Primary Care

Low Back Pain

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ABOUT two thirds of adults suffer from low back pain at some time. Low back pain is second to upper respiratory problems as a symptom-related reason for visits to a physician.[1,2] There are wide variations in care, a fact that suggests there is professional uncertainty about the optimal approach.[3,4] In addition, there is evidence of excessive imaging and surgery for low back pain in the United States,[5-8] and many experts believe the problem has been "overmedicalized."[9-11] In recent years, magnetic resonance imaging (MRI) has come to be widely used, the roles of exercise and bed rest have been clarified, and more information has been gained from clinical trials.

CAUSES AND EPIDEMIOLOGIC PATTERNS

Experimental studies suggest that low back pain may originate from many spinal structures, including ligaments, facet joints, the vertebral periosteum, the paravertebral musculature and fascia, blood vessels, the anulus fibrosus, and spinal nerve roots. Perhaps most common are musculoligamentous injuries and age-related degenerative processes in the intervertebral disks and facet joints. Other common problems include spinal stenosis and disk herniation. Stenosis is narrowing of the central spinal canal or its lateral recesses, typically from hypertrophic degenerative changes in spinal structures (Fig. 1). Table 1 provides a broad differential diagnosis for low back pain, with estimates of prevalence in office practice.[2,12-14]

Perhaps 85 percent of patients with isolated low back pain cannot be given a precise pathoanatomical diagnosis. The association between symptoms and imaging results is weak.[15] Thus, nonspecific terms, such as strain, sprain, or degenerative processes, are commonly used.[2,13] Strain and sprain have never been anatomically or histologically characterized, and patients given these diagnoses might accurately be said to have idiopathic low back pain.

Low back pain affects men and women equally, with onset most often between the ages of 30 and 50 years. It is the most common cause of work-related disability in people under 45 years of age and the most expensive cause of work-related disability, in terms of workers' compensation and medical expenses.[1] Risk factors include heavy lifting and twisting, bodily vibration, obesity, and poor conditioning, although low back pain is common even in people without these risk factors.[16]

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DIAGNOSTIC EVALUATION

Because a precise anatomical diagnosis is elusive, diagnostic evaluation is often frustrating for both physicians and patients. Rather than perform an exhaustive search, it is generally more useful to address three questions: Is a systemic disease causing the pain? Is there social or psychological distress that may amplify or prolong the pain? Is there neurologic compromise that may require surgical evaluation? For most patients, these questions can be answered from a careful history taking and physical examination, and imaging is often unnecessary.[13]

Medical History

Clues to underlying systemic disease include the patient's age; a history of cancer, unexplained weight loss, injection-drug use, or chronic infection; the duration of pain; the presence of nighttime pain; and the response to previous therapy. In many patients whose low back pain is due to infection or cancer, the pain is not relieved when the patient lies down. However, this finding is not specific for the presence of these conditions. Inflammatory spondyloarthropathy is most common in men under 40 years of age, but clinical and demographic characteristics have limited accuracy.[13,17,18] Inflammatory arthritis of the hips or knees increases the likelihood of spondylitis.[17]

Neurologic involvement is usually suggested by the presence of sciatica or pseudoclaudication (leg pain after walking that mimics ischemic claudication). The leg pain of sciatica or pseudoclaudication is often associated with numbness or paresthesia, and sciatica due to disk herniation typically increases with cough, sneezing, or performance of the Valsalva maneuver. Bowel or bladder dysfunction may be a symptom of severe compression of the cauda equina (cauda equina syndrome). This rare condition is usually caused by a tumor or a massive midline disk herniation. Urinary retention with overflow incontinence is usually present, often in association with sensory loss in a saddle distribution, bilateral sciatica, and leg weakness.[13] Prolonged back pain may be associated with the failure of previous treatment, depression, and somatization. Substance abuse, job dissatisfaction, pursuit of disability compensation, and involvement in litigation may also be associated with persistent unexplained symptoms.[1,19-21]

Physical Examination

Fever suggests the possibility of spinal infection. Vertebral tenderness has sensitivity for infection but not specificity. The finding of soft-tissue tenderness is not reproducible from one examiner to another. Lim-

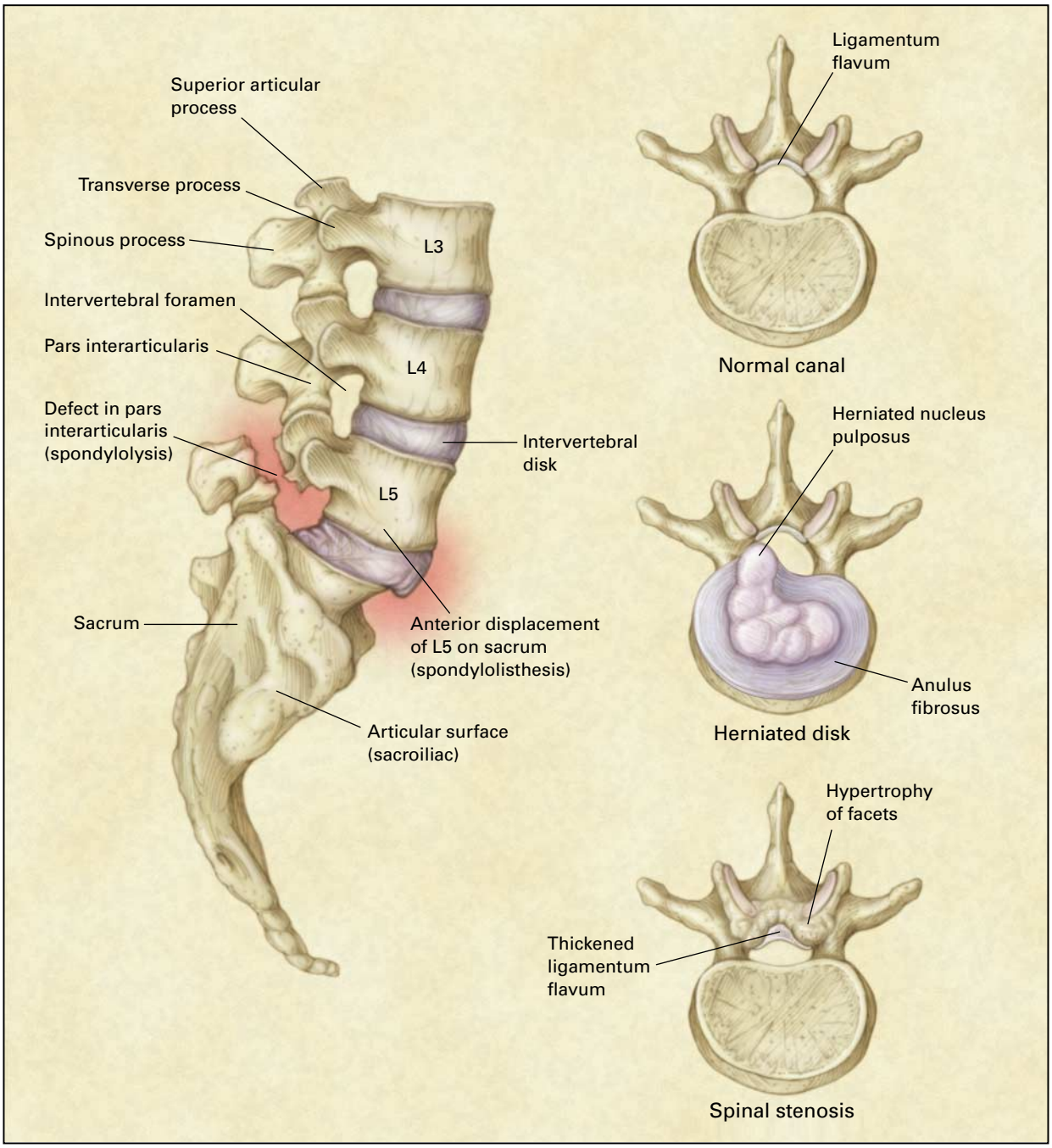

Figure 1. Common Pathoanatomical Conditions of the Lumbar Spine.

A superior view of a lumbar vertebra with normal anatomy and canal configuration is shown in the upper right. In the superior view of a lumbar vertebra and intervertebral disk (center right), herniation of the nucleus pulposus into the spinal canal is evident. The nucleus pulposus has a soft consistency, at least from childhood to middle age, and may protrude through confluent fissures in the anulus fibrosus. This usually occurs in the lateral part of the spinal canal, as shown. The usual abnormalities that result in spinal stenosis (lower right) include hypertrophic degenerative changes of the facets and thickening of the ligamentum flavum. These processes may result in a severely narrowed canal, either centrally or in the lateral recesses of the canal. A lateral view of the lumbosacral spine, illustrating spondylolysis of the L5 vertebra with associated spondylolisthesis at L5–S1, is shown on the left. Spondylolysis refers to a defect in the pars interarticularis of the vertebra, which may be congenital or a result of stress fracture. Spondylolisthesis refers to the anterior displacement of a vertebra on the one beneath it. This may occur as a result of spondylolysis as shown (called isthmic spondylolisthesis) or as a result of degenerative disk disease, usually in the elderly. This process may contribute to narrowing of the spinal canal in spinal stenosis.

TABLE 1. DIFFERENTIAL DIAGNOSIS OF LOW BACK PAIN.*

MECHANICAL LOW BACK OR LEG PAIN (97%)†	NONMECHANICAL SPINAL CONDITIONS (ABOUT 1%)‡	VISCERAL DISEASE (2%)
Lumbar strain, sprain (70%)§	Neoplasia (0.7%)	Disease of pelvic organs
Degenerative processes of disks and facets, usually age-related (10%)	Multiple myeloma	Prostatitis
Herniated disk (4%)	Metastatic carcinoma	Endometriosis
Spinal stenosis (3%)	Lymphoma and leukemia	Chronic pelvic inflammatory disease
Osteoporotic compression fracture (4%)	Spinal cord tumors	Renal disease
Spondylolisthesis (2%)	Retroperitoneal tumors	Nephrolithiasis
Traumatic fracture (<1%)	Primary vertebral tumors	Pyelonephritis
Congenital disease (<1%)	Infection (0.01%)	Perinephric abscess
Severe kyphosis	Osteomyelitis	Aortic aneurysm
Severe scoliosis	Septic diskitis	Gastrointestinal disease
Transitional vertebrae	Paraspinous abscess	Pancreatitis
Spondylolysis¶	Epidural abscess	Cholecystitis
Internal disk disruption or diskogenic low back pain‖	*Shingles*	Penetrating ulcer
Presumed instability**	Inflammatory arthritis (often associated with HLA-B27) (0.3%)	
	Ankylosing spondylitis	
	Psoriatic spondylitis	
	Reiter's syndrome	
	Inflammatory bowel disease	
	Scheuermann's disease (osteochondrosis)	
	Paget's disease of bone	

*Figures in parentheses indicate the estimated percentages of patients with these conditions among all adult patients with low back pain in primary care. Diagnoses in italics are often associated with neurogenic leg pain. Percentages may vary substantially according to demographic characteristics or referral patterns in a practice. For example, spinal stenosis and osteoporosis will be more common among geriatric patients, spinal infection among injection-drug users, and so forth. Data are adapted from Hart et al.,[2] Deyo,[12] Deyo et al.,[13] and Deyo and Diehl.[14]

†The term "mechanical" is used here to designate an anatomical or functional abnormality without an underlying malignant, neoplastic, or inflammatory disease. Approximately 2 percent of cases of mechanical low back or leg pain are accounted for by spondylolysis, internal disk disruption or diskogenic low back pain, and presumed instability.

‡Scheuermann's disease and Paget's disease of bone probably account for less than 0.01 percent of nonmechanical spinal conditions.

§"Strain" and "sprain" are nonspecific terms with no pathoanatomical confirmation. "Idiopathic low back pain" may be a preferable term.

¶Spondylolysis is as common among asymptomatic persons as among those with low back pain, so its role in causing low back pain remains ambiguous.

‖Internal disk disruption is diagnosed by provocative diskography (injection of contrast material into a degenerated disk, with assessment of pain at the time of injection). However, diskography often causes pain in asymptomatic adults, and the condition of many patients with positive diskograms improves spontaneously. Thus, the clinical importance and appropriate management of this condition remain unclear. "Diskogenic low back pain" is used more or less synonymously with "internal disk disruption."

**Presumed instability is loosely defined as greater than 10 degrees of angulation or 4 mm of vertebral displacement on lateral flexion and extension radiograms. However, the diagnostic criteria, natural history, and surgical indications remain controversial.

ited spinal motion is not strongly associated with any specific diagnosis, but this finding may help in planning or monitoring physical therapy.[13] Chest expansion of less than 2.5 cm has specificity, but not sensitivity, for ankylosing spondylitis.[17]

Among patients with sciatica or pseudoclaudication, a straight-leg–raising test should be performed, with the patient supine and the examiner's hand holding the leg straight and cupping the heel with the other hand. However, the test is often negative in patients with spinal stenosis. An elevation of less than 60 degrees is abnormal, suggesting compression or irritation of the nerve roots. A positive test reproduces the symptoms of sciatica, with pain that radiates below the knee, not merely back or hamstring pain. Ipsilateral straight-leg raising has sensitivity but not specificity for a herniated disk, whereas crossed straight-leg raising (with the symptoms of sciatica reproduced when the opposite leg is raised) is insensitive but highly specific.[13,22] The remainder of the neurologic examination should focus on ankle and great-toe dorsiflexion strength (the L5 nerve root), plantar flexion strength (S1), ankle and knee reflexes (S1 and L4), and dermatomal sensory loss. The L5 and S1 nerve roots are involved in approximately 95 percent of lumbar-disk herniations.[12,13]

Imaging

Plain radiography should be limited to patients with clinical findings suggestive of systemic disease or trauma. Guidelines recommend plain radiography for pa-

tients with fever, unexplained weight loss, a history of cancer, neurologic deficits, alcohol or injection-drug abuse, an age of more than 50 years, or trauma.[23] Strict adherence to these criteria might increase the use of plain radiographs,[24,25] and some observers therefore argue for further refinement of the criteria. Failure of the pain to improve after four to six weeks should prompt radiography, because improvement occurs in most patients in the absence of infection, cancer, or inflammatory disease.[23] Plain radiography is not highly sensitive for early cancer or infection, and therefore ancillary tests, such as measurement of the erythrocyte sedimentation rate and a complete blood count, may help rule out systemic diseases.[14]

Computed tomography (CT) and MRI are more sensitive than plain radiography for the detection of early spinal infections and cancers. These imaging techniques also reveal herniated disks and spinal stenosis, which plain radiography cannot. Early or frequent use of these tests is discouraged, however, because disk and other abnormalities are common among asymptomatic adults (Table 2).[26-29] Degenerated, bulging, and herniated disks are frequently incidental findings, even among patients with low back pain, and may be misleading. Incidental findings may lead to overdiagnosis, anxiety on the part of patients, dependence on medical care, a conviction about the presence of disease, and unnecessary tests or treatments. CT and MRI should be reserved for patients for whom there is a strong clinical suggestion of underlying infection, cancer, or persistent neurologic deficit. These tests have similar accuracy in detecting herniated disks and spinal stenosis,[30] but MRI is more sensitive for infections, metastatic cancer, and rare neural tumors. These tests have largely supplanted myelography, although CT myelography is sometimes performed for the planning of surgery.

Evaluation of Older Adults

Among patients over 65 years of age, the diagnostic probabilities shown in Table 1 change. Cancer, compression fractures, spinal stenosis, and aortic aneurysms become more common. Osteoporotic fractures may occur even in the absence of recognized trauma. Because hormone-replacement therapy and other medications may prevent further fractures, early radiography is recommended for older patients.

Spinal stenosis due to hypertrophic degenerative processes and degenerative spondylolisthesis is more common in older than in younger adults. Pseudoclaudication is the classic symptom of central-canal stenosis. The symptoms of stenosis are often diffuse, because the disease usually is bilateral and involves several vertebrae.[31] Pain, numbness, and tingling may occur in one or both legs. The symptoms are usually relieved by spinal flexion, so that patients report less pain when they are sitting[32] or pushing a grocery cart. Pain is often increased by extension of the lumbar spine.[32,33] The diagnosis can usually be made on the basis of CT or MRI, although electromyography or measurement of somatosensory evoked potentials may help define the extent of neurologic involvement[31,33] and differentiate this condition from peripheral neuropathy.

Aortic aneurysm should be suspected among older adults with coronary artery disease or multiple risk factors. Some aneurysms are detected by physical examination, although ultrasonography, CT, or MRI is often necessary.

NATURAL HISTORY

Recovery from nonspecific low back pain is generally rapid. In one study, 90 percent of patients seen within three days of onset recovered within two weeks.[20] However, in cross-sectional studies, which oversample patients with multiple visits, the progno-

TABLE 2. REPRESENTATIVE RESULTS OF MAGNETIC RESONANCE IMAGING STUDIES IN ASYMPTOMATIC ADULTS.*

STUDY	SUBJECTS	ANATOMICAL FINDINGS				
		HERNIATED DISK	BULGING DISK	DEGENERATIVE DISK	STENOSIS	ANNULAR TEAR
		prevalence (%)				
Boden et al.[26]	Volunteers <60 yr old	22	54	46	1	NR
	Volunteers ≥60 yr old	36	79	93	21	NR
Jensen et al.[27]	Volunteers (mean age, 42 yr)	28	52	NR	7	14
Weishaupt et al.[28]	Volunteers (mean age, 35 yr)	40	24	72	NR	33
Stadnik et al.[29]	Patients referred for head or neck imaging (median age, 42 yr)	33	81	72	NR	56

*NR denotes not reported.

sis is less favorable. These studies may best reflect the experience of primary care physicians. They suggest that a third of patients are substantially improved at one week and two thirds at seven weeks.[21,34] Recurrences are common, affecting 40 percent of patients within six months.[35] Most recurrences are not disabling, but the emerging picture is that of a chronic problem with intermittent exacerbations, analogous to asthma, rather than an acute disease that can be cured.

The natural history of herniated disks is also favorable. Improvement is the norm, although it is often slower than improvement in low back pain alone. Only about 10 percent of patients have sufficient pain after six weeks that surgery is considered. Sequential MRI studies reveal that the herniated portion of the disk tends to regress with time, with partial or complete resolution in two thirds of cases after six months.[36,37]

In contrast, spinal stenosis usually remains stable or gradually worsens. In this indolent condition, symptoms evolve gradually. About 15 percent of patients improve over a period of four years, 70 percent remain stable, and 15 percent have deterioration.[38]

Return to work after an episode of low back pain is influenced by clinical, social, and economic factors. Low back pain is rarely permanently disabling. Patients with herniated disks who undergo surgery do not return to work earlier than those who receive nonsurgical therapy, although they have better symptomatic and functional outcomes.[19]

THERAPY

Nonspecific Low Back Pain

There are few large, randomized trials of therapy for nonspecific low back pain. Recommendations have been derived from small studies of variable methodologic quality.[23,39] Nonsteroidal antiinflammatory drugs (NSAIDs) are effective for symptom relief, as are some muscle relaxants. Clinical trials do not clearly identify which patients benefit from muscle relaxants, and side effects, especially sedation, are common. In general, medication for symptomatic relief should be prescribed on a regular schedule rather than on an as-needed basis.[40] Spinal manipulation and physical therapy are alternative treatments for symptomatic relief among patients with acute or subacute low back pain, but their effects are limited.[41,42] In general, we recommend delaying referral for manipulation or physical therapy until an episode of pain has persisted for three weeks, because half of the patients spontaneously improve within this period.[21] For most patients, the best recommendation is a rapid return to normal activities, with neither bed rest nor exercise in the acute phase.[43-45] This recommendation must be tempered by consideration of the patient's usual job or life demands. Heavy lifting, trunk twisting, and bodily vibration should be avoided in the acute phase.

Several common treatments have not been found effective in randomized trials. Bed rest does not increase the speed of recovery from acute low back pain and sometimes delays recovery.[43-45] If a patient obtains symptomatic relief from bed rest, it can be recommended for a day or two, with reassurance that it is safe to get out of bed even if pain persists. Back exercises are also not helpful in the acute phase, although they are useful later for preventing recurrences and for treating chronic low back pain.[39,45-47] Conventional traction, facet-joint injections, and transcutaneous electrical nerve stimulation appear ineffective or minimally effective in randomized trials.[48-50]

The most popular alternative therapies for low back pain are spinal manipulation, acupuncture, and massage.[51] Although clinical trials suggest that spinal manipulation has some efficacy, systematic reviews have found little support for acupuncture.[41,42,52] Massage has rarely been studied, but promising preliminary results of clinical trials suggest that research on massage therapy should be assigned a high priority.[53,54] There is no evidence from clinical trials or cohort studies that surgery is effective for patients who have low back pain unless they have sciatica, pseudoclaudication, or spondylolisthesis.[55]

Herniated Intervertebral Disks

In the absence of the cauda equina syndrome or progressive neurologic deficit, patients with suspected disk herniation should be treated nonsurgically for at least a month. Early treatment resembles that for nonspecific low back pain, although the safety and efficacy of spinal manipulation remain unclear. Narcotic analgesics may be necessary for pain relief, but they should be used only for limited periods. Bed rest does not accelerate recovery.[56] Epidural corticosteroid injections offer temporary symptomatic relief for some patients.[57] If severe pain or neurologic deficits persist, CT or MRI and consideration of surgery are appropriate (Table 3).

Diskectomy produced better pain relief than nonsurgical treatment over a period of 4 years, but it is unclear whether there is any advantage after 10 years.[55,58,59] The effectiveness of microdiskectomy, which is performed through a small incision with the aid of magnifying lenses, is similar to that of standard diskectomy, but two newer techniques, automated percutaneous diskectomy and laser diskectomy, are less effective than standard diskectomy.[55] For selected patients, arthroscopic diskectomy is promising, and its effectiveness may be similar to that of standard diskectomy.[60]

Spinal Stenosis

Evidence regarding nonsurgical therapy for spinal stenosis is sparse. Avoidance of alcohol and sedatives and strengthening of the legs may reduce the risk of falls. Use of an exercise bicycle or walking is recommended, with brief rest when pain occurs.[33] Analge-

TABLE 3. INDICATIONS FOR SURGICAL REFERRAL AMONG PATIENTS WITH LOW BACK PAIN.

SCIATICA AND PROBABLE HERNIATED DISKS
The cauda equina syndrome (surgical emergency): characterized by bowel or bladder dysfunction (usually urinary retention), numbness in the perineum and medial thighs (i.e., in a saddle distribution), bilateral leg pain, weakness, and numbness
Progressive or severe neurologic deficit
Persistent neuromotor deficit after 4–6 weeks of nonoperative therapy
Persistent sciatica (not low back pain alone) for 4–6 weeks, with consistent clinical and neurologic findings (in this circumstance, and for persistent neuromotor deficit, surgery is elective, and patients should be involved in decision making)
SPINAL STENOSIS
Progressive or severe neurologic deficit, as for herniated disks
Back and leg pain that is persistent and disabling, improves with spine flexion, and is associated with spinal stenosis on imaging tests; surgery is elective, and patients should be involved in decision making
SPONDYLOLISTHESIS
Progressive or severe neurologic deficit, as for herniated disks
Spinal stenosis with referral indications as above
Severe back pain or sciatica with severe functional impairment that persists for a year or longer

sics, NSAIDs, physical therapy, and epidural corticosteroids may be useful, although there are no data from clinical trials. For persistent severe pain, decompressive laminectomy is an option. If degenerative spondylolisthesis contributes to the stenosis, adding spinal fusion to decompression may improve the outcomes over those with decompression alone.[55,61] Cohort studies suggest that surgery results in better pain relief and functional recovery than nonsurgical treatment, at least for a few years.[62,63] Even with successful surgery, symptoms often recur after several years. At four years of postoperative follow-up, about 30 percent of patients have severe pain and about 10 percent have undergone reoperation.[63,64]

Chronic Low Back Pain

Many patients with chronic low back pain have no radiculopathy or anatomical abnormalities that clearly explain their symptoms. Recent evidence of neuroplasticity suggests that central nervous system changes — including neuronal hyperactivity, changes in membrane excitability, and expression of new genes — may perpetuate the perception of pain in the absence of ongoing tissue injury.[65]

Intensive exercise reduces pain and improves function in patients with chronic low back pain.[39,66,67] However, maintaining adherence to the sort of exercise regimen that is required for long-term benefits is often difficult. Antidepressant-drug therapy is useful for the one third of patients with low back pain who also have depression. There is conflicting evidence regarding patients without clinical depression.[68,69] Tricyclic antidepressants may be more effective for treating pain in patients without depression than selective serotonin-reuptake inhibitors.[70] Long-term opioid therapy for patients with persistent pain has been proposed, and a small, randomized trial showed that opioids have a greater effect on pain and mood than NSAIDs. However, opioids did not improve activity levels, and in a third of subjects they caused side effects such as drowsiness, headache, constipation, and nausea.[71] Until further evidence of their safety and efficacy is available from clinical trials, we do not advocate the long-term use of opioids.

Referral to a multidisciplinary pain center may be appropriate for some patients with chronic low back pain. Such centers typically combine cognitive–behavioral therapy, patient education, supervised exercise, selective nerve blocks, and other strategies to restore functioning. Complete relief of symptoms may be unrealistic, and therapeutic goals may need to be refocused on optimizing daily function. Multiple surgical procedures are rarely helpful.

PREVENTION

Exercise programs that combine aerobic conditioning with specific strengthening of the back and legs can reduce the frequency of recurrence of low back pain.[46] The use of corsets and education about lifting technique are generally ineffective in preventing low back problems.[46,72,73] Epidemiologic studies suggest that weight loss and smoking cessation may have preventive value, but no intervention trials involving these approaches have been conducted. There are, of course, other compelling reasons to recommend weight loss and smoking cessation. Ergonomic redesign of strenuous job tasks may facilitate return to work and reduce the chronic nature of pain.[74]

CONCLUSIONS

For patients with nonspecific low back pain, a precise pathoanatomical diagnosis is often impossible, which leads to various imprecise diagnoses (e.g., sprain or strain). The natural history of low back pain is favorable, and patients need this reassurance. The favorable natural history may partly explain the proliferation of unproved treatments that may seem to be effective. The use of plain radiography can be limited to patients with clinical findings suggestive of underlying systemic disease, and more advanced imaging can be reserved for potential candidates for surgery. The role of imaging in other situations is limited because of the poor association between symptoms and anatomical findings. Bed rest is not recommended for the treatment of low back pain or sciatica, and a rapid return to normal activities is usually the best course. Back exercises are not useful for the acute phase but help to prevent recurrences and treat chronic pain. Surgery is appropriate for a small proportion of patients with low back symptoms; it is most successful for those

with sciatica or pseudoclaudication that persists after nonsurgical therapy has been tried.

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