Failed Back Surgery Syndrome: Diagnostic Evaluation

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Abstract

Failed back surgery syndrome is a common problem with enormous costs to patients, insurers, and society. The etiology of failed back surgery can be poor patient selection, incorrect diagnosis, suboptimal selection of surgery, poor technique, failure to achieve surgical goals, and/or recurrent pathology. Successful intervention in this difficult patient population requires a detailed history, precise physical examination, and carefully chosen diagnostic tests. The diagnostic evaluation should endeavor to accurately identify symptoms, rule out extraspinal causes, identify a specific spinal etiology, and assess the psychological state of the patient. Only after these factors have been assessed can further treatment be planned.

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Failed back surgery syndrome (FBSS) is a common condition that may arise from several identifiable causes related to the initial surgery, including poor patient selection, mismatch of the procedure with patient pathology, unrealistic expectations, failure of the procedure to achieve its goals (eg, union), and iatrogenic complications. FBSS may also arise from new sources of pain that may or may not be related to the initial surgery.

Some of the more common types of FBSS present as unresolved symptoms or new onset of symptoms following lumbar diskectomy, spinal stenosis decompression, or fusion. The initial step is to attempt to resolve the patient's symptomatology and to meticulously reassess the patient. Appropriate history, physical examination, and radiographic and neurodiagnostic evaluation may delineate a potential source and guide treatment selection.

Etiology of Failed Back Surgery

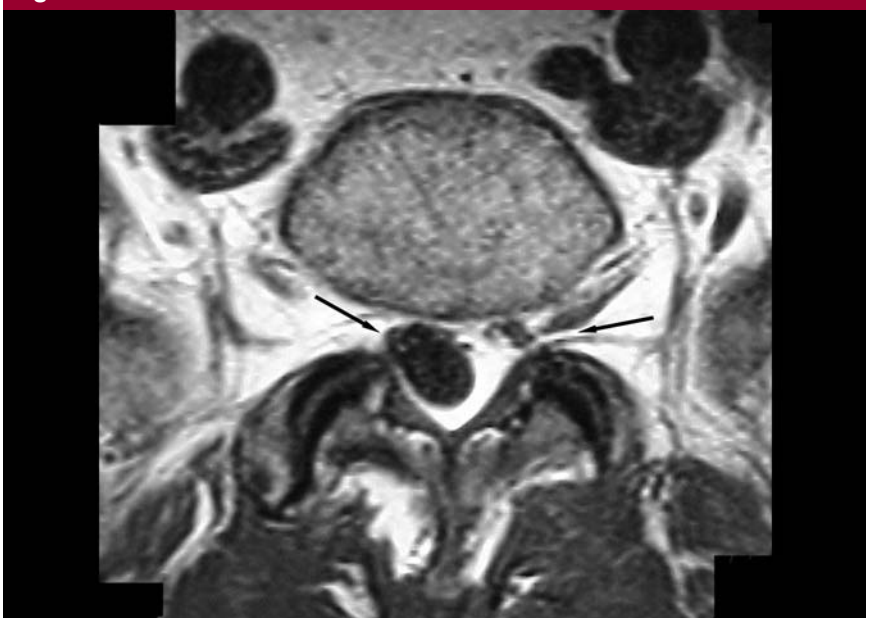
The several common identifiable causes of failure of back surgery to reduce preoperative symptoms include poor patient selection, incorrect diagnosis, wrong procedure, poor technique, failure to achieve surgical goals, and progressive disease (Table 1). Some overlap exists in these categories. In some patients, determination of the cause of ongoing complaints or a new symptom that arises after surgery may be difficult. Familiarity with the potential sources of symptoms in the patient with failed back surgery can help direct appropriate diagnostic evaluation and treatment. In assessing the patient with FBSS, making a correct diagnosis is of critical importance before initiating further treatment. Further surgery based on incomplete or inaccurate diagnosis will compound the patient's problem.

Table 1

Etiology of Failed Back Surgery

- Poor patient selection
  - Abnormal psychometrics
  - Chronic pain behavior
  - Unreachable expectations
  - Incorrect diagnosis
- Wrong procedure
  - Wrong level
  - Missed spinal stenosis
- Poor technique
  - Battered root syndrome
  - Iatrogenic instability
  - Residual deformity
- Failure to achieve goal of surgery
  - Pseudarthrosis
  - Incomplete decompression
  - Incomplete correction of deformity
- Progressive disease
  - Recurrent disk herniation or spinal stenosis
  - Transition syndrome

Figure 1



Axial T1-weighted magnetic resonance image demonstrating a conjoined left L5 root (left arrow) and right S1 root (right arrow).

Poor Patient Selection

The most common cause of failed back surgery is likely poor patient selection, which may be related to intrinsic psychological factors. Several studies have reported that psychological disturbances that are documented on the Minnesota Multiphasic Personality Inventory (MMPI) can be related to poor outcomes after spine surgery.[1-3] The most predictive components are elevation of hysteria, hypochondriasis, and depression scales. Poor results are more frequent in patients who exhibit abnormal pain behavior, have clinical depression or anxiety,[4-6] or receive worker's compensation or are involved in litigation.[7-9] The influence and extent of impact of each of these factors on outcome is poorly understood, however. To help predict outcomes, a comprehensive evaluation incorporating a variety of medical and psychosocial risk factors has been developed. Block et al[10] reported that their quantitative analysis of psychological factors is predictive of spine surgery outcome in 82% of patients.

Incorrect or Incomplete Diagnosis

A potential cause of a poor outcome is a misdiagnosed or overlooked element of intraspinal pathology. The pain may be incorrectly attributed to radiologic evidence of degenerative or age-related changes, such as disk herniation, spondylolysis, or spondylolisthesis, which may be asymptomatic. The physician must carefully correlate patient symptoms with the physical examination and imaging studies. When these are discordant, the chance of failure is markedly increased. For instance, failure to diagnose a painful degenerated segment (a transitional segment) above or below an area to be fused will result in continued pain following surgery. Missed diagnosis of a conjoined nerve root (Figure 1) or far lateral herniation will result in a failure to relieve leg pain after the index operation. Failure to diagnose and address foraminal or lateral recess stenosis in a patient with central stenosis is not uncommon and may result in continued radicular pain.

Wrong Surgical Procedure

The most common type of error in spinal surgery is wrong-level diskectomy. Failure to correctly identify the level of stenosis or incorporating the wrong levels in a fusion are other examples of error. The Joint Accreditation Commission on Healthcare Organizations mandates that all institutions have a program to prevent wrong-site surgery. The North American Spine Society has an accepted paradigm for correct site spine surgery that includes using intraoperative radiologic localization in almost all cases.[11]

Another example of incorrect procedure is selecting an operation that inadequately addresses all of the patient's symptomatic pathology. Decompression of only one level is generally inadequate in a patient with

Table 2

Classification of Failed Back Surgeries

Temporal factors
Early (no improvement)
Intermediate (1-6 mos)
Late (>6 mos)
Index surgical procedure
Diskectomy
Spinal stenosis decompression
Fusion
Deformity correction
Pain location
Spine (lower back)
Lower extremity
Widespread

multiple pain origins, such as foraminal stenosis as well as a herniated disk, or multiple levels of spinal stenosis. Another example of selecting a less-than-optimal procedure is performing a posterior fusion to address discogenic pain. These patients often have good results after revision anterior interbody fusion.[12,13]

Poor Technique

Even with correctly identified pathology and an appropriately selected procedure, the result will be poor if the surgery is incompletely or inappropriately executed (eg, incomplete decompression, creation of iatrogenic instability). Additional examples are failure to adequately place or recess a transforaminal lumbar interbody fusion or posterior lumbar interbody fusion graft so that it impinges on neural structures. Inappropriate pedicle screw placement may result in neural impingement and radiculopathy. Complications must be diagnosed in a timely fashion and adequately treated.

Failure to Achieve the Goal of Surgery

Failed spine surgery occurs when the goals of surgery are not completely achieved. The patient with instability or degeneration who requires a fusion for relief of symptoms may have acceptable relief of pain but experience recurrence with a symptomatic pseudarthrosis. Similarly, the patient with both a pseudarthrosis and a flat back may have persistent symptoms with incomplete correction of the flat back.

Progressive Disease

Recurrence of symptoms may be caused by an ongoing degenerative process or accelerated by alterations in spinal biomechanics created by prior surgery. Recurrent disk herniations occur in 5% to 15% of patients;[14] almost half occur at a new level or on the contralateral side. The nerve roots may become tethered because of scarring and thus become less able to adapt to facet hypertrophy or other degenerative changes. Stability of a fused segment will increase load onto the adjacent segments and accelerate disk degeneration in a process called "transition syndrome."[15,16] This syndrome occurs within 10 years in up to 25% of patients who undergo anterior cervical fusion.[15] In one lumbar spine study with a mean 5-year follow-up, 31 of 83 patients (36%) had radiographic evidence of adjacent segment degeneration.[16] A similar process may occur with time at the sacroiliac joint after lumbar fusion with degeneration extended to the sacrum. In addition to the possibility of disk changes, stenosis and/or instability may develop at the adjacent segments.

Classification of Patients With Failed Back Surgery

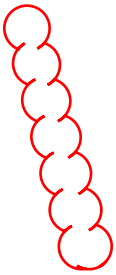
There is no accepted classification for failed back surgery. Identification of several key items may be helpful, such as the length of time between surgery and the onset of pain (Table 2). Onset is considered immediate or early when pain or symptoms either present immediately following surgery or recur within 2 to 3 weeks; intermediate when pain recurs or new symptoms occur approximately 1 to 6 months after surgery; and late when the patient has experienced at least 6 months of acceptable pain relief. Additional factors in classifying failed surgery include the type of index spinal surgery performed and the location of the pain.

Temporal Factors

No Relief or Early Onset of New Symptoms

Following surgery, the patient should experience some improvement in pain even though complete initial relief postoperatively is not anticipated. When no change in symptoms is reported, the surgeon must consider that the symptomatic pathology was not addressed and that wrong-level surgery or the wrong procedure was performed. Another possible reason for lack of immediate improvement is that the procedure did not adequately address the patient's pathology. The most likely causes are inadequate removal of an extruded disk fragment, incomplete decompression, and failure to address pathology at an adjacent segment. Similarly, failure to identify all of the causes of the patient's symptoms may result in immediate failure. For example, a patient may have continued pain if treatment of L5-S1 spondylolisthesis did not address pain arising from the L4-5 adjacent disk. Partial pain relief may be related to incomplete diagnostic workup and/or a procedure that only partially addressed the symptom-producing pathology.

Severe leg pain or temperature differences in the extremities immediately after surgery warrant special attention. This may arise from vascular occlusion or injury or from compartment syndrome. When pulses are not palpable, a Doppler examination of the extremities should be performed. When none of the above are abnormal, then nerve root injury should be considered. If pedicle screws or fusion cages have been in-



serted, their position should be assessed. Imaging in patients with metallic implants can be difficult to interpret because of artifact. In these patients, computed tomography (CT) myelography is helpful in identifying compression of the thecal sac or nerve roots. In the case of fusion cages or interbody bone graft, severe radicular pain can be caused by disk tissue displaced by the interbody implants compressing the nerve roots. In such cases, early reintervention is indicated to address the offending implant or disk tissue.

Another cause of persistent leg pain may be the stretching of the nerve roots during placement of interbody devices. When direct compression of the nerve roots has been ruled out, this may be the most likely cause of the radicular pain. Typically, it resolves over the course of several weeks to months, and reintervention is not indicated.

Subacute Onset of Pain

During the intermediate postoperative period (4 weeks to 6 months), some patients do well initially and then report a recurrence of pain or the onset of new symptoms. The location and character of the current pain should be assessed in relation to the symptoms for which surgery was performed. The surgeon also must determine whether the symptoms are related to a specific event or developed gradually. It is not unusual for patients to report some new pain as they begin an active postoperative rehabilitation program. Generally, this can be addressed with anti-inflammatory medication and/or reduced activity, followed by a slower progression to more advanced activities. Of greater concern are severe symptoms that develop suddenly, particularly after a fall or trauma. Such symptoms may be related to recurrent disk herniation, or hardware or graft failure or displacement. Iatrogenic causes, such as symptoms from instability, may develop during this postoperative phase.

Late Postoperative Pain

Some patients have an acceptable result for up to 6 months postoperatively before pain redevelops. The most likely cause is recurrent pathology at the same or adjacent segments. In patients who have undergone fusion, a nonunion may become symptomatic during this time. Not infrequently, increasing pain develops following completion of rehabilitation and permission to return to work.

Index Surgical Procedure

Diskectomy

Microdiskectomy yields good results in 70% of properly selected patients.[17] In the remaining patients, persistent or recurrent pain may be related to neurologic compression that was not reversed by surgery, an incomplete diskectomy or retained disk fragments, recurrent disk herniation, or changes related to altered biomechanics of the operated segment. For patients with significant pain after diskectomy, stratification into early or late failures is useful to the surgeon in determining the etiology of the pain. Early failure can point to poor patient selection, such as psychosocial factors, incorrect diagnosis, the wrong procedure, or occult infection. The onset of pain following a good surgical result may be indicative of a recurrent disk herniation, instability of the operated segment, or disease at a different disk level.

A subset of patients following diskectomy experience partial relief with varying degrees of persistent pain. This may be the case in patients who had surgery for a long-standing compression of a nerve root that resulted in chronic intrinsic neuropathy.

Lumbar Stenosis Decompression

As with patients who underwent previous diskectomy surgery, classification of lumbar stenosis by timing of symptom onset and predominant location of pain is useful. The patient who remains symptomatic after stenosis decompression, with little or no immediate relief of leg symptoms, may not have been adequately decompressed, or the pain may be arising from another source. This pain can be caused by wrong-level surgery, failure to diagnose and decompress the lateral recess or foraminal stenosis, or failure to diagnose and decompress additional locations of stenosis. Early return of similar radicular and low back symptoms may represent either failure to diagnose preexisting instability or the development of iatrogenic instability.

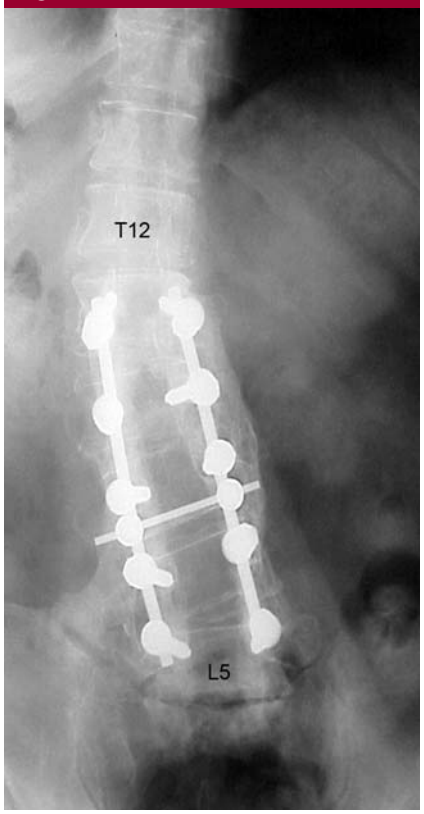
Progressive scoliosis, rotary subluxation, or spondylolisthesis may develop after wide decompression. One of the most common causes of surgical failure is incomplete relief of the lateral recess and foraminal stenosis. During decompressive surgery, the areas beneath the facet and the foramina should be carefully probed and the mobility of the root assessed. A methodical approach to probing and inspecting the central canal, lateral recess, and foramen minimizes the chance of inadequate decompression in both the initial and salvage operations.

Late causes of pain following a successful initial operation generally fall into the categories of recurrent stenosis at the same level, a new area of stenosis, disk herniation, or fibrosis (whether perineural, epidural, or arachnoiditis).

Lumbar Fusion and Deformity Correction

Failures following lumbar fusion are most often related to poor identification of surgical indications. Back pain following a period of relief from symptoms may be caused by adjacent segment degeneration, pseudarthrosis, instrumentation-related stress phenomena (eg, spondylolysis, pedicle stress fracture), adjacent segment instability, instrumentation failure, compression fracture above

Figure 2



Standing anteroposterior radiograph of a 68-year-old man demonstrating degeneration of a segment (L5-S1) adjacent to a previous fusion (L1-L5).

an instrumented segment, or stenosis of an adjacent segment. Several authors have reported that persistent axial pain may be the result of painful disrupted disks within a solidly posteriorly fused segment.[12,13]

New leg pain following lumbar fusion has several possible etiologies. Instrument-related causes include misplaced pedicle or translaminar facet screws, and fusion cages or structural bone graft placed into the neural foramen. Cages or structural graft placed through the anterior approach may displace disk or bone fragments posteriorly into either the spinal canal or foramen. Intertransverse bone graft may become displaced into the spinal canal or anteriorly onto the exiting nerve roots. Use of fusion cages or intervertebral graft via the posterior route may cause traction neurapraxia or direct trauma to the cauda equina, individual nerve roots, or ganglia. These complications can be recognized by immediate postoperative symptoms such as severe radicular pain, motor dysfunction, or cauda equina syndrome. Before accepting such a diagnosis, however, the surgeon must determine that all hardware had been properly inserted.

Late-onset leg pain is most often related to adjacent segment degeneration (Figure 2), degenerative spondylolisthesis, or focal spinal stenosis. Occasionally, hypertrophic pseudarthrosis may produce root or thecal sac impingement.

Should the instrumentation include a sagittal transition area or the majority of the lumbar spine, the patient may have flat back syndrome. This condition is caused by the shape and rigidity of the rods used to straighten the deformity. Patients may present with difficulty standing erect. Many patients try to compensate for the flat back by bending at the hips and/or knees, resulting in even poorer posture.

Little conclusive data are available on the role of instrumentation in the presence of a solid fusion as a cause for pain in the absence of malpositioned implants. In our experience, hardware removal often is beneficial, particularly in patients with a positive response to hardware injection (ie, those whose pain was temporarily relieved by an injection of anesthesia around the implants). Instrumentation should not be removed until the patient has undergone an extensive diagnostic workup to rule out other potential sources of pain, including psychological issues. The mechanism by which instrumentation may cause pain is not fully understood. Several studies have demonstrated an inflammatory response to metal debris from implants.[18-20] One study, however, reported that the problem was significant only in patients with pseudarthrosis.[20]

Pain Location

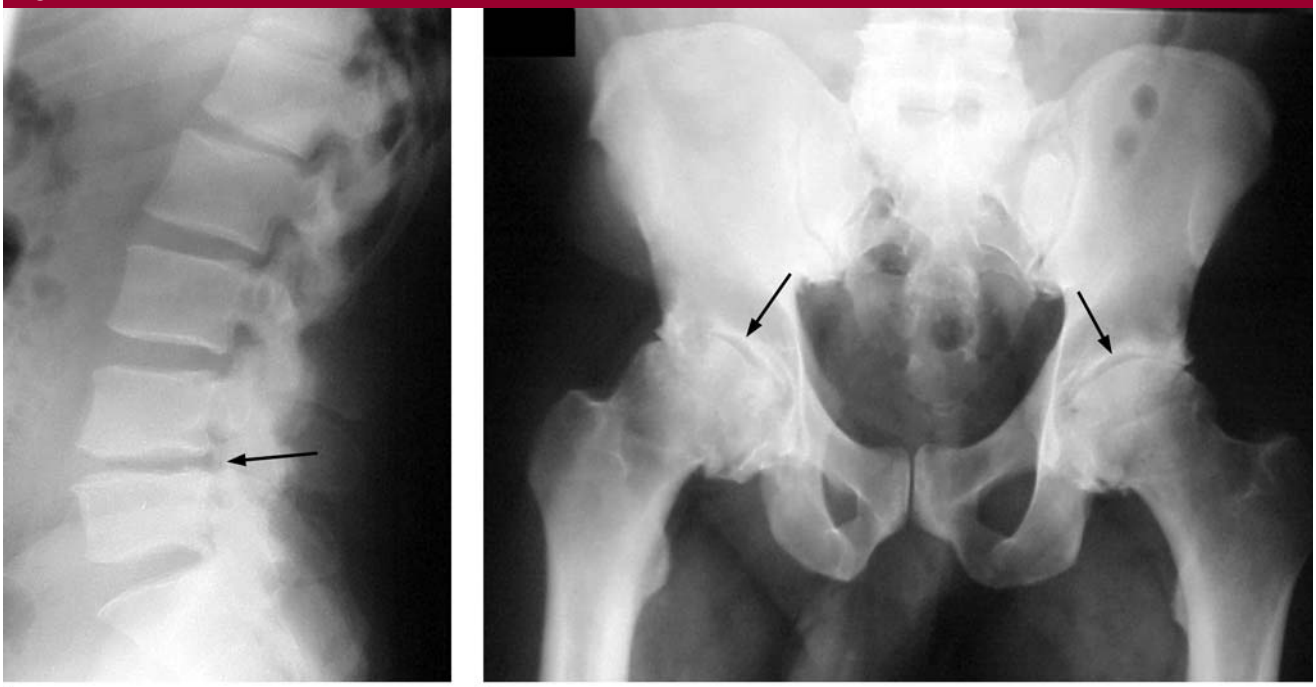
As in the evaluation of any patient with back pain, careful assessment of the location and pattern of the patient's pain can provide valuable information. Generally, it is important to determine whether the primary complaint is pain in the back or in one or both of the lower extremities. Widespread pain patterns more often indicate a psychogenic and/or neuropathic component. Although the surgeon must be aware of these possibilities, a physiologic cause of pain must be determined by exclusion, particularly when the patient reports symptoms that may be related to problems such as malpositioned implants, neural compression, infection, or tumor.

Lower Extremity

Lower extremity pain has many etiologies. Vascular claudication can masquerade as neurogenic claudication. Various entrapment syndromes of the sciatic, peroneal, femoral, lateral femoral cutaneous, tibial, and digital nerves may cause pseudoradicular pain. Diabetic neuropathy may simulate radiculopathy. Pelvic tumors, infections, inflammatory processes, and aneurysms may compress the lumbosacral plexus.

Typically, pain radiating below the knee in a dermatomal pattern is the easiest to evaluate. This pain pattern is generally related to nerve root compression. When the pain is similar to the preoperative pain, the surgeon must consider missed pathology as the source of ongoing pain. The most likely sources include a missed extruded disk fragment or inadequate decompression of stenosis. Leg pain appearing immediately after surgery that is different or more severe than the original symptoms suggests malpositioned instrumentation, including pedicle screws or interbody implants. Recurrent disk herniation is a possibility in the patient who has experienced several months or more of pain relief before presenting with onset of pain.

Figure 3



A B

Lateral spine **(A)** and anteroposterior pelvis **(B)** radiographs of a 48-year-old man referred for treatment of lumbar spinal stenosis. Further history revealed groin pain more consistent with hip joint arthritis than neurogenic claudication. **A,** Spondylosis with foraminal stenosis, predominantly at L4-5 (arrow). **B,** Advanced arthrosis of both hip joints (arrows).

In the patient with radicular pain in a different radicular pattern, pathology may have developed at a different spinal level. However, the facet joints can also produce pain into the thigh, and occasionally below the knee.[21]

Back

Back pain may be caused by pelvic and abdominal inflammatory and infectious entities, including kidney and bladder infections, cholelithiasis/cholecystitis, psoas abscesses, and pancreatitis. Systemic rheumatologic problems, such as ankylosing spondylitis, regional enteritis, diffuse idiopathic skeletal hyperostosis, Reiter syndrome, and rheumatoid arthritis, can be missed or attributed to an asymptomatic herniated disk found on magnetic resonance imaging (MRI) scans. Thoracic and abdominal tumors and infections can cause flank and back pain, as can thoracic and abdominal aneurysms. Degenerative conditions of the sacroiliac joint can cause groin, thigh, and/or back pain (Figure 3). Other potential sources of back and leg pain must always be considered, even when spinal pathology is evident.

A less clear clinical presentation is that of back pain following spine surgery. The pain may be related to muscle weakness following posterior spine surgery. Pain may also arise from a disrupted disk that was not addressed during the original surgery, such as pain from a disk in a patient operated on for spondylolisthesis. Back pain may also occur as a result of pain coming from a facet joint. In the patient with an acceptable result for 1 to 6 months who later reports back pain, instability of the operated segment should be considered.

Widespread Pain Patterns

Some patients present with pain either in patterns inconsistent with dermatomal distributions or in widespread patterns. Although these are characteristics of psychogenic pain, physiologic causes must not be ruled out too quickly. It would be unusual for a patient with a relatively clear preoperative clinical picture to have a psychogenic presentation shortly after surgery. One possible cause of the widespread pain is complex regional pain syndrome or reflex sympathetic dystrophy. Sachs et al[22] reported that this occurs in approximately 1.2% of patients following spine surgery. Such patients should be treated by a pain specialist familiar with the diagnosis.

Patient Evaluation

Patients with failed back surgery require careful assessment to determine the exact cause of symptoms and the effect on the patients' emotional and functional state. Because results of revision back surgery are

significantly poorer than those of index surgical procedures, a thorough evaluation is mandatory before proceeding with further surgery. Nonspinal causes of leg and back pain must be considered once the spine-related causes are ruled out. Even though an obvious nonspinal cause (eg, psychosocial source) may be present, a thorough spinal workup should be performed. Similarly, all patients should undergo a thorough and detailed expanded history and physical examination. Such an approach can help avoid serious and potentially devastating omissions.

History

Details of postoperative symptoms and their relation to preoperative clinical symptoms will provide insight into possible causes of persistent low back pain. Careful review of medical records, surgical reports, and radiographs can identify events such as wrong-level surgery or incorrect initial diagnosis. As with all spinal conditions, the degree of nociceptive back pain and neuropathic leg pain is essential to planning further treatment. Assessment of the medical history, review of systems, and social history can identify comorbidities and the possibility of somatization or addiction disorders.

Depression is common in most patients with failed back surgery and is assessed by determining the presence or absence of classic neuropsychopathic signs, such as sleep disturbance, loss of appetite, weight change, feelings of despair, loss of sexual desire, irritability, and inability to make decisions. Other factors to assess include substance abuse, work history and motivation for return to work, and personality disorders. Undertaking additional surgery without addressing these psychosocial factors increases the risk for further failure. Constitutional symptoms (eg, night sweats, fever, chills, weight loss) may indicate occult infection.

Physical Examination

The physical examination is similar to any initial patient evaluation. Nonorganic physical findings should be assessed, as described by Waddell et al.[23] Waddell signs include behavior such as superficial or nonanatomic tenderness, overreaction to stimuli, or reports of pain during evaluations that are designed not to be painful. More than two Waddell findings strongly predicts poor outcome, regardless of spinal pathology. Standard tests of posture, gait, tenderness, range of motion, nerve root tension signs, and neurologic examination are performed. The examination should exclude other common causes of leg pain, incorporating examination of the hip and knees for pain and range of motion as well as assessment of peripheral pulses.

Imaging

Biplanar standing radiographs are obtained to evaluate the site of prior surgery, changes in alignment, degree of resection of the posterior elements, and progressive degenerative changes. When fusion has occurred at L5-S1, an anteroposterior Ferguson view may be helpful. Flexion-extension radiographs are indicated in the patient who has had fusion or has any possibility of instability. The location of implanted hardware and any loosening or subsidence should be scrutinized.

A fused or sclerotic sacroiliac joint may explain buttock and posterior thigh pain that is unrelieved by surgery performed on an asymptomatic, abnormal-appearing disk. Hip joint pathology, such as osteoarthritis, osteonecrosis, or unrecognized stress fractures, may be the true source of groin pain radiating into the thigh. The iliac crest bone graft site also should be evaluated clinically and radiographically to evaluate the possibility of a pelvic fracture or sacroiliac joint dysfunction.

Neural imaging is indicated in most patients with FBSS. Even patients with pain limited to the back may have neurologic compression that may require treatment. MRI with and without gadolinium enhancement is the most sensitive test for evaluating these patients.[24] Enhancement with gadolinium results in increased signal in vascularized tissues, especially epidural scar. Comparing enhanced and nonenhanced sequences can accurately distinguish epidural scar from nonenhancing recurrent disk herniation. In addition, gadolinium enhancement in the intervertebral disk and vertebral bodies may demonstrate the presence of postoperative infection.

CT myelography is indicated in the patient with contraindications to MRI, with stainless steel hardware, or whose images are degraded by titanium hardware. CT myelography is also useful for evaluating the patient with dynamic problems (eg, instability, facet impingement) or whose spine is less well visualized by MRI (eg, patient with scoliosis).

Evaluation of patients who have had spinal fusion, especially with instrumentation, is often difficult. Pseudarthrosis should be suspected in the presence of a short period of pain relief followed by progressively increasing mechanical back pain. Plain radiographs, particularly flexion and extension views, have been used to assess incorporation of the fusion. Progressive lucency around screws or evidence of hardware failure is suggestive of pseudarthrosis. Lucencies around the hardware or subsidence have been found to have a poor correlation with findings at the time of open revision, however.[25-27] Pseudarthrosis is likely when motion is present on flexion-extension radiographs. CT with fine-section coronal and sagittal reconstructions is generally best to determine fusion status. As with any imaging study, however, this may fail to yield results correlative with findings at revision, particularly with metallic implants that create artifacts on imaging.

In more complex cases, the overall sagittal balance should be assessed. On standing 36-inch radiographs, the weight-bearing line should pass from C7 to the sacrum. Displacement of this line anteriorly may indicate flat back syndrome.

Electrodiagnostic Studies

Electromyograms (EMGs) and nerve conduction velocity (NCV) studies are rarely indicated but may be helpful to evaluate extraspinal neural compression, assess the severity and location of nerve injury, and discriminate from other causes of neuropathic pain, such as peripheral neuropathy. Physical examination findings are sometimes difficult to interpret in patients with FBSS, and more objective diagnostic tests (eg, EMG, NCV) can be valuable, although they may not be predictive of outcome of further surgery.

Laboratory Tests

The patient presenting with constitutional symptoms, a history of infection, or prolonged wound drainage should be assessed for occult infection. Early or midterm onset of severe low back pain of a different quality after diskectomy may indicate diskitis. Erythrocyte sedimentation rate and C-reactive protein levels are usually elevated, although they are not specific for infection. C-reactive protein returns to a normal level sooner than does the erythrocyte sedimentation rate, usually in 14 days, and may be useful in determining response to treatment.

Psychological Assessment

The psychological state of the patient with FBSS is assessed by careful review of the medical history and physical examination. A low threshold for more careful analysis is indicated in this population. Although many techniques are available to measure psychological distress, the most popular is the MMPI. High scores on the scales of hysteria, depression, and hypochondria predict the probability of a poor outcome. Referral to a psychologist or psychiatrist who specializes in chronic pain is recommended before further surgery in many patients with FBSS who have chronic pain. In general, the patient with significant abnormalities on psychometric testing is difficult to rehabilitate into a good surgical candidate. Depression and its accompanying sleep disturbance are common and should be treated both pre- and perioperatively.

Diagnostic Block

Selective nerve root blocks are helpful to confirm exact localizations of neural abnormalities and perhaps to predict outcomes of surgery. Although important information is obtained from both the anesthetic response and, in the long term, from the corticosteroid response, controlled studies documenting their ability to predict outcome in the patient group with FBSS are lacking. The use of provocative diskography is controversial, and the resultant pain provocation is even less well understood in patients with prior surgery. Diskography has identified painful disk segments after posterior fusion with good clinical outcomes following interbody fusion. Diskography also can be used to identify painful transitional motion segments. Similarly, diagnostic facet blocks may be used to identify painful transitional motion segments.

Chronic Pain

The psychological component of failed surgery and its impact on patients' lives cannot be overlooked. Chronic pain and disability often lead to depression and anxiety and can result in interference with daily activities, recreation, and sleep. Medications to treat chronic pain often have the undesired effect of aggravating these psychologic conditions. All these factors can put a patient on a spiral of pain, pain behavior, and physiologic changes that cause the wind-up phenomenon, with the patient becoming more sensitive to pain.

Until recently, many care providers did not have an adequate appreciation for the physical causes of pain sensitization that can occur in patients with chronic pain. Previously, pain was described as a hard-wired system similar to a telephone, with signals sent from the periphery to the brain. This may be an appropriate analogy for the patient with acute pain, but it is an oversimplification for the patient with chronic pain. With chronic pain, plasticity occurs in the pain modulation system, creating increased pain sensitization to noxious stimulation. Pain, inactivity, change in diet, lack of sleep, and stress can amplify pain and lead to physiologic changes. A stimulus that generally is not painful can be painful in the patient with chronic pain. Although such patients can benefit from psychological counseling and participation in a pain program, a physical cause for at least a portion of the ongoing symptoms cannot be ruled out. In these patients, any of the aforementioned physical problems could be responsible for pain related to failed back surgery. Patients whose symptoms are seemingly out of proportion for their physical condition may be referred to a psychologist or psychiatrist for evaluation and possible intervention. Components of the evaluation may include a structured interview and formal testing for personality profile, depression, and coping skills. The psychologist often can play a helpful role in identifying behavioral components of the patient's pain and strategies to manage them. Such problems may include stress at work, problems with the health care system, or issues with family members. Intervention may include relaxation therapy and assistance with coping skills.

Prevention

The best patient management is the prevention of failed back surgery. The most important element in prevention is presurgical patient assessment. Symptoms should be of sufficient severity and character to warrant surgery. In most patients, surgery is indicated for disabling radicular or mechanical axial pain, neurologic changes, or progressive deformity. The symptoms must correlate with physical examination abnormalities and the imaging studies. The physical examination should assess findings of pain behavior (ie, Waddell signs) as well as other diagnoses (eg, hip arthrosis, vascular disease, peripheral neuropathy) that would explain the pain symptoms.

At surgery, a time-out should be used in which the correct level to be operated on is confirmed by the circulating nurse, anesthesiologist, and surgeon. Usually, this is confirmed radiographically at the time of the surgical procedure. Confusion is most likely to occur when the patient has a transitional vertebra. This can be avoided when, during surgical planning, the surgeon is aware of potential confusion and carefully identifies intraoperative landmarks. Correctly identifying the levels in the thoracic spine is more difficult than in the lumbar or cervical regions. Scout imaging that includes the craniocervical or lumbosacral junction facilitates counting from an easily discernible point. In addition, identification and matching of other landmarks, such as fractures or osteophytes, can be helpful in confirming the appropriate treatment level.

Following spine decompression, the nerve root should be checked for mobility and the neuroforamina palpated to ensure adequate opening. When instrumentation has been placed, the spinal cord and neuroforamina should be inspected for misplaced metal; if possible, the position of the instrumentation should be verified radiographically. Postoperatively, any complication should be identified promptly and treated aggressively even if revision is required. Delays often lead to further neural injury.

Summary

Because of the very nature of their problem, patients with FBSS fall into a high-risk category for failure following subsequent surgical treatment. Lack of success in addressing the original problem, accompanied by new problems stemming from the index procedure, can lower the likelihood and degree of success of subsequent intervention. Often, the patient presents with a complex history of multiple failed operations for conflicting diagnoses. Documentation and studies are often incomplete. The surgeon must persist in delineating the causes of pain and failure of the previous operation. For some diagnoses, such as recurrent herniation, pseudarthrosis, or adjacent segment degeneration, the results of revision surgery may be gratifying. Other conditions, such as arachnoiditis and epidural/perineural fibrosis, once regarded as having a bleak outlook, are now treated successfully with spinal cord stimulation in some patients.[28] Because patients with FBSS have chronic pain and may have emotional problems related to their longstanding health problems, evaluation by a psychologist familiar with patients who have chronic back pain is helpful. Preoperative screening by a psychologist can help avoid additional surgery in patients whose personality or emotional state is likely to preclude a favorable surgical result.

Careful diagnosis of the cause of persistent pain is invariably the first step in appropriate treatment. An organized evaluation plan for patients with FBSS should include assessing details of any pain-free interval, the location of the pain, and appropriate use of imaging, injection, and neural studies. Should a clear diagnosis be found, a well-thought-out and executed plan may provide a good result.

References

Citation numbers printed in **bold type** indicate references published within the past 5 years.

1. Block AR, Gatchel RJ, Deardorff WW, Guyer RD: *The Psychology of Spine Surgery*. Washington, DC: American Psychological Association, 2003.
2. Spengler DM, Freeman C, Westbrook R, Miller JW: Low-back pain following multiple lumbar spine procedures: Failure of initial selection? *Spine* 1980;5:356-360.
3. Wiltse LL, Rocchio PD: Preoperative psychological tests as predictors of success of chemonucleolysis in the treatment of the low-back syndrome. *J Bone Joint Surg Am* 1975;57:478-483.
4. Dhar S, Porter RW: Failed lumbar spinal surgery. *Int Orthop* 1992;16:152-156.
5. Trief PM, Grant W, Fredrickson B: A prospective study of psychological predictors of lumbar surgery outcome. *Spine* 2000;25:2616-2621.
6. Waddell G, McCulloch JA, Kummel E, Venner RM: Nonorganic physical signs in low-back pain. *Spine* 1980;5:117-125.
7. Klekamp J, McCarty E, Spengler DM: Results of elective lumbar discectomy for patients involved in the workers' compensation system. *J Spinal Disord* 1998;11:277-282.
8. Taylor VM, Deyo RA, Ciol M, et al: Patient-oriented outcomes from low back surgery: A community-based study. *Spine* 2000;25:2445-2452.
9. Waddell G, Main CJ, Morris EW, Di Paola M, Gray ICM: Chronic low-back pain, psychologic distress, and illness behavior. *Spine* 1984;9:209-213.
10. Block AR, Ohnmeiss DD, Guyer RD, Rashbaum RF, Hochschuler SH: The use of presurgical psychological screening to predict the outcome of spine surgery. *Spine J* 2001;1:274-282.
11. Wong DA: Present initiatives and future directions: How best to serve our patients and members. North American Spine Society Presidential Address, San Diego, CA. *Spine J* 2004;4:8-14.
12. Weatherley CR, Prickett CF, O'Brien JP: Discogenic pain persisting despite solid posterior fusion. *J Bone Joint Surg Br* 1986;68:142-143.

13. Barrick WT, Schofferman JA, Reynolds JB, et al: Anterior lumbar fusion improves discogenic pain at levels of prior posterolateral fusion. *Spine* 2000;25:853-857.
14. Carragee EJ, Han MY, Suen PW, Kim D: Clinical outcomes after lumbar discectomy for sciatica: The effects of fragment type and anular competence. *J Bone Joint Surg Am* 2003;85: 102-108.
15. Hilibrand AS, Carlson GD, Palumbo MA, Jones PK, Bohlman HH: Radiculopathy and myelopathy at segments adjacent to the site of a previous anterior cervical arthrodesis. *J Bone Joint Surg Am* 1999;81:519-528.
16. Kumar MN, Baklanov A, Chopin D: Correlation between sagittal plane changes and adjacent segment degeneration following lumbar spine fusion. *Eur Spine J* 2001;10:314-319.
17. Atlas SJ, Keller RB, Chang Y, Deyo RA, Singer DE: Surgical and nonsurgical management of sciatica secondary to a lumbar disc herniation: Five-year outcomes from the Maine Lumbar Spine Study. *Spine* 2001;26:1179-1187.
18. Johnson D, Tucci M, McGuire R, Hughes J: Evaluation of the biomaterial-interface of screw threads in patients having clinical pain. *Biomed Sci Instrum* 1996;32: 127-133.
19. Mody DR, Esses SI, Heggeness MH: A histologic study of soft-tissue reactions to spinal implants. *Spine* 1994; 19:1153-1156.
20. Wang JC, Yu WD, Sandhu HS, Betts F, Bhuta S, Delamarter RB: Metal debris from titanium spinal implants. *Spine* 1999;24:899-903.
21. Mooney V, Robertson J: The facet syndrome. *Clin Orthop Relat Res* 1976; 115:149-156.
22. Sachs BL, Zindrick MR, Beasley RD: Reflex sympathetic dystrophy after operative procedures on the lumbar spine. *J Bone Joint Surg Am* 1993;75: 721-725.
23. Waddell G, McCulloch JA, Kummel E, Venner RM: Nonorganic physical signs in low-back pain. *Spine* 1980;5: 117-125.
24. Ross JS, Masaryk TJ, Schrader M, Gentili A, Bohlman H, Modic MT: MR imaging of the postoperative lumbar spine: Assessment with gadopentetate dimeglumine. *AJR Am J Roentgenol* 1990;155:867-872.
25. Brodsky AE, Kovalsky ES, Khalil MA: Correlation of radiologic assessment of lumbar spine fusions with surgical exploration. *Spine* 1991;16(6 suppl): S261-S265.
26. Blumenthal SL, Gill K: Can lumbar spine radiographs accurately determine fusion in postoperative patients? Correlation of routine radiographs with a second surgical look at lumbar fusions. *Spine* 1993;18:1186-1189.
27. Larsen JM, Rimoldi RL, Capen DA, Nelson RW, Nagelberg S, Thomas JC Jr: Assessment of pseudarthrosis in pedicle screw fusion: A prospective study comparing plain radiographs, flexion/extension radiographs, CT scanning, and bone scintigraphy with operative findings. *J Spinal Disord* 1996;9:117-120.
28. LeDoux MS, Langford KH: Spinal cord stimulation for the failed back syndrome. *Spine* 1993;18:191-194.