TABLE 22-2 LUMBOSACRAL RADICULOPATHY: NEUROLOGIC FEATURES

Lumbosacral Nerve Roots	Examination Findings			Pain Distribution
	Reflex	Sensory	Motor	
L2[a]	—	Upper anterior thigh	Psoas (hip flexors)	Anterior thigh
L3[a]	—	Lower anterior thigh	Psoas (hip flexors)	Anterior thigh, knee
		Anterior knee	Quadriceps (knee extensors)	
			Thigh adductors	
L4[a]	Quadriceps (knee)	Medial calf	Quadriceps (knee extensors)[b]	Knee, medial calf
			Thigh adductors	Anterolateral thigh
L5[c]	—	Dorsal surface—foot	Peronei (foot evertors)[b]	Lateral calf, dorsal foot, posterolateral thigh, buttocks
		Lateral calf	Tibialis anterior (foot dorsiflexors)	
			Gluteus medius (hip abductors)	
			Toe dorsiflexors	
S1[c]	Gastrocnemius/soleus (ankle)	Plantar surface—foot	Gastrocnemius/soleus (foot plantar flexors)[b]	Bottom foot, posterior calf, posterior thigh, buttocks
		Lateral aspect—foot	Abductor hallucis (toe flexors)[b]	
			Gluteus maximus (hip extensors)	

[a]Reverse straight leg–raising sign present—see "Examination of the Back." [b]These muscles receive the majority of innervation from this root. [c]Straight leg–raising sign present—see "Examination of the Back."

vertebrae, bone fragments within the spinal canal, or misalignment. CT scans are increasingly used as a primary screening modality for moderate to severe acute trauma. Magnetic resonance imaging (MRI) or CT myelography is the radiologic test of choice for evaluation of most serious diseases involving the spine. MRI is superior for the definition of soft tissue structures, whereas CT myelography provides optimal imaging of the lateral recess of the spinal canal and is better tolerated by claustrophobic patients.

Annual population surveys in the United States suggest that patients with back pain have reported progressively worse functional limitations in recent years, rather than progressive improvements, despite rapid increases in spine imaging, opioid prescribing, injections, and spine surgery. This suggests that more selective use of diagnostic and treatment modalities may be appropriate.

Spine imaging often reveals abnormalities of dubious clinical relevance that may alarm clinicians and patients alike and prompt further testing and unnecessary therapy. Both randomized trials and observational studies have suggested such a "cascade effect" of imaging may create a gateway to other unnecessary care. Based in part on such evidence, the American College of Physicians has made parsimonious spine imaging a high priority in its "Choosing Wisely" campaign, aimed at reducing unnecessary care. Successful efforts to reduce unnecessary imaging have typically been multifaceted. Some include physician education by clinical leaders and computerized decision support, to identify any recent relevant imaging tests and require approved indications for ordering an imaging test. Other strategies have included audit and feedback regarding individual rates of ordering and indications, and more rapid access to physical therapy or consultation for patients without imaging indications.

When imaging tests are reported, it may be useful to indicate that certain degenerative findings are common in normal, pain-free individuals. In an observational study, this strategy was associated with lower rates of repeat imaging, opioid therapy, and physical therapy referral.

Electrodiagnostic studies can be used to assess the functional integrity of the peripheral nervous system (Chap. 442e). Sensory nerve conduction studies are normal when focal sensory loss confirmed by examination is due to nerve root damage because the nerve roots are proximal to the nerve cell bodies in the dorsal root ganglia. Injury to nerve tissue distal to the dorsal root ganglion (e.g., plexus or peripheral nerve) results in reduced sensory nerve signals. Needle EMG complements nerve conduction studies by detecting denervation or reinnervation changes in a myotomal (segmental) distribution. Multiple muscles supplied by different nerve roots and nerves are sampled; the pattern of muscle involvement indicates the nerve root(s) responsible for the injury. Needle EMG provides objective information about motor nerve fiber injury when clinical evaluation of weakness is limited by pain or poor effort. EMG and nerve conduction studies will be normal when sensory nerve root injury or irritation is the pain source.

CAUSES OF BACK PAIN

(Table 22-3)

LUMBAR DISK DISEASE

This is a common cause of acute, chronic, or recurrent low back and leg pain (Figs. 22-3 and 22-4). Disk disease is most likely to occur at the L4-L5 or L5-S1 levels, but upper lumbar levels are involved occasionally. The cause is often unknown, but the risk is increased in overweight individuals. Disk herniation is unusual prior to age 20 years and is rare in the fibrotic disks of the elderly. Complex genetic factors may play a role in predisposing some patients to disk disease. The pain may be located in the low back only or referred to a leg, buttock, or hip. A sneeze, cough, or trivial movement may cause the nucleus pulposus to prolapse, pushing the frayed and weakened annulus posteriorly. With severe disk disease, the nucleus may protrude through the annulus (herniation) or become extruded to lie as a free fragment in the spinal canal.

The mechanism by which intervertebral disk injury causes back pain is controversial. The inner annulus fibrosus and nucleus pulposus are normally devoid of innervation. Inflammation and production of proinflammatory cytokines within a ruptured nucleus pulposus may trigger or perpetuate back pain. Ingrowth of nociceptive (pain) nerve fibers into inner portions of a diseased disk may be responsible for some chronic "diskogenic" pain. Nerve root injury (radiculopathy) from disk herniation is usually due to inflammation, but lateral herniation may produce compression in the lateral recess or at the intervertebral foramen.

A ruptured disk may be asymptomatic or cause back pain, abnormal posture, limitation of spine motion (particularly flexion), a focal neurologic deficit, or radicular pain. A dermatomal pattern of sensory loss or a reduced or absent deep tendon reflex is more suggestive of a specific root lesion than is the pattern of pain. Motor findings (focal weakness, muscle atrophy, or fasciculations) occur less frequently than focal sensory or reflex changes. Symptoms and signs are usually unilateral, but bilateral involvement does occur with large central disk herniations that compress multiple roots or cause inflammation of