Herniated Lumbar Intervertebral Disk


This Journal feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the authors’ clinical recommendations.

A 41-year-old man reports the sudden onset of low back and left leg pain. The symptoms began while he was doing yard work and pulling out large bushes. Since the onset of the pain 2 days ago, it has worsened, although he took a single dose of ibuprofen when the pain began. The patient has no clinically significant medical history, and the physical examination is normal other than severe pain in the left leg with a straight-leg-raising maneuver to 40 degrees. He says, “I’m sure I slipped a disk,” and he requests magnetic resonance imaging (MRI) of the low back. What testing and treatment would you recommend?
The natural history of herniated lumbar disks is generally favorable, but patients with this condition have a slower recovery than those with nonspecific back pain. In one study involving patients with a herniated disk and no indication for immediate surgery, 87% who received only oral analgesics had decreased pain at 3 months. Even in randomized trials that enrolled patients with persistent sciatica, the condition of most patients who did not undergo surgery improved. The condition of patients who have motor deficits corresponding to a single nerve root (such as weakness on dorsiflexion of the foot, or foot drop) associated with herniated disks also improves over time. In one study, 81% of patients with initial paresis had recovered without surgery after 1 year. Sensory deficits may be more persistent; the rate of recovery is 50% at 1 year. MRI shows shrinkage of most herniated disks over time, and up to 76% partially or completely resolve by 1 year. However, recurrences of pain are common. In one study involving a cohort of persons who presented with sciatica, 25% of those whose sciatica resolved had a recurrence of symptoms within 1 year.

The differential diagnosis of sciatica includes conditions other than herniated disks. These conditions include tumors, a vertebral fracture, an epidural abscess, spondylothesis, lumbar stenosis, a synovial cyst or cysts, and herpetic and diabetic mononeuropathies. Clues to these conditions (e.g., a history of cancer or trauma or the presence of fever) are usually apparent from the history and physical examination. Back pain may precede sciatica, but the pain and paresthesia of sciatica often become dominant, and the pain typically radiates to below the knee. Often there is no specific precipitating event; a “nonsudden” onset is common.

Data obtained from the patient’s clinical history and physical examination are moderately accurate in establishing the diagnosis: the straight-leg-raising test for nerve-root compression is widely used, and it is typically considered to be positive if sciatica is reproduced by elevating the leg to between 30 and 70 degrees. A positive ipsilateral straight-leg-raising test (in which the leg with sciatica is raised and pain is elicited on the side of the raised leg) is sensitive but not specific. In contrast, a positive crossed straight-leg-raising test (in which sciatica is reproduced by raising the opposite leg) is specific but not sensitive.

In two studies of surgery for sciatica, at least 95% of herniated disks were at the L4–L5 or L5–S1 levels. Thus, neurologic examination can focus on the L5 and S1 nerve roots. Rarely, a massive midline disk herniation may compress the cauda equina; this is known as the cauda equina syndrome. This compression typically causes unilateral or bilateral sciatica, motor weakness, and urinary incontinence or retention. Saddle anesthesia (loss of sensation in the area of the buttocks, posterior superior thighs, and perineum) is characteristic, and anal sphincter tone may be diminished.
Table 1. Estimated Accuracy of Findings on Clinical Assessment for Diagnosis of Nerve-Root Compression Due to a Herniated Disk, According to Either MRI or Surgical Findings.*

<table>
<thead>
<tr>
<th>Assessment and Finding</th>
<th>Patient Sample</th>
<th>Reference Standard</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive Predictive Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MRI</td>
<td>10% Prevalence</td>
<td>50% Prevalence</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical history†</strong></td>
<td></td>
<td>MRI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg pain worse than back pain</td>
<td>Referred from primary care to neurology</td>
<td>MRI</td>
<td>82</td>
<td>54</td>
<td>17</td>
</tr>
<tr>
<td>Typical dermatomal pattern of symptom distribution</td>
<td>Referred from primary care to neurology</td>
<td>MRI</td>
<td>89</td>
<td>31</td>
<td>13</td>
</tr>
<tr>
<td>Pain worse on coughing, sneezing, or straining</td>
<td>Referred from primary care to neurology</td>
<td>MRI</td>
<td>50</td>
<td>67</td>
<td>14</td>
</tr>
<tr>
<td><strong>Physical examination‡</strong></td>
<td></td>
<td>MRI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive ipsilateral straight-leg-raising test</td>
<td>Primary care</td>
<td>MRI</td>
<td>64</td>
<td>57</td>
<td>14</td>
</tr>
<tr>
<td>Referred for surgery</td>
<td>MRI</td>
<td>92</td>
<td>28</td>
<td>13</td>
<td>56</td>
</tr>
<tr>
<td>Positive crossed straight-leg-raising test</td>
<td>Referred for surgery</td>
<td>Surgical findings</td>
<td>28</td>
<td>90</td>
<td>24</td>
</tr>
<tr>
<td>Paresis</td>
<td>Primary care</td>
<td>MRI</td>
<td>27</td>
<td>93</td>
<td>30</td>
</tr>
<tr>
<td>Muscle atrophy</td>
<td>Referred for surgery</td>
<td>Surgical findings</td>
<td>15–38</td>
<td>50–94</td>
<td>3–41</td>
</tr>
<tr>
<td>Impaired reflexes§</td>
<td>Primary care</td>
<td>MRI</td>
<td>15</td>
<td>93</td>
<td>19</td>
</tr>
<tr>
<td>Neurologist's assessment based on clinical history and physical examination†</td>
<td>Referred from primary care to neurology</td>
<td>MRI</td>
<td>81</td>
<td>52</td>
<td>16</td>
</tr>
</tbody>
</table>

* Estimates vary substantially among studies, in part because of varying patient selection criteria and procedures. The prevalence of a herniated disk as the cause of back and leg pain may be approximately 10% in primary care and 50% in specialty care. MRI denotes magnetic resonance imaging.

† Data on clinical history are calculated from the data in a study by Vroomen et al. That study included patients with back and leg pain. MRI showed herniated disk and nerve-root compression in 152 patients, and 122 patients had other diagnoses.

‡ Estimates are based on data from a systematic review of multiple studies by van der Windt et al. The L5 nerve root affects neither the Achilles tendon nor the patellar reflex and is one of the two most commonly affected nerve roots. Thus, in a person with suspected L5 radiculopathy, normal reflexes convey no information.
Plain radiography does not show herniated disks, but it helps to rule out a tumor or fracture, infection, and spondylolisthesis. Most guidelines recommend the use of plain radiography only in patients who have a high risk of underlying systemic disease (e.g., a history of cancer) and patients who use injection drugs or receive oral or parenteral glucocorticoids.20

Computed tomography (CT) or MRI can confirm a clinical diagnosis of a herniated disk. Early MRI is indicated in patients with progressive or severe deficits (e.g., multiple nerve roots) or clinical findings that suggest an underlying tumor or infection (e.g., findings that indicate injection-drug use or fever). Otherwise, CT or MRI is necessary only in a patient whose condition has not improved over 4 to 6 weeks with conservative treatment and who may be a candidate for epidural glucocorticoid injections or surgery.

On imaging, disk bulging is common among asymptomatic persons (in approximately 60% of persons at 50 years of age), as is disk protrusion (in 36% of persons at 50 years of age).6 Thus, there is a substantial risk of misleading MRI findings, and an ill-advised cascade of subsequent testing and intervention may result.21 We therefore do not recommend the routine use of CT or MRI.

CT and MRI terminology was inconsistent in the past, but a consensus now distinguishes among disk bulging, protrusion, extrusion, and sequestration (Fig. 2). The latter three terms define a herniated disk, whereas bulging does not.22 Extrusion and sequestration are most likely to cause radicular symptoms.

Electromyography is usually unnecessary. However, it may be helpful in patients with ambiguous symptoms or findings on examination and CT or MRI.

**CONSERVATIVE THERAPY**

Cohort studies suggest that the condition of many patients with a herniated lumbar disk improves in 6 weeks; thus, conservative therapy is generally recommended for 6 weeks in the absence of a major neurologic deficit. In one study, 36% of patients reported improvement in their condition at 2 weeks, and this percentage increased substantially with longer follow-up.23 Furthermore, persistent pain after 6 weeks of conservative therapy has been the entry criterion in most randomized trials of disk surgery.10,11

The favorable natural history of sciatica may explain why certain treatments that have not proved to be effective in clinical trials have been
perceived as being effective. For example, randomized trials have not shown that recovery from sciatica or back pain is faster with bed rest than with watchful waiting. Similarly, a meta-analysis of 32 randomized trials (16 of which were judged to have a low risk of bias) showed no significant benefit of lumbar traction over sham therapy with respect to pain relief, improved function, or reduced absenteeism from work.

There is no evidence that conservative treatments change the natural history of disk herniation, but some offer slight relief of symptoms. Nonsteroidal antiinflammatory drugs (NSAIDs) reduce back pain somewhat in the short term, but they have a less clear benefit in patients with sciatica. The few randomized trials of NSAIDs for sciatica are generally of low quality, and trials to assess the use of acetaminophen in patients with sciatica are lacking.

Randomized trials show no significant advantage of systemic glucocorticoid therapy over placebo with respect to pain relief or reduced rates of subsequent surgical intervention, and they show little, if any, advantage with respect to improvement in physical function. Adverse effects, including insomnia, nervousness, and increased appetite, are common. There is insufficient evidence to judge the efficacy of antiepileptic drugs, antidepressants, or muscle relaxants in patients with sciatica.

Data from randomized trials to support the use of opioids in patients with sciatica are lacking. Systematic reviews suggest that opioids have slight short-term benefits with respect to reduced back pain. Convincing evidence of benefits of long-term use is lacking, and there is growing concern regarding serious long-term adverse effects such as fractures and opioid overdose and abuse. The use of opioids should be limited to patients with severe pain and should be time-limited from the outset.

The use of epidural glucocorticoid injections in patients with herniated disks has increased rapidly in recent years, although these injections...
are used on an off-label basis. A systematic review showed that patients with radiculopathy who received epidural glucocorticoid injections had slightly better pain relief (by 7.5 points on a 100-point scale) and functional improvement at 2 weeks than patients who received placebo. There were no significant advantages at later follow-up and no effect on long-term rates of surgery. Procedural complications are rare, but neurologic events such as paraplegia have been reported, and the Food and Drug Administration recently required a warning on product labels for glucocorticoids. Systemic side effects, including cortisol suppression and osteopenia, may also occur.

In patients with acute disk herniations, avoidance of prolonged inactivity in order to prevent debilitation is important. Most patients can be encouraged to stand and walk. The ability to sit comfortably is a sign of improvement in the patient’s condition and suggests that more structured exercise can be undertaken. Evidence regarding the effects of physical therapy and exercise is limited. A systematic review of five randomized trials showed that patients who participated in supervised exercise had greater short-term pain relief than patients who received counseling alone, but this reduction in pain was small and these patients did not have a long-term benefit with respect to reduced pain or disability.

A randomized trial of chiropractic manipulation for subacute or chronic “back-related leg pain” (without confirmation of nerve-root compression on MRI) showed that manipulation was more effective than home exercise with respect to pain relief at 12 weeks (by a mean 1-point decrease on a pain-intensity scale on which scores ranged from 0 to 10, with higher scores indicating greater severity of pain) but not at 1 year. In addition, a randomized trial involving patients who had acute sciatica with MRI-confirmed disk protrusion showed that at 6 months, significantly more patients who underwent chiropractic manipulation had an absence of pain than did those who underwent sham manipulation (55% vs. 20%). Neurologic complications in the lumbar spine, including worsened disk herniation or the cauda equina syndrome, have been reported anecdotally, but they appear to be extremely rare.

Surgery
Wide geographic variations in rates of spinal surgery have aroused concern about overuse of spinal surgery in some areas. Unless patients have major neurologic deficits, surgery is generally appropriate only in those who have nerve-root compression that is confirmed on CT or MRI, a corresponding sciatica syndrome, and no response to 6 weeks of conservative therapy. The major benefit of surgery is that relief of sciatica is faster than relief with conservative therapy, but, on average, there is a smaller advantage of surgery with respect to the magnitude of relief of back pain. North American Spine Society guidelines note that, on average, patients with signs of psychological distress such as somatization or depression have worse surgical outcomes than those who do not have these signs, and patients with a positive straight-leg-raising test have better surgical outcomes than those with negative results on this test.

Several randomized trials have compared surgery with conservative treatment for herniated lumbar disks. These trials included patients with minor neurologic deficits but not major or progressive deficits (for whom delaying surgery is ill-advised). All the trials involved the use of open diskectomy or microdiskectomy. Conservative care was not standardized, but it included at least the use of pain medication and physical therapy. None of the trials were blinded (i.e., none required sham surgery), so bias owing to patient expectations was possible. Each trial had substantial crossover between the conservative group and the surgical group; this may have “diluted” a benefit of surgery.

These trials have consistently shown faster relief of pain with surgery than with conservative treatment. However, most, although not all, trials showed no significant advantage of surgery over conservative treatment with respect to relief of sciatica at 1 to 4 years of follow-up. For example, in one trial, the median time to resolution of symptoms was 4 weeks with early surgery and 12 weeks with prolonged conservative therapy; at 1 year, 5% of patients in each group had not recovered. In patients assigned to conservative treatment who later crossed over to the surgical group, the results of surgery were similar to those in patients who underwent earlier surgery; this suggests the absence of a therapeutic window for surgery that closed quickly. Recovery from mild motor deficits occurred in most patients with or without surgery.

Given these results, either surgery or conser-
ervative treatment may be a reasonable option, depending on the patient’s preferences for immediate pain relief, how averse the patient is to surgical risks, and other considerations. Thus, shared decision making involving both patients and physicians is valuable; meaningful involvement requires that patients be well informed about these options and their associated benefits and risks. In one randomized trial, patients with a herniated disk who saw a computer-based decision aid were less likely to choose surgery than those who received conventional written materials. Despite between-group differences with respect to rates of surgery, there were no significant differences in outcomes at 1 year of follow-up.43

Several diskectomy techniques are available (Fig. 3). With the emergence of microdiskectomy (see the video) and minimally invasive techniques, there has been a striking shift from inpatient to ambulatory surgery. Patients may return to work quickly even after they have undergone open diskectomy. In a case series involving patients who had no restrictions on activity after surgery, one third returned to work within 1 week, and 97% returned to work by 8 weeks. The interval between surgery and return to full duty was longer in patients with physically strenuous occupations.44

Procedural complications of lumbar discectomy are less common than procedural complications of other types of spine surgery. A registry study indicated that an estimated 0.6 deaths per 1000 procedures had occurred at 60 days after the procedure.45 New or worsening neurologic deficits occur in 1 to 3% of patients, direct nerve-root injury occurs in 1 to 2%, and wound complications (e.g., infection, dehiscence, and seroma) occur in 1 to 2%.46 Incidental durotomy, which occurs in approximately 3% of patients, is associated with increases in the duration of surgery, blood loss during surgery, and the length of inpatient stay,47 as well as potential long-term effects such as headache. All tissues at the surgical site heal with some scarring, which contracts and binds nerves to surrounding structures. Normally, nerve roots glide a few millimeters in the neuroforamen with each walking step. Stretch of tethered nerves may be one source of chronic postsurgical pain.

Repeat operations, for a variety of reasons, occur in approximately 6% of patients after 1 year and in approximately 13% of patients after 4 years48; rates vary substantially according to the surgeon. Even after adjustment for patient demographic factors and coexisting conditions, rates of reoperation at 4 years in one state varied from 10% to 19%; this suggests variability in patient selection, quality of care, and surgical skill.48

### Areas of Uncertainty

Data from epidemiologic studies and biomechanical models suggest that lifestyle modifications such as smoking cessation, weight loss, and regular exercise may prevent sciatica or help to reduce its recurrence. However, we are unaware of relevant randomized trials. There is insufficient evidence to make a recommendation regarding acupuncture for sciatica.

An inflammatory component to lumbar radiculopathy has been recognized, and anticytokine therapy has been proposed. Limited clinical-trial data have been inconsistent, and this approach remains experimental.49

### Guidelines

A guideline from the American College of Physicians recommends the use of CT or MRI in patients without severe neurologic deficits only if they are candidates for surgery or epidural glucocorticoid injections after a 1-month trial of conservative therapy.20 An American Pain Society guideline recommends epidural glucocorticoid injections as an option for patients with persistent radiculopathy due to a herniated disk, with shared decision making and consideration of the inconsistent evidence, moderate short-term benefits, and lack of long-term benefits associated with this treatment. It similarly recommends shared decision making regarding surgery.50 The recommendations in this review are generally concordant with the guidelines of the American College of Physicians, the American Pain Society, and the North American Spine Society.59

### Conclusions and Recommendations

The patient described in the vignette presents with back and leg pain and a positive straight-leg-raising test that suggests a herniated disk. Patients should be reassured regarding the favorable prognosis of herniated disks with sciatica. Clinicians should avoid the use of frightening terms such as...
“ruptured disk” (which implies severe tissue damage) in favor of terms such as “protruded” disk.

Conservative therapy for 6 weeks, often including NSAIDs and exercise-based physical therapy, is appropriate for most patients in the absence of severe neurologic deficits, and we would recommend this approach for the patient described. The use of CT or MRI should be discouraged unless the symptoms do not decrease over 4 to 6 weeks and the patient is considered to be a
candidate for epidural glucocorticoid injections or surgery, at which point MRI would be the best test for diagnostic confirmation and surgical planning. Epidural glucocorticoid injections may offer temporary relief in patients with the most severe pain.

In patients with pain that persists beyond 6 weeks and symptoms, findings on examination, and MRI results that are congruent, surgery is an option. Patients and physicians should be engaged in shared decision making regarding surgery, with attention to potential risks and benefits. Patients should be informed that relief of leg pain will probably be faster with surgery than with conservative therapy, that later surgery remains an option if they continue to receive conservative care, and that by 1 year, outcomes of early surgery generally do not differ from those of prolonged conservative therapy.

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