5 in 4 patients	7 in 7 patients	12 in 11 patients

Note: One patient in each group had two prolapses at different levels. Disc bulges were not considered pathologic.

Table 2. Disc Size

	Small	Large
Back pain group	8	4
Leg pain group	2	10

Table 3. Position of Disc Prolapse in Spinal Canal

	Central	Central Posterolateral	Lateral Posterolateral	Lateral
Back pain	4	7	1	0
Leg pain	2	6	3	1

Table 4. Thecal or Nerve Root Compression

	Thecal Only	Nerve Root Only	Both
Back pain	3	0	9
Leg pain	0	2	10

Table 5. Level of Disc Protrusion/Extrusion

	L2–L3	L3–L4	L4–L5	L5–S1
Back pain	0	3	5	4
Leg pain	0	0	5	7

■ Discussion

Eleven of 12 patients with acute low back pain and no leg pain, and who demonstrated significant restriction of passive SLR due to back pain only, were found to have disc protrusions or extrusions (prolapses) on lumbar spine MRI. Disc bulges were not considered clinically significant. A comparable group of patients with acute leg pain and a restricted SLR clinically considered to be due to an acute disc prolapse were similarly investigated and found to have the same proportion of disc prolapses.

The disc prolapses in the back pain only group were more likely to be central and smaller, to compress the theca only, and were at a higher lumbar level compared with the leg pain only group, which tended to have more lateral and larger disc prolapses that were more likely to compress the nerve root only, and to be at a lower lumbar level.

There was, inevitably, overlap of these MRI characteristics in the two groups, although the clinical entities

were quite separate. However, taking into account the complex interactions between mechanical and chemical stimuli that induce spinal pain, and the variability and interconnections of the spinal nerve supply, such overlap is in no way surprising. The crucial finding is of substantial disc abnormalities in nearly all the back pain only patients that were significantly higher than one would expect in a normal, nonpainful population.^{8,9}

The inference from these findings is that the pain, in the back pain only group, was due to compression or tensioning of the anterior theca by a disc protrusion or extrusion. In that respect, the restricted SLR in this group should be considered a thecal tension sign rather than a root tension sign.

The innervation of the spinal dura mater is generally accepted to be the sinuvertebral nerve (recurrent meningeal nerve) with a double origin from branches of the sympathetic ramus communicans, and the anterior primary ramus. The sinuvertebral nerve traverses back through the intervertebral foramen into the spinal canal from its origin and divides to supply the vessels, ligaments and disc, as well as the dura.¹⁰ Histologic and immunocytochemical studies of the lumbar spinal dura confirm a rich innervation with nociceptive fibers and complex neural communications with adjacent structures such as the posterior longitudinal ligament.^{10–12}

The innervation of the anterior dura is substantially greater than the posterior dura,^{10–12} and this may explain why patients having a lumbar puncture do not usually complain of pain when the dura is pierced. Stimulation of the sinuvertebral nerve from a theca, compressed and inflamed by an acute disc prolapse, is likely to give rise to back pain.

Although the spinal dura mater of the nerve root is also innervated by the sinuvertebral nerve, its close proximity to the axons within it implies that compression or tensioning of the nerve root stretches the neuronal elements as well, resulting in typical sciatica. When the anterior theca is compressed by a central small- or moderate-sized disc prolapse, back pain is more likely to be induced than leg pain as the nerves of the cauda equina tend to lie dorsal to the anterior theca away from the area of compression.

Only when a central disc prolapse is so large that it distorts the central nerve roots within are typical symptoms of a cauda equina lesion produced.

The anterior dura at L3–L4 and L4–L5 is more closely adherent to the posterior surface of the disc and vertebral bodies by the ligaments of Hofmann.¹³ This is in contrast to the dura behind the L5–S1 disc where it is more free of attachments. Clearly from these anatomic considerations, anterior thecal distortion is more likely to occur at these higher levels as suggested by our findings.

We conclude therefore that patients presenting with acute low back pain only, and who demonstrate reduced SLR of 45° or less, and with supportive thecal tension signs, are likely to have a central disc protrusion or extrusion compressing the anterior theca, most likely at the L4–L5 level or higher.

Because of our wish to restrict the key group to those who have only back pain, we only report a relatively small number of patients. Patients more frequently present with a combination of back and leg pain in varying degrees of intensity. Pure acute back pain presenting to our spinal service is relatively uncommon.

We consider that the degree of back or leg pain caused by an acute disc prolapse depends, in part, on the position, size, and level of the disc prolapse.

The higher, more central, and smaller prolapses will be likely to cause back pain when compressing the theca, whereas the more lateral, larger, and lower prolapses will cause leg pain when compressing the nerve root. Extruded discs are more likely to cause leg pain as they are usually larger than protrusions. The majority of patients present with a combination of both back and leg pain, and this may be due to the relative degree of compression of the theca and nerve root.

We stress at this point that these considerations are restricted to those patients presenting with acute back pain and not chronic back pain, in which there are so many more variable and influential factors that localization of pain to a single anatomic source becomes more problematic.

While the clinical demonstration of anterior thecal compression gives little assistance in determining appropriate treatment or clinical outcome, it may be useful to both clinician and patient alike to have, after a simple examination, a likely source of pain, which can start as a focal point for further discussion and investigation.

■ Key Points

- Patients presenting with acute low back pain and a significantly reduced straight leg raising are as likely to have an intervertebral disc prolapse on MR imaging as patients with typical sciatica and similarly reduced straight leg raising.

- The disc prolapses in the back pain only group were more likely to be smaller, more central, to compress the theca only, and to be at a higher lumbar level than patients in the leg pain only group. Anatomic considerations would indicate that the pain source, in the back pain group, is the anterior theca compressed by the disc prolapse.
- The degree of back or leg pain caused by an acute disc prolapse may depend in part on the degree of thecal or nerve root compression.

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