Back Surgery That Does Not Relieve Pain

A significant portion of spine surgery patients do not report notably reduced pain. In those patients, an interdisciplinary pain management approach may be best suited to better control pain and to increase patient function.

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Editor’s Note: Back pain that does not resolve after surgery is a huge disappointment for patient and practitioner. When this occurs, the term “Failed Back Surgery Syndrome” is typically applied. This term, however, is a gross misnomer. It is not a syndrome, disease, or disorder but an unfortunate occurrence which in many, if not most cases, could not have been prevented. Surgery that does not relieve pain is not necessarily a failure. Patients suffering severe back pain that is destroying their entire well-being and self-perception as decent people deserve and want the hope, prayer, and cure that only back surgery can bring. Rather than criticize or condemn back surgery, PPM simply wants all parties to better assess and appreciate the risk-benefit of back surgery. We must always keep in mind that the “miracle” of back surgery has brought relief and sanity to millions. When pain persists after surgery, we pain practitioners shouldn’t unjustly criticize or claim “unnecessary surgery.” We must pick up the pieces, carry on, and provide the best non-surgical treatment we can muster. Gatchel and colleagues give us an up-to-date status report to help us better position ourselves in dealing with pain that persists after back surgery. Forest Tennant, MD, DrPH [1]

In 2004, Gatchel, Miller and Lou 1 published a review of failed back surgery syndrome (FBSS) in Practical Pain Management. While the Editor’s Note preceding this article notes that FBSS is not an optimal term to use, it will be used herein due to the lack of a better term at this point. The purpose of the present article is to update that earlier review, as well as comment on any advances made in the more effective management of FBSS. The prevalence of FBSS has remained high and effective assessment/treatment protocols for its prevention and management have not yet been consistently embraced by the surgical community.

As a preamble, it is important to begin by understanding the epidemiology of acute and chronic low back pain. Acute and chronic low back pain are increasing public health problem across industrialized nations. In the United States, 85% of people will experience an episode of low back pain at some point in their lives. 2 According to the National Health Interview Survey, 28% of adults report experiencing low back pain within the last three months. 3 A recent survey also found that the prevalence of chronic low back pain (CLBP) in North Carolina has risen substantially over a 14-year period, with 10.2% now reporting chronic, impairing low back pain. 4 Low back pain results in 31 million office visits 5 and 2.6 million emergency room visits 6 each year. LBP is also the second most common pain condition causing lost time from work. 7 Low back pain has serious economic implications as well. From 1997 to 2005, the total national expenditures for treating adults with spinal disorders increased by an inflation-adjusted 65%. 8 When both medical costs and loss of productivity are considered, back and neck pain have the highest total costs to employers of any medical condition. 9 In 2007, a total of $30.3 billion was spent on treatments for back pain. 10 Despite the increase in healthcare spending for spinal disorders, there has been little improvement in health status, functional ability, work ability, or social functioning of patients suffering from spinal disorders. 8

Most patients with low back pain recover quickly. Thirty-five percent of patients can be expected to recover within one month, 85% recover within three months, and 95% recover within six months. 2 However, those patients whose pain persists past the normal healing time are likely to develop the disabling physical and psychosocial symptoms that accompany chronic pain syndromes. These patients endure a cycle of pain that is detrimental to their physical and psychosocial health, lifestyle, and productivity. Back and spine problems were the reported cause of disability in over 10 million Americans
between the ages of 21 and 64. Moreover, according to the Healthcare Cost and Utilization project, there were over 633,000 hospital admissions for low back disorders and 350,000 spinal fusion surgeries in 2007 alone.

Many of the most chronic back pain patients do not achieve the pain relief they desire from non-operative care. These patients often then present as surgical candidates. Annually, neurosurgeons perform at least 100,000 operations for lumbar disc disease alone and orthopedic surgeons perform a similar number. However, despite many positive outcomes to low back surgery, lumbar spine fusion surgery has drawn special attention over concerns about efficacy, adverse outcomes in the Workers’ Compensation setting and lack of clear surgical indications. Indeed, many patients with FBSS will subsequently undergo additional non-operative care, and further surgery to try to correct the failed procedure. However, rates of surgical success fall off with each additional operation: only 30% of second spine surgeries, 15% of third surgeries, and 5% of fourth surgeries are successful. Other patients will receive additional procedures to attempt to alleviate their continuing pain including spinal cord stimulators or implanted drug infusion devices. As many as 4,000 patients receive implanted spinal cord stimulators annually as a treatment for FBSS. Still others with FBSS will be treated at chronic pain centers. Patients with FBSS present a more complicated clinical case than patients with un-operated CLBP. Interdisciplinary rehabilitation programs offer many treatment modalities based on a biopsychosocial treatment model including medication management, counseling, physical and occupational therapy, stress management and relaxation training, and psychiatric care. However, such comprehensive treatment is often not being made available to these patients because of managed healthcare insurance policies.

**Indications for Spinal Surgery**

Surgery is an important option for managing CLBP but it should also be viewed as a “last resort” option. Unless delaying surgery leads to permanent damage, it should only be considered after less invasive treatment options have been attempted. In fact, the Occupational Disability Guidelines published by the Work Loss Data Institute recommend that spinal fusion not be used within the first six months after diagnosis except for fractures, dislocations or in cases of severe neurological loss; while discectomy is recommended only for carefully selected patient groups. If non-operative treatments are ineffectual in improving the patient’s CLBP, then surgery might be beneficial. The most common conditions for which surgery is recommended are disc bulge, disc stenosis, spondylosis, spondylolisthesis, and FBSS.

**Disc Pathologies (Bulges, Herniation, Disruption)**

Spinal disc degeneration occurs naturally with aging. The nucleus pulposus loses some of its gel-like consistency due to lowered water and proteoglycan content. The disc may sag, and the nucleus pulposus may push against the annulus fibrosus (the wall that surrounds the disc material) causing a disc bulge. Patients with disc bulges are usually asymptomatic. A disc bulge is only problematic when it is concomitant with a narrow spinal canal, leading to spinal nerve compression. Disc degeneration is influenced by mechanical load, genetic predisposition, and nutrition.

Disc herniations occur when the nucleus pulposus protrudes against the annulus wall to such a degree that it compresses nerve roots. If the nucleus material remains within the disc, it is called a “contained herniation.” In some cases of contained herniation, nuclear tissue travels through tears in the degraded inner annulus until it reaches the intact annulus outer wall. This can cause pain because the intact outer wall of the annulus contains pain receptors. In addition, the nucleus material contains cytotoxic agents that can cause chemical irritation and inflammation. A more severe form of a herniation occurs when the nucleus material completely tears through the annulus wall, causing a protrusion of nucleus material. This can compress nerve roots and also cause chemical irritation and inflammation. In severe cases, the protruding fragment can completely separate from the disc and travel into the spinal canal where it lodges.
Over 97% of disc herniations occur at either the L4-L5 or L5-S1 level. Symptoms of disc herniation include sharp, shooting pain that may radiate down the back of the leg (sciatica). Leg weakness and cauda equina syndrome (loss of bowel and/or bladder control) are also known to occur. In some cases, the sciatica can be severe and lead to a disabled state. Surgical intervention is most appropriate where there is significant and/or progressing neurologic deficit or when chronic pain is not amenable to more conservative treatments.

Disc disruption is a syndrome thought to be caused by trauma to the intervertebral disc. In disc disruption, the disc annulus is torn but there is no MRI-detectable bulging or herniation. Furthermore, the tear in the annulus leads to dehydration of the disc material. Discography—in which a radiographic contrast material is injected into the intervertebral disc suspected to be the source of the pain—is often used to make a diagnosis although there is controversy surrounding this diagnostic test.

Spinal Stenosis

Spinal stenosis can be congenital or acquired. It is characterized by a narrowing that primarily occurs at two locations: the spinal canal and the foraminal openings. Congenital stenosis can cause pain if a disc bulge develops or if the ligamentum flavum thickens. Acquired spinal stenosis that is caused by aging may be accompanied by the degeneration of facet joints and intervertebral disc spaces. Disc degeneration and narrowing of the spinal canal occur naturally with aging, beginning as early as age 30. The narrowing does not cause symptoms in the majority of patients but, if there is extreme narrowing of the spinal canal that compresses spinal contents, radicular pain along with neurogenic claudication may occur. Surgery is not performed in most cases of spinal stenosis. However, if there is persistent pain that does not respond to non-operative and conservative care, surgery may be a viable option. Spinal stenosis represents the most common reason for spinal surgery in patients over the age of 65.

Spondylolisthesis

Spondylolisthesis occurs when a vertebra slips onto the vertebra in front of it, while the neural arch remains intact. Lumbar slippage can occur at any level of the spine but it most often occurs in the lower lumbar area at the L4-5 level. It has a higher rate of occurrence in women compared to men. In addition, it rarely occurs before the age of 50. The severity of a lumbar slip is classified by a grading system based on a ratio of amount slippage to vertebral-body width. Grades I through IV are divided into percentages of slippage such that Grade I represents a 0% to 25% slippage, and so on. Lumbar slips rarely exceed 30% of vertebral width and are generally asymptomatic. Spondylolisthesis can cause a variety of pain symptoms. The patient can present with symptoms ranging from low-grade lumbar pain to a loss of ambulation and radiculopathy caused by nerve root compression. The patient may also present with leg weakness and cauda equina syndrome. There are different sources for the resulting pain. Possible causes include fracture of the pars interarticularis, compression of the nerve roots because of vertebra misalignment, or damage to the inferior vertebra caused by the superior vertebra. While surgery is not required in most cases, surgery is recommended in the case of Grade II slippage or pain that is intractable to non-operative treatments.

Surgical Procedures

There are several types of surgical procedures used to treat CLBP. The most common is laminectomy discectomy and is used to treat a herniated disc. In this procedure, a small piece of bone is removed from the lamina (the arched bony roof of the spinal canal) to allow access to the spine. An incision is made in the ligaments connecting the vertebrae, the nerve root may be retracted, and the bulging portion of the annulus is removed. This decompression relieves the pressure on the nerve root. If pain results from spinal stenosis, decompressive laminotomy may be performed. This procedure removes portions of the articular process until the diameter of the spinal canal is at least 6 mm. As long as the lateral two-thirds of the facet joints are preserved, this procedure may be performed on multiple spinal
levels. Laminectomy has been shown to be effective for relieving pain in herniated discs as well as in lumbar spinal stenosis, although results are usually better for leg pain than for back pain.

Low back pain may also be treated with spinal fusion. In spinal fusion procedures, bone grafts are placed so that adjacent vertebrae are joined together. This type of procedure may or may not be accompanied by the placement of hardware such as metal screws or cages. With interbody fusion procedures, a portion of the diseased disc is removed and traditionally is replaced with bone harvested from the iliac crest (although the use of iliac crest is less and less common today). In fusion with instrumentation, screws may be used to attach vertebral segments and limit their motion, or titanium cylinders (cages) may be inserted into the disc space to join the vertebrae. There is conflicting evidence regarding the efficacy of lumbar fusions. Outcomes for fusions seem to be slightly better than outcomes for low intensity physical therapy but worse than for intensive multidisciplinary rehabilitation.

Although used in Europe for years, artificial discs have only recently been approved by the FDA for use in the United States. Artificial discs have been reported to have similar outcomes to fusion surgeries. Other newer devices include implants that are placed between the spinous processes to reduce pathological bending at the affected level while still allowing normal flexion, rotation, and lateral movement. These devices can be placed without resecting the ligaments or removing any tissue from the spine. Initial results for patients receiving this type of surgical treatment show greater improvement in symptoms severity and physical function than patients treated non-operatively with epidural injections and physical therapy.

**Surgical Complications**

Several types of complications can result from spinal surgeries. A study of Washington State workers’ compensation patients reported that 11.8% of patients developed complications following lumbar fusion surgeries. Other studies, especially among non-workers’ compensation patients have shown lower complication rates. The complications in the Washington State study included post-operative infections, anesthesia complications, deep vascular thromboses, graft and device complications; neural injuries, and pulmonary embolisms. Other researchers have reported higher rates of dural tears following spine surgery. In older adults, major medical complications such as respiratory failure, stroke, cardiac arrest, myocardial infarction, and pulmonary embolism were reported in 3.1% of spinal surgery patients while another 1.2% of patients experienced wound complications.

Failure rates of spinal surgeries are also much higher for certain types of procedures. Martin and colleagues found that reoperation rates were significantly higher in spinal fusion patients than in decompressive laminectomy surgery patients. Deyo and Mirza reported that reoperation rates were higher in complex fusion procedures with instrumentation than in fusion procedures with bone grafting alone. Remarkably, the rate of complex fusion procedures has increased fifteen-fold from 2002-2007—especially in older adults—while rates of decompression surgeries and simple fusions have declined. Researchers from varying specialties have shown mixed results regarding the value of fusion surgery as compared to long-term non-operative care.

**Failed Back Surgery Syndrome**

FBSS is typically a term used to describe a patient who has undergone lumbar surgery with little, if any, reduction in pain. This term has been indiscriminately applied regardless of the technical result or functional improvement. Observers have often attempted to label the surgery as a “syndrome starting point” and use the term FBSS to include even the signs and symptoms that were present prior to surgery. Simply stated, if pain wasn’t eliminated, the surgery has “failed.” For example, 30% of patients report persistent and chronic back pain despite an apparent adequately-performed surgery. Both physical and psychosocial problems may naturally follow surgery as the pain and disability that pre-existed are still present. These may include insomnia, depression, family problems, financial difficulties,
and dependence/abuse of narcotic pain medications. Patients who have had unsuccessful back surgery may also experience significantly reduced morale and productivity as they had high hopes for a successful surgery. As bills for surgeries and therapy add up, economic factors may also contribute to a downward spiral. Faced with a plethora of physical, socioeconomic, and psychological problems, FBSS-labeled patients usually seek help from pain practitioners. In the United States alone, approximately two-thirds of all patients enrolled in chronic pain centers have had back surgery.

**Etiology of FBSS**

Frymoyer initially proposed a classification system for the failure of back surgeries based on the duration of symptoms relief post-operatively. Early failures occurred either immediately or within two to three weeks of surgery and were most often caused by: infection, fusion of the wrong level, insufficient levels fused, nerve impingement from the fixation device, or psychosocial distress. Mid-term failures happened within one to six months of surgery and were most often caused by: pseudoarthritis, disc disruption, inadequate reconditioning, loosening of hardware, or adjacent disc degeneration. Long-term failures occurred after at least six months and included causes such as: late pseudoarthritis, adjacent level instability, acquired spondylosis, compression fracture above the fusion, adjacent level stenosis, or stenosis above the fusion. Slipman and colleagues attempted to classify spinal surgery failures according to their view of legitimate surgical or non-surgical diagnoses. Examples of common surgical etiologies for FBSS include stenosis, internal disc disruption and recurrent or retained disc. Non-surgical etiologies for FBSS include fibrosis, degenerative disc disease, radiculopathy, physical deconditioning and arachnoiditis. Both surgical and non-surgical etiologies of FBSS were equally prevalent in their study population.

**Poor Patient Selection for Surgery**

One of the greatest challenges for physicians is to identify which patients have the best hope that surgery will relieve pain. It is not surprising that a common cause of FBSS is poor selection for surgery. This means that a patient may have had a psychosocial profile or physical pathology that was contraindicated or not appropriate for successful surgery. Indeed, psychosocial factors can have a profound effect on the outcome of surgery. Selecting patients who have many psychosocial and work-related issues may increase the rate of surgical failure. In addition, most patients with refractory CLBP have at least one major psychiatric disorder. Factors that appear to predispose patients to failed surgery include worker’s compensation, job dissatisfaction, low education and income, heavy job requirements, cigarette smoking, psychosocial disturbances, and being over the age of 40. With these factors in mind, it is therefore recommended that the physician perform a psychosocial evaluation prior to surgery. A family interview may help complete the psychiatric evaluation and reveal more about the patient. If surgery is necessary, patients with psychiatric diagnoses should be surgically treated but it is imperative that the patient receives appropriate treatment for the psychosocial disorder in addition to the surgical treatment.

In terms of medical diagnosis, if a patient is misdiagnosed, the surgery is obviously incorrect and potentially damaging. Sciatica and claudication have a myriad of causes that can be mistaken for disc herniation and spinal stenosis. Arthritis can be misdiagnosed as a lumbar disc disease. Neural tumors might also be present in patients suspected with lumbar disc herniation. Poorly-evaluated indications for spinal surgery may also lead to surgical failure. In fact, an early study found that an analysis of patient histories, physical findings, and myelograms did not substantiate the initial diagnosis of nerve root compression or ruptured disc for many failed surgery patients. Improper selection and misdiagnosis may follow an inadequate pre-operative evaluation and diagnostic assessment. A full diagnostic assessment should include a focused history, as well as medical and psychosocial evaluations. The medical evaluation should include a physical examination and history, imaging and other relevant diagnostic procedures. Radiography, computed tomography (CT), magnetic resonance imaging (MRI), myelograms, bone scanning, electromyography, discography and various diagnostic injections may be used to assist the physician in determining the diagnosis, location, and cause of the
patient’s pain. Patients should also be kept informed with information about pain and the risk-benefit of surgery and be advised to remain active.  

Unnecessary Surgery

Unnecessary surgery will obviously not reduce pain or disability. The United States has the highest rate of spine surgery in the world. Between 1996 and 2001, the annual number of spinal fusions rose by 77%. Some critics of lumbar fusion surgeries have claimed “overuse” of spine surgery, citing a tripling of its incidence over the past decade. These statistics, however, may mean the rest of the world does too little surgery. Spinal surgery also shows a wider geographic variation than many other surgical procedures. Unnecessary surgery obviously has serious ramifications for a patient. Creating a needless excision in the nucleus pulposus disturbs disc contents and may result in misalignment or segmental instability that leads to CLBP. Furthermore, it places patients at risk for surgical side effects including injured nerve roots, dural tears, CSF leakage and wound infection. Finally, even the duration of “positive surgical outcomes” is still unclear. Surgery for radiculopathy with herniated lumbar disc has been shown to yield better short-term benefits relative to non-operative treatments. However, with time, the reported benefits may taper off and the pain may return.

Improper or Inadequate Surgery

Technical error during surgery may not reduce pain and disability. Failures occur when improper, incomplete, or inadequate operations are performed. One example of an improper surgery is disc excision at the wrong level. There is no general consensus among physicians on the amount and type of evidence needed to determine the level of the disc rupture. In addition, factors such as obesity or anatomical variation can lead to inadequate radiographic confirmation. Finally, segmentation errors can also complicate identification of the correct lumbosacral disc.

Failure to perform adequate disc decompression is another surgical oversight that may lead to continued pain. The most common instance of inadequate disc decompression occurs when foraminal stenosis is not recognized as a cause for the patient’s symptoms. This leads to inadequate decompression of the bony component. Conjoined nerve roots are another cause of failed surgery. If a conjoined nerve root is not identified in the patient, it can result in nerve root avulsion, damage of the nerve root that increases scarring, or overlooking the compressed root entirely. Retained disc fragments can also lead to continued or increased pain. Fragments left over from surgery can cause nerve root compression or scar tissue may develop around the retained fragments. Free fat grafts placed by the surgeon over decompressed nerve roots to prevent scarring can also recompress the nerves. Moreover, such improper surgeries are not easily rectified by performing additional operations. The chance of successful surgery is reduced with each additional procedure.

Pre-Surgical Psychosocial Screening

A number of studies support the notion that psychosocial variables affect surgery outcomes and that psychological screening can assist healthcare providers in deciding who is an appropriate candidate for surgery. A comprehensive screening protocol is recommended that includes medical record review, a semi-structured interview to identify surgical risk factors, observation of pain-related behaviors, psychosocial testing to identify other risk factors, and determination of surgical prognosis. Tests often used in pre-surgical screening include the Minnesota Multiphasic Personality Inventory (MMPI), the Medical Outcomes Study Short Form-36 questionnaire and the Oswestry Disability Index. Using such an approach, Block identified several risk factors for poor surgery outcomes. Patients with elevations in the hysteria, hypochondriasis, and depression scales on the MMPI were more likely to have poor surgical outcomes. Other psychosocial risk factors included high pain sensitivity, anger, clinical depression, anxiety and poor coping skills. Social risk factors for poor surgery outcomes included a non-amiable relationship with spouse, pending litigation, workers’ compensation, history of abuse, past psychological
treatment and substance abuse. Job demand and obesity were also found to predict poor surgery outcomes. 60 Further, Devlin advised caution in treating patients with borderline personality disorder characteristics. 58

DeBerard identified psychosocial predictors of outcomes to discectomy surgeries. 61 Patients who were older, had attorney involvement and had a longer time between injury and surgery were more likely to remain disabled. Likewise, older age, less education, longer time between injury and surgery and involvement of a case manager or attorney predicted failure to return-to-work. Patients with a longer time between injury and surgery were also less likely to reduce medication usage post-operatively. In addition, Voorhies et al 62 found that compensation claims, psychiatric factors, high pain levels, and axial joint pain predicted poor outcomes in decompressive laminectomy.

Several other studies have also examined the role of psychosocial risk factors in predicting outcomes of spinal fusion surgery. Depression, smoking, and attorney involvement were found to predict continued disability. 63 While high levels of fear-avoidance were found to predict high pain intensity post-operatively. 64 Litigation, obesity, number of levels fused, number of prior surgeries, and high preoperative levels of depression, pain, and anxiety were found to predict higher medical costs associated with fusion surgery. 63,65 Also, longer time off work prior to surgery predicted poor fusion outcomes. 57 Finally, additional studies have examined the role of psychosocial risk factors on spine surgeries in general. Epker and Block 66 found that spousal reinforcement of pain behavior, premorbid psychological treatment, workers’ compensation involvement, heavy job requirements, and poor coping skills predicted poor surgery outcomes. Further, Gross 67 found that self-reliance and loss of control were predictive of surgical outcome even after controlling for medical status and somatization.

It is thus clear that psychosocial screening is a critical component of the pre-surgical evaluation process. Psychosocial screening for surgery helps the physician and patient better predict if pain and disability will be improved with surgery. Consideration of psychosocial factors, in combination with physical factors, will lead to the most accurate predictions about those patients who will, or will not, benefit from surgery. This information collected will provide a better risk-benefit message that can be clearly given to patient and family prior to surgery.

**Treatment of Persistent Pain After Surgery**

Depending on a patient’s specific diagnosis, treatment of pain after surgery may include one or more of the following:

- additional surgery
- medical-psychologic
- adhesiolysis
- implantable devices

Diagnostic scenarios (as extracted from literature) is given for each of these approaches are described in the following sections.

**Additional Surgery**

Wilkinson 13 had earlier described three possible diagnostic scenarios that occur in post-surgical patients who continue to complain of low back pain. First, the pain may be preoperative pain that was inadequately resolved with surgery. Second, the preoperative pain may persist despite adequate surgical treatment. Third, the problem may be newly acquired pain. Due to these diagnostic complications, the management of patients with FBSS requires a thorough and rigorous evaluation of pain complaints along with the standard medical and psychosocial evaluations discussed in the previous section before additional surgery is performed. In fact, many patients with FBSS are typically treated
with additional surgery. A few studies suggest that if a clear pathology amenable to surgical treatment could be identified, then reoperation might be successful in treating FBSS. Indeed, Skaff and coworkers emphasized that proper selection for reoperation was critical to the success of the operation. Kim and Michelsen found that surgery outcomes were better when pseudoarthrosis was successfully repaired with fusion than if the repair was unsuccessful. If FBSS was found to be caused by sagittal spinal imbalance, then additional surgery was successful in 84% of the patients. North and colleagues found that 34% of FBSS patients who underwent reoperation had successful outcomes at a 5-year follow up. Factors found to predict better reoperation outcomes were younger age, female gender, good results from previous operations, absence of epidural scarring, employment prior to surgery and predominant leg pain (as opposed to back pain). Philips and Cunningham recommended additional decompressive surgery only in FBSS patients with well-defined discrete pathology who had pain refractory to conservative care.

Unless a patient presents with urgent symptoms—such as cauda equina syndrome, CSF leak, or progressive neurological deterioration; signs of an infectious process such as arachnoiditis, wound infection, or severe spinal instability—conservative treatment is usually recommended in FBSS patients. Because patients with FBSS usually have a long history of chronic pain problems, an interdisciplinary pain management approach is best. This may include physical therapy, pharmacotherapy, psychiatric/psychological treatment measures as may be available in the patient's community. If conservative therapy is not effective, the patient can be evaluated for mildly invasive procedures such as epidural injections. If pain is intractable, implanted devices may be considered. Given the cost and rejection of implants by most patients, intractable pain patients who have continued pain despite back surgery should be medically managed by physicians who specialize in such cases.

**Interdisciplinary Pain Management**

The difficulty of individual disciplines to adequately treat many complex, chronic pain patients, along with the recognition that chronic pain is a biopsychosocial phenomenon, has given rise to the interdisciplinary treatment approach. Individual disciplines have proven to be inadequate when attempting to treat the complex issues present in many chronic pain patients. Physical and psychosocial deconditioning, medication requirements, depression and secondary gain issues are only some of the factors that must be addressed when treating the chronic pain patient as a whole. The biopsychosocial approach to understanding the pain condition takes into account not only the physiological injury but also how various psychosocial factors may interact in a dynamic nature to exacerbate the pain condition and often deter the progress of treatment. It is through a comprehensive evaluation—including a full assessment of biopsychosocial factors—that an optimal treatment plan may best be developed for the individual chronic pain patient. These interdisciplinary teams typically include medical physicians, psychologists/psychiatrists, physical therapists, occupational therapists, biofeedback specialists and disability case managers. Treatment goals can be set and progress systematically measured throughout the treatment period. The broad aims of the interdisciplinary approach is to increase functioning, decrease pain, limit additional health care utilization, increase physical activity, and maintain therapeutic gains. The treatment team should communicate regularly to discuss the progress of each patient. Modifications to the treatment regimen can be recommended when sufficient progress is delayed. Effective communication, not only within the interdisciplinary team but also with the patient, helps make this biopsychosocial approach successful in treating patients with chronic pain conditions.

Research has shown that treatment outcomes are consistently better for patients with chronic pain conditions who participate in interdisciplinary treatment programs geared to functional restoration. There has also been evidence supporting the early application of interdisciplinary treatment as a efficacious and less expensive resolution. Recent studies have provided some evidence that exercise and cognitive-behavioral interventions may be equivalent to lumbar fusion without the cost and surgical complications. By using the biopsychosocial approach, therefore, chronic pain patients have an opportunity to decrease pain, increase function and mobility and improve their psychosocial
status to allow the individual to resume his/her regular, pre-injury lifestyle and activities. In addition to reporting a reduction in self-reported pain and disability along with improved physical functioning, functional restoration has also been shown to positively affect social outcome measures, such as return-to-work and retaining work post-treatment. Moreover, a study of functional restoration treatment specifically for FBSS found that FBSS patients significantly improved on measures of pain intensity, aerobic capacity, strength, daily activities, range of motion, and perceived disability following treatment.

**Adhesiolysis**

In cases where the main cause of FBSS is epidural fibrosis or adhesions, treatments designed to treat adhesions may be appropriate. Epidural adhesions, or scar tissue within the spinal canal, can cause pain by compression of the nerve root, restriction of the movement of the nerve through the nerve sleeve, or decreased flexibility of the nerve root. Adhesiolysis may be performed either mechanically (via an endoscopic catheter) or percutaneously (via injection with hypertonic saline or steroids). A meta-analysis of percutaneous adhesiolysis (both mechanical and by injection) for pain following laminectomy found evidence for both short-term (less than six months) and long-term (greater than six months) pain relief in three randomized controlled trials and four observational studies. However, a meta-analysis of endoscopic adhesiolysis found evidence for only short-term pain relief. A study comparing epidural steroid injection to epidural steroids in combination with percutaneous adhesiolysis, found that the group treated with adhesiolysis showed more improvement in pain and disability but no differences in work status or opiate use. In addition, the adhesiolysis group received significantly more treatments per year than the epidural steroid group. This suggests that the long-term effects of adhesiolysis may require repeated administrations in order to be effective. Thus, overall, the results as to the efficacy of this particular treatment modality are still mixed and require further scientific evaluation.

**Implantable Devices**

**Spinal Cord Stimulators.**

The use of spinal cord stimulators for symptom control of FBSS has expanded in recent decades. Based on the gate-control theory of pain developed by Melzack and Wall, spinal cord stimulation (SCS) implants electrodes into the spinal column in order to provide pulsed electrical stimulation of the spinal cord. This depolarizes the large fiber afferent neurons in the dorsal horn of the spinal column which then produces inhibitory neural responses that decrease the transmission of pain signals in dorsal horn neurons (essentially “closing the gate” to pain signal transmission). The electrical signal produces a tingling sensation in the stimulated dermatome that overrides the painful sensations from that area. SCS is indicated for neuropathic pain and the best response is seen in patients with radicular limb pain. The usual protocol used for this procedure involves implanting trial electrodes percutaneously—using fluoroscopic guidance—through an epidural needle under local anesthesia. The trial period with the percutaneous stimulator can last up to four weeks. If the patient experiences at least 50% in pain relief, parasthesia over at least 80% of the painful region, functional gains and a decrease in the use of oral pain medications, then the trial is considered a success and the device is permanently implanted. The pulse generator is usually implanted in a subcutaneous pocket of the upper abdominal wall. There may be complications associated with SCS placement that include lead migration, lead breakage, or infection. SCS is used frequently in lieu of reoperation for FBSS, and FBSS is the most frequent indication for SCS placement. Van Buyten recommends that if there is no definite surgical failure, then a trial of SCS prior to reoperation is appropriate. Although there has been no significant increase in the volume of SCS procedures in the United States, the inpatient costs of the procedure have more than tripled between 1993 and 2006. This may be due to more SCS procedures being conducted in outpatient surgery clinics (with only high-risk patients being treated in an inpatient setting) or due to the increased complexity (and price) of the implants themselves. Although there have been many clinical studies...
evaluating the effectiveness of SCS. Some of these studies suffer from methodological flaws. Recent meta-analyses \(^98,99\) have only been able to identify a few randomized controlled trials testing the efficacy of SCS for FBSS. One study compared SCS with conservative management and found greater success rates (greater than 50% pain relief and satisfaction with treatment) in SCS patients at six months. However, at 12 months—after correcting for treatment crossover—only 34% of the SCS patients demonstrated treatment success. \(^97\) North and colleagues \(^100\) compared SCS efficacy to reoperation for FBSS. A two-year follow-up showed that SCS was more effective than reoperation in causing greater than 50% pain relief, treatment satisfaction, and less opioid medication use. However, no differences were found between groups in ability to perform activities of daily living or to return to work. Eldabe and colleagues \(^101\) compared SCS to conservative care and found greater improvements in pain relief, functional abilities, and health-related quality of life in the SCS patients at six months. However, 35-40% of patients continued to experience serious difficulties with lifting, standing, and pain/discomfort at 24 months.

In the meta-analysis by Frey and colleagues, nine observational studies of SCS showed long-term (greater than 12 months) pain relief in 40% to 70% of patients, and four studies showed decrease in medication use. However, only 16% to 31% of patients were able to return to work. \(^99\) Another study of workers’ compensation compared patients treated with SCS to patients treated in a pain clinic and patients treated with usual care. It was found that patients treated with SCS had greater improvement in leg pain at six months but, at 12 and 24 months, found no differences between the three groups in leg or back pain, physical function, return to work, or mental health. \(^102\) Again, results are quite mixed.

It should be no surprise that proper selection for SCS is important to treatment success. Patients with severe psychopathology, substance abuse disorders, extremely high levels of somatization, or cognitive deficits may not be appropriate candidates for SCS procedures. \(^103\) These criteria reflect potential problems such as: lack of understanding on how to use the device, the internal sensations that may be generated by the device that may be difficult to deal with—especially in those predisposed to somatic delusions—and significant psychosocial problems that will continue to exacerbate pain complaints regardless of medical treatment. These issues will need to be addressed and managed if there is to be a successful outcome from SCS placement. A series of studies by Gatchel and colleagues \(^104-106\) confirms this approach.

Implanted drug infusion devices. Another option for the treatment of FBSS is intrathecal administration of medications. Medications that may be administered via intrathecal infusion pump include opiate analgesics (morphine, hydromorphone, fentanyl), local anesthetics (bupivacaine), muscle relaxants (baclofen), anxiolytics (midazolam), calcium channel blockers (ziconotide), and α-2-adrenergic receptor agonists (clonidine). \(^107,108\) Opiate analgesics work best for nociceptive pain, while muscle relaxants are indicated for spasticity, and local anesthetics work best for neuropathic pain. \(^108\) For mixed nociceptive and neuropathic pain, combinations of drugs may work better than monotherapy with a single drug.

Intrathecal pumps are generally recommended only as a last resort for FBSS. Only patients who have failed conservative treatment and a trial of SCS should be considered for intrathecal pump placement. A trial of intrathecal analgesia should be given prior to pump implantation. This can be accomplished with a single intrathecal bolus or with a portable temporary intrathecal pump. \(^95\) Patients who experience significant pain relief with trial infusions become candidates for permanent pump implantation. Intrathecal catheters are connected to a subcutaneous reservoir and require refilling by percutaneous injection every few weeks. \(^109\) Pumps may be programmable (transcutaneously using a magnetic processor) or at a fixed rate. \(^95\) It should be kept in mind, though, that the complication rate is high for intrathecal pumps, with 22% of patients experiencing at least one complication. The most common complications are infection, catheter migration, catheter occlusion, and CSF leak. \(^110\)

Although the effectiveness of implanted drug infusion devices is well established for cancer pain in the last three months of life, there is less evidence for the effectiveness of such devices in chronic non-
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malignant pain. There have been no randomized controlled trials of intrathecal medication pumps in FBSS. One survey of patients with implanted intrathecal pumps compared current pain ratings to the patients’ retrospective ratings of pain before the procedure and found that patients reported improvements in pain intensity, sleep, and mobility—although only 27% of patients returned to work at the four-year follow-up. A Registry-based outcomes study found that both back and leg pain decreased following implantation of intrathecal opioid pumps. Patients also demonstrated improvement in functional abilities and a decrease in oral pain medications. However, only 23% of patients demonstrated improvement in work status. Systematic reviews have found only limited evidence for the effectiveness of intrathecal infusion devices. Demartini and colleagues recommend intrathecal drug administration as a “means to allow a multidisciplinary rehabilitation program so as to obtain long term results.” As in the case of SCS, interdisciplinary evaluations of patients need to be the standard of care in this area before consideration of the use of intrathecal pumps. Such patients’ pre-screening is essential for good therapeutic outcomes with both intrathecal pumps and SCS. When any implant is done, it is highly recommended that patient and family be clearly advised that basic medical treatment must still be continued as implants are not cures and will likely have to be eventually removed.

Cost Effectiveness of Treatment Options

With rising medical costs becoming a national priority, research on cost-effectiveness of different treatments for FBSS has been increasing. In a retrospective study with matched controls, Doleys and colleagues compared the costs of implanted drug infusion pumps, interdisciplinary rehabilitation, and outpatient opiate medication therapy over four years. The estimated cost per patient for the implanted device was $61,000, compared to $24,000 for interdisciplinary rehabilitation and $18,000 for outpatient opioid therapy. Despite these significant differences in costs, there were few differences in outcomes among the groups. The only significant difference found between the groups was that the implanted device group had a greater numerical reduction in pain intensity scores than the other two groups. Bell and colleagues also compared the costs of SCS to conventional management, which included additional surgery, medications, and rehabilitation. They emphasized that their model reflected cost savings with SCS-only versus medical care having “multiple and uncoordinated medical care providers” who provided “repetitive and inappropriate care.” Even so, cost savings of SCS were only found in successful surgeries (38% of the cases) but, when SCS was unsuccessful, it cost more than conventional management. Finally, de Lissovoy et al compared the costs of implanted intrathecal morphine pumps to conservative care. At best, only a modest cost savings over conservative care could be found for the implanted devices, with savings ranging only from 511 to 683 dollars.

Conclusions

Although back surgery may be indicated in cases of intractable spinal conditions—such as disc pathologies (bulges, herniations, or disruptions), spinal stenosis, or spondylolisthesis—there is a significant portion of surgical patients who do not report significantly reduced pain. The most common causes of FBSS include improper screening of candidates, poor selection of surgical candidates, errors in diagnosis, improper or inadequate surgery, and development of epidural adhesions. Treatments for continued pain after surgery can include additional surgery, interdisciplinary rehabilitation, adhesiolysis, spinal cord stimulators, implanted intrathecal medication pumps, and oral opioid medication. In those patients who have continued pain, an interdisciplinary pain management approach is recommended as a means of increasing patient functioning and helping patients to better control pain. If pain cannot be adequately controlled with conservative approaches, the suitability of the patient for a more invasive procedure, such as additional surgery or implanted devices, can be considered.

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