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On the cover: Postoperative 3-D CT scan of a 27-year-old patient with congenital kyphoscoliosis who underwent a posterior spinal instrumented fusion (screws and rods shown in blue). See page 12 for an overview of the management of adult spinal deformity.
Dear Colleagues,

Welcome to the 2012–2013 edition of *Spinal Column* from Cleveland Clinic’s Center for Spine Health. We are delighted to share in these pages a few of the notable clinical and research developments under way in our center as well as our expert staff’s perspectives on some of today’s leading issues in spinal care.

The diversity of contributions in this issue speaks to the breadth of clinical services we offer and our commitment to providing patients comprehensive evaluations that consider the full range of medical, interventional and surgical management options.

This range of options and the thoughtful consideration behind them is exemplified in the new Cleveland Clinic Spine Carepath, which Daniel Mazanec, MD, outlines in our lead article. As Dr. Mazanec explains, we are embedding this evidence-based decision-making tool into our electronic medical record to help overcome the inertia that too often prevents optimal compliance with clinical guidelines for spinal care.

The issue’s next contribution, from medical spine specialist E. Kano Mayer, MD, illustrates how our clinical approach includes systematic tracking of the psychosocial outcomes of patients with spine pain. As Dr. Mayer notes, close collaboration with our behavioral health colleagues in Cleveland Clinic’s Neurological Center for Pain enables us to comprehensively address the mental as well as the physical sequelae of spine injury.

Interdisciplinary collaboration is likewise a touchstone of the next two articles — companion pieces by our rheumatologist colleague Chad Deal, MD, and spine surgeon Richard Schlenk, MD, on our complementary medical and surgical approaches to vertebral compression fractures. Dr. Deal brings to bear his expertise as a national osteoporosis thought leader, while Dr. Schlenk reviews the relative merits of vertebroplasty and kyphoplasty and explains how we weigh the somewhat controversial findings from recent randomized controlled trials of vertebroplasty.

The issue’s remaining articles underscore the extent of our medical and surgical offerings across a broad spectrum of issues in spine care. On the medical side, Russell DeMicco, DO, and a junior colleague review their clinical approach to the latest interventional techniques for patients with low back pain. They conclude with their perspectives on the recent linkage of a large number of meningitis cases (some fatal) to contaminated lots of a steroid used for spinal injections. In his second contribution to this issue, Dr. Mazanec shares promising clinical outcomes data in an area where they have been sorely lacking — the use of acupuncture for chronic spinal pain. And medical spine specialist Tagreed Khalaf, MD, presents a practical review of widely used herbal supplements and how to minimize their potential risks when treating patients for spine problems.

On the surgical side, Douglas Orr, MD, describes the special challenges of managing spinal deformity in adults and how a nuanced surgical approach can yield important patient benefits. Thomas Mroz, MD, surveys the evidence on newer, less-invasive techniques in spine surgery and shares general guidance on when and how they stack up most favorably against traditional open methods. Finally, Andre Machado, MD, PhD, concludes the issue with a thoughtful overview of when and how to consider spinal cord stimulation for postlaminectomy syndrome.

As these pages attest, our Center for Spine Health is prepared to partner with you and your patients at any point along the continuum of spine care. A thorough evaluation and a collaborative approach to management decisions are the hallmarks of our care ethic. I hope you enjoy reviewing this issue as much as we enjoyed preparing it. We welcome your feedback and opportunities to collaborate to advance spine care for all our patients.

Respectfully,

Gordon R. Bell, MD
Director, Center for Spine Health
Cleveland Clinic Neurological Institute
There is a broad consensus among the more than 10 clinical practice guidelines published in the last decade on the best evidence-based approach to managing back pain. Unfortunately, there is little to suggest that dissemination of these guidelines has altered physician practice, improved patient outcomes or enhanced the value of care delivered. The Cleveland Clinic Spine Carepath is a unique initiative to implement high-quality, literature-informed clinical spine care while systematically assessing patient outcomes and regularly capturing provider adherence to key process measures. Once the Spine Carepath is embedded in the electronic medical record (EMR) — projected by early 2013 — it will assist the physician by providing a flexible, state-of-the-art road map for high-value spine care.

A Crushing Clinical and Cost Burden
Spine disorders are common and costly. The point prevalence of low back pain in the adult population is approximately 25 percent, and the lifetime prevalence approaches 90 percent. The direct medical cost of caring for spinal disorders doubled between 1997 and 2004 and is now estimated to be nearly $90 billion annually in the United States. In Medicare patients alone, charges for epidural steroid injections increased 629 percent between 1994 and 2001. Despite escalating expenditures for spine care, however, the rate of self-reported disability from back pain has increased in recent years — from 20.7 percent in 1997 to 24.7 percent in 2005.1

Guidelines Have Been Ineffectual
Clinical practice guidelines for back pain have consistently emphasized a very favorable short-term prognosis, with the exception of cases with rare serious causes such as malignancy or infection. Recommendations for acute back pain therapy emphasize the central role of education, simple non-preservation analgesics and the benefit of continued physical activity as tolerated. With few exceptions, imaging of any kind is not indicated in such patients and does not improve clinical outcomes.
Unfortunately, adoption of guideline recommendations by providers is poor. In fact, a recent study of the care of patients with acute back pain found no change in patterns of care after guideline publication. Twenty-five percent of patients underwent imaging, while only 20.5 percent received education and advice. Contrary to guideline recommendations, almost 50 percent of patients received prescription drugs, including nonsteroidal anti-inflammatory drugs and opioids. For chronic nonspecific low back pain, care is even more variable and costly.

Spine care is fragmented among multiple providers, including medical and surgical physicians of various specialties, chiropractors, physical therapists, anesthesiologists, radiologists and alternative medicine practitioners. Inappropriate use of widely available imaging tools demonstrates “abnormalities” of doubtful clinical significance, leading to errors of symptom attribution and misdirected medical and surgical therapy. In this milieu, practitioners may use a diversity of unvalidated management strategies with variable and unstudied outcomes.

Overcoming Inertia with an EMR-Embedded Carepath

The Cleveland Clinic Spine Carepath addresses these issues by providing an evidence-informed strategy for back care (Figure) that will be embedded in the EMR. Key elements of care are captured in structured documentation — i.e., clinical notes — within the EMR. For example, historical “red flags” suggestive of back pain due to malignancy are in the documentation required at the initial patient encounter. Diagnostic and therapeutic orders are recorded in a retrievable data set, allowing retrospective study of the process of care and its impact on clinical outcome. The Spine Carepath is linked to Cleveland Clinic’s Knowledge Program®, an interactive database that elicits patient-reported validated outcome measures at appropriate intervals throughout the course of care.

The Spine Carepath is among the latest of several carepaths — shared decision-making models — developed recently for various conditions managed within Cleveland Clinic’s Neurological Institute. Clearly, an evidence-informed and structured carepath with well-defined process measures and regular assessment of relevant clinical health status measures provides an opportunity to reduce potentially harmful variability in spine care while improving patient outcomes. Appropriate and timely utilization of medical services may reduce the cost of care, improving value. Finally, the carepath fosters a continuous quality improvement model as systematic analysis of process and outcome data directs ongoing revision and re-evaluation of the clinical algorithm itself.

References


Figure. The recommended work flow for low back pain under the Cleveland Clinic Spine Carepath.
The connection between mind and body has been well recognized in medicine since the time of Hippocrates. A growing body of spine medicine research demonstrates social benefit from early recognition and appropriate management of the mental as well as physical distress related to spine injury. This research comes at a time when the financial stakes of managing the most challenging spine cases are extraordinarily high, as less than 10 percent of spine pain patients account for more than 85 percent of annual U.S. spending on spine-related care. This reality has led to demands for cost-effectiveness research to better understand and curb the growing social and financial burden of spinal injuries. Improved management of the mental effects of spinal injury may have a central role in such efforts.

To that end, the Center for Spine Health has collaborated with other centers in Cleveland Clinic’s Neurological Institute to develop a broad-based multidomain outcomes tracking system. We are using this tracking system to continually adjust our practice in response to trends recognizable only with thorough prospective outcomes monitoring, quality control and practice improvement strategies.

Mental Distress in Spine Injury: A Long-Elusive Role

It seems that every generation redefines the fine line between physical and mental perceptions of pain and disability. Regardless of where the line actually lies, it is clear that physical stress and distress create mental distress. Reciprocally, poor coping skills and poor social support clearly magnify physical distress and predispose an injured patient to disability.

Various measures of distress or psychiatric comorbidities have been studied over time by spine medicine thought leaders. Among the most notable was Dr. Leon Wiltse’s pioneering use of the Minnesota Multiphasic Personality Inventory in the 1970s. Since then, various spine surgeons have used many “objective” questionnaires to try to determine factors that predict poor treatment response or development of chronic disabling spine pain. Although psychometric test development remains a cottage industry, there are no signs of a silver bullet that will identify which patients will develop chronic pain. Even with ongoing test development and the deployment of automated data-collection tools, consistent application of widespread, broad-based outcomes testing has been idiosyncratically applied in spine medicine. Multiple research papers have used portions of the 36-item Short Form Health Survey (SF-36), the Beck Depression Inventory, the Structured Clinical Interview for DSM-IV and the Fear-Avoidance Beliefs Questionnaire to assess patients’ success in returning to their previous social, occupational and avocational function while avoiding chronic disabling low back pain. Nevertheless, collection of outcomes data to inform continuous practice improvement is not widespread in spine care.

Comprehensive Outcomes-Tracking Platform

Our Center for Spine Health uses an outcomes-tracking platform developed at Cleveland Clinic called the Knowledge Program in which six specific, well-validated domains of patient-entered information are used to track the outcomes of interventions including physical therapy, medications, spinal injection procedures, acupuncture, spinal surgery and osteopathic manipulation. These data are used alongside “hard anchor” data (such as return to work, days missed from activities, disability application and early retirement) to track the benefits and failures of chosen spine interventions. The specific domains include two validated functional questionnaires, a cost-utility questionnaire, a psychological distress questionnaire and a depression/suicidality-specific questionnaire. The data specific to interventions provided by the Center for Spine Health are published in an outcomes report updated annually by Cleveland Clinic’s Neurological Institute.

Psychosocial Improvement Correlates with Functional Gains

Some general trends with regard to depression in the context of spinal problems have emerged from the two most recent years of data. Much to our surprise, lumbar radiculopathy was associated with a higher mean
the cost utility of a comprehensive spine program that collected and appropriately controlled data that evaluate our future goals include publication of prospectively collected data. It allows for treatment of even the most refractory cases.

pain neurologists, psychiatric nurses and psychiatrists from the Center's ample supply of well-trained pain psychologists, program directed by Edward Covington, MD. That program's ample supply of well-trained pain psychologists, pain neurologists, psychiatric nurses and psychiatrists allows for treatment of even the most refractory cases.

Our future goals include publication of prospectively collected and appropriately controlled data that evaluate the cost utility of a comprehensive spine program that can yield early reductions in both physical and mental distress; bolster patients' social coping skills; and return patients to appropriate work, family and community roles at the lowest cost and without duplication of services. We move forward fully recognizing that changing the cost curve in spine care relates directly to the ability to measure — and then modify — treatment strategies to best address the mental as well as physical impairments associated with spine injuries.

**Assets and Ambitions Moving Forward**

The Center for Spine Health is fortunate to have a close association with Cleveland Clinic's internationally recognized Neurological Center for Pain, an interdisciplinary program directed by Edward Covington, MD. That program's ample supply of well-trained pain psychologists, pain neurologists, psychiatric nurses and psychiatrists allows for treatment of even the most refractory cases.

Despite this finding, the overall trends for spine interventions are favorable. In 2011, more than 70 percent of patients treated with spinal injections for lumbar disc herniation noted improvement in depression/psychosocial distress as measured by the Patient Health Questionnaire (PHQ-9) (Figure 1). Similarly, among patients who elected to undergo surgical decompression for lumbar disc herniation, greater than 80 percent had improvement in depression (Figure 2). These changes in depression correlated with functional improvements as measured by the Pain Disability Questionnaire. Nearly 70 percent of patients receiving injections noted improvement in function at work and home (Figure 1), as did nearly 90 percent of patients who underwent surgery (Figure 2). The overall improvement in depression/distress scores (PHQ-9) was most robust following treatment of lumbar disc herniation (with either spinal injection or surgery) when compared with treatment of other spinal conditions. In this population with lumbar disc herniation, depression scores began in a moderate range (mean = 11) and decreased to a mild level (mean = 4) in the PHQ-9 scoring system. 3

As might be expected, patients who did not enjoy significant improvements in either function or depression after spinal injection or surgery tended to have higher preoperative PHQ-9 scores (mean = 16). This general trend was seen across the multiple diagnostic reasons for surgery beyond just lumbar microdiscectomy. The blunting effect of a high PHQ-9 score on postsurgical outcome was most starkly demonstrated in the treatment of cervical myelopathy. Among patients with a mean depression score of 18 or higher, a full 28 percent failed to achieve functional gains after surgical decompression of the cervical spine.

**References**


Vertebral compression fracture (VCF) is a common but often asymptomatic event that poses a range of management challenges. All patients with nontraumatic VCFs require treatment for osteoporosis, yet there is a large care gap in the treatment of all fractures, including VCFs: Less than half of patients with fractures are offered osteoporosis treatment. For patients with a symptomatic VCF, management decisions have been complicated by recent controversies about the merits of vertebral augmentation approaches.

Cleveland Clinic’s Center for Spine Health aims to manage patients with VCF in a highly individualized fashion, drawing on interdisciplinary collaboration to provide medical therapy for the underlying osteoporosis, as I discuss here, as well as on judicious use of medical and surgical therapy for fracture-related pain, as discussed in the companion piece by my colleague Richard Schlenk, MD, that follows this article. Our articles outline principles that guide Cleveland Clinic’s approach to the complexities of VCF management that we often encounter.

VCFs: Common but Often Undetected

In the Framingham study, a large population-based cohort trial established in 1948, about 20 percent of men and women had one or more VCFs. Up to 53 percent of white women over age 80 have evidence of a VCF. Yet only one-third of patients with a VCF have symptoms and are likely to seek medical attention.

The fact that two-thirds of VCFs are asymptomatic means that clinicians should always review lateral chest X-rays for thoracic fractures. Likewise, height measurements of patients should be taken as part of the clinic visit at least once a year, and patients with more than a 1.5-inch loss in height should undergo spine X-rays for fracture evaluation (Figure). Asymptomatic VCFs are termed “morphometric vertebral fractures.”

All Nontraumatic VCFs Merit Osteoporosis Therapy

When a nontraumatic VCF (often called a fragility fracture) is identified, treatment for osteoporosis is required, regardless of bone mass, as recommended by current National Osteoporosis Foundation guidelines. Osteoporosis medications may be divided into anti-resorptive agents and anabolic agents. The anti-resorptive agents include estrogen, calcitonin, estrogen agonist-antagonists (raloxifene), bisphosphonates and denosumab. The only anabolic agent available for osteoporosis is teriparatide. Both anti-resorptive and anabolic therapies have been demonstrated in randomized controlled trials to reduce the incidence of VCFs by 50 to 65 percent.

Many Factors Guide Therapy Choice

The choice among anti-resorptive agents depends on many factors. Estrogen preparations are often used in women who need hormone therapy to control menopausal symptoms. Raloxifene is often used in younger women (in their 50s and 60s) with low spinal bone mass but is not a good option in older women or those with low hip density since raloxifene has not been shown to reduce nonvertebral and hip fractures. Most patients are treated with a bisphosphonate; these compounds are available in oral formulations for weekly or monthly dosing or in intravenous formulations for administration every three months (ibandronate) or 12 months (zoledronate). Denosumab, a monoclonal antibody that targets the RANK ligand (RANKL), was approved in 2010 for osteoporosis treatment in postmenopausal women and is given as a subcutaneous injection every six months.

Another Option for High-Risk Patients

The one available anabolic therapy for osteoporosis, teriparatide, should be considered only in patients at high risk for fracture, in light of its high cost (> $900 a month) and the need to administer it as a daily injection. Patients at high fracture risk include those with a previous VCF, especially those with recent fractures that are moderate (> 25 percent height loss) or severe (> 40 percent height loss); patients
with multiple fractures; and patients with very low T-scores (< −3.0), even in the absence of fracture.

Reanalysis of the original registration trial for teriparatide, using semiquantitative and morphometric methods to identify incident fractures, showed that it reduced VCFs by up to 84 percent; additionally, it reduced nonvertebral fractures by 54 percent. The drug carries an FDA-mandated black-box warning regarding osteosarcoma because it was found to cause osteosarcoma in Fisher 344 rats when given in high doses for more than 80 percent of the rats’ lives. However, use of the drug in more than 1 million patients since its introduction in 2002 has not been associated with an increased signal of osteosarcoma. A registry is enrolling patients started on teriparatide to identify osteosarcoma risk. The duration of teriparatide therapy is limited to two years, after which an anti-resorptive agent should be initiated to consolidate the teriparatide-induced effect on bone mass and strength.

On the Horizon

In addition to these commercially available therapies, a monoclonal antibody to sclerostin (AMG 785, or romosozumab) looks promising in ongoing clinical trials for osteoporosis and fracture healing. It has been associated with a greater than 11 percent increase in lumbar spine bone density over 12 months. Romosozumab is given as a subcutaneous injection once a month (vs. daily for teriparatide). Its registration trial is currently enrolling patients, and clinical trials are under way to assess its effect on fracture healing for both hip and tibial fractures.

Foundational Measures Remain Essential

In addition to the above prescription therapies, adequate intake of calcium and vitamin D is a cornerstone of osteoporosis management in patients with VCF. All patients should receive the U.S. Recommended Dietary Allowance of calcium (1,200 to 1,500 mg) and vitamin D (800 to 1,000 IU) (many patients may need higher doses of vitamin D).

Additionally, a fall-prevention program, including physical therapy for balance training, is recommended for fracture patients who fall or have poor balance. Patients also should be instructed in the mechanics of using the back without putting stress on the vertebrae, stress that often occurs with activities that involve bending and lifting with the trunk flexed.

These types of strategies are brought to bear in the Center for Osteoporosis and Metabolic Bone Disease in Cleveland Clinic’s Department of Rheumatic and Immunologic Diseases. Our goal is to evaluate patients at an early stage to prevent the complications of osteoporosis, including recurrent VCFs. We use bone densitometry, absolute risk calculation (using the WHO FRAX tool) and appropriate laboratory evaluations to rule out secondary causes of low bone mass and guide management of complex osteoporosis cases referred by our colleagues in the Center for Spine Health and beyond.

References

Management of Painful Vertebral Fractures: Considerations for Navigating the Controversies
By Richard Schlenk, MD

As noted by my colleague Chad Deal, MD, in the preceding article, two-thirds of all osteoporotic vertebral compression fractures (VCFs) are pain-free and go undetected. However, the remaining third of VCFs are chronically painful and associated with significant human costs. These include reduced quality of life, decreased respiratory capacitance and significant pulmonary disease, which is the most common cause of death in patients with VCFs. Multiple VCFs can lead to noticeable spinal deformity and loss of apparent height. This article reviews considerations that guide our decision-making in Cleveland Clinic’s Center for Spine Health regarding vertebral augmentation for the management of painful VCFs in light of recent controversies over augmentation methods.

General Considerations in Managing Painful VCFs
Many patients with symptomatic VCFs report a recent event, prior to the onset of pain, that gave rise to pain different from usual back pain. Their pain typically worsens when they are in the upright position and improves when they are recumbent. On physical examination, palpation of the spinous process and/or flexion and extension provoke typical pain. Fractures are usually seen with plain radiographs. However, CT or MRI can help differentiate old from new fractures.

Conservative measures have been the mainstay of treatment for decades and include bracing, analgesics and activity modification. While most VCFs heal spontaneously within four months, they do so in a collapsed, deformed position. Surgeons should avoid open surgical treatment of VCFs because of the magnitude of the procedures involved and the significant associated complications.

Vertebral Augmentation Options
The chief indication for vertebral augmentation is persistent mechanical back pain from a VCF. Healed compression fractures are not currently amenable to treatment using vertebral augmentation techniques. Acute and subacute fractures are identified by MRI, and patients who cannot undergo MRI may need a bone scan and serial radiographs to determine fracture acuity. VCFs from primary and secondary osteoporosis as well as from lytic metastatic disease (multiple myeloma) can be treated from T4 through L5.

Minimally invasive surgical treatment of VCF was introduced in 1986 in France with the development of vertebroplasty (VP), the percutaneous injection of bone cement into a fractured vertebra to achieve stabilization and pain relief.

Kyphoplasty (KP) is a similar minimally invasive technique for reducing and stabilizing VCFs. Tubular instruments are passed into the fractured vertebral body through two quarter-inch incisions. An inflatable bone tamp (IBT) is then passed through the cannula into the vertebral body. The IBT is inflated to reduce

Vertebroplasty’s critics cite cement leakage rates as high as 30 percent, while its supporters note that height restoration and kyphosis correction with kyphoplasty are clinically insignificant.
the fracture deformity and create a cavity within the vertebra, after which the IBT is deflated and removed. The cavity is then filled with a suitable bone void filler to stabilize the fracture in the corrected position. For both of these vertebral augmentation procedures, the entire operation, including the cement injection, is visualized with fluoroscopy to ensure proper placement of instruments and the bone void filler. Both VP and KP can be performed using general or local anesthesia and require approximately 30 minutes for augmentation of a single vertebra.

**Vertebroplasty vs. Kyphoplasty**

Critics of the use of VP over KP cite consistent reports of cement leakage rates as high as 30 percent with VP compared with rates of 10 percent with KP. Supporters of VP make several observations: pain reduction scores with VP are similar to those with KP; VP is less costly; cement leakage is rarely symptomatic; and height restoration and kyphosis correction, touted as important by many early KP proponents, have been shown to be modest and clinically insignificant.

**New England Journal Papers Raise as Many Questions as Answers**

In 2009, two randomized controlled trials were published simultaneously in the *New England Journal of Medicine* comparing VP with a sham control procedure (injection of a local anesthetic) (*N Engl J Med*. 2009;361:557-568 and *N Engl J Med*. 2009;361:569-579). Pain and disability scores were not shown to be different between the VP and control groups. Critics of these studies have argued the following:

- Less than 10 percent of screened patients were included.
- The inclusion criteria were set too low (visual analogue scale score of 3).
- The authors included mainly chronic fractures (of four to five months’ duration).
- There was no clear correlation in either study between patients’ pain location, severity of pain, imaging findings and pain on physical examination.
- Introduction of a local anesthetic to the pedicle may treat symptoms and not represent a true sham control.
- One study did not require MRI/bone scanning for every patient to discern old from new fractures.
- The studies simply may have been underpowered (there was a trend toward improvement with VP).

We offer patients a thorough explanation of treatment options to partner with them in arriving at the best individual management decisions the current state of evidence allows.

Many have noted that the results of these two randomized trials contradict several meta-analyses that concluded that vertebral augmentation is effective in reducing pain and disability. The fact that no randomized trials have been conducted to assess KP adds no clarity about the relative merits of the two augmentation procedures. These uncertainties leave management recommendations hard to define, particularly in cases involving elderly patients with severe refractory mechanical back pain from a spontaneous VCF.

In the Center for Spine Health, we critically examine the available literature on these questions and draw on nuances of study findings specific to select subpopulations where we can. We also offer patients a comprehensive evaluation and thorough explanation of treatment options to partner with them in arriving at the best individual management decisions that the current state of evidence allows. We look forward to working with colleagues around the nation and the world to better define best practices in the surgical management of painful VCFs.
Spinal Deformity in Adults: More Than Managing ‘Big Kids’
By R. Douglas Orr, MD

To many people, spinal deformity is synonymous with adolescent idiopathic scoliosis (AIS). Although this is the case in younger age groups, spinal deformity is much more varied and complex in adulthood. This article reviews the special challenges of managing spinal deformity in adults as well as principles and approaches we have found effective in managing these cases at Cleveland Clinic’s Center for Spine Health.

Deformity in Adults: How It Stacks Up Against AIS
The management of AIS centers around curve measurements and involves predominantly the thoracic spine. Pain, although sometimes present, is not a major feature in management. In contrast, in adult deformity we are concerned mostly with the lumbar spine, and pain is the dominant presenting complaint. Curve magnitude and progression generally do not constitute an independent indication for treatment, and there is no role for bracing in the adult population.

Adult spinal deformity can develop via a number of processes, including de novo deformity due to degenerative change, development of symptoms from treated or untreated AIS, deformity secondary to trauma, or iatrogenic deformity resulting from previous surgery.

Decision-making in the management of adult spinal deformity is often very complex and involves weighing a large variety of treatment approaches and options. In some cases the deformity is incidental to the presenting problem, whereas in others the deformity is a major cause of symptoms.

All About Balance
There is a wide variation in what is considered “normal” spinal alignment. The human body goes to great lengths to maintain the head’s position directly over the pelvis in both the frontal and sagittal planes. This allows standing and walking to be done with minimal energy expenditure. We call this spinal balance, and in adults with deformity it is the single most important factor in treatment options and in patient-perceived outcome. Patients who are balanced have fewer symptoms and a higher level of function before and after treatment. A primary goal of treatment is the maintenance or restoration of balance.

Assessment
The first step in assessing the adult with spinal deformity is to identify the dominant presenting complaint. In many cases patients are unaware that they have a deformity, and they mostly want information on natural history and activities to be avoided or encouraged. Patients most often present complaining of pain. In these cases it is important to get a clear description of the pain and attempt to determine its cause.

Patients with spinal deformity are subject to the same aging-related spine problems as the rest of the population. Most acute back pain in these patients is muscular and self-limiting. Also, herniated discs and spinal stenosis can occur in the presence of spinal deformities.

Obtaining a history of the pattern of pain — including onset, location, exacerbating and alleviating factors, and response to treatments to date — will often lead to a presumptive diagnosis. The physical examination should include a neurologic exam as well as assessment of spinal alignment, motion and balance. Hip and knee exams are also often important. In the acute setting, the indication for imaging should be the same as in a patient without deformity. In the absence of red flags, imaging is not indicated at first presentation. Once imaging is indicated, it should begin with standing X-rays in both the anteroposterior and lateral planes, ideally including the entire spine from occiput to hip joints. Advanced imaging, such as MRI or CT, is indicated for assessing the neural axis and for surgical planning, and CT may be useful for assessing the status of any previous fusion (see “Case study” sidebar).

Initial Treatment: No Special Measures Required
Whereas surgery is often considered prophylactic in AIS, there is little or no role for prophylactic surgery in adult deformity. In asymptomatic cases, education and sometimes observation is the mainstay of treatment. Initial treatment of back or leg pain in an adult with deformity should in most cases be no different than in a person with normal alignment. Acute back pain should be treated with NSAIDs, mobilization and core-strengthening exercise. Acute radicular pain should be managed expectantly, as most cases will resolve. Claudicant leg pain is managed with exercise, activity modification, medications and possibly interventional therapies such as epidural injections. Essentially, the spinal deformity becomes a factor in treatment only
Surgery for Pain in the Setting of Spinal Deformity

When appropriate nonoperative management has failed and surgery is being considered, the first step is to determine what role, if any, the deformity plays in causing the pain. A patient with a balanced, stable scoliosis with sciatica due to a herniated disc may do very well with just a microdiscectomy. On the other hand, a patient with a fixed deformity who is unable to stand with head balanced over hips will not benefit from an operation that does not restore balance.

If the dominant symptoms are the direct result of the deformity, then surgery must address the deformity. In general, any patient who is no longer in balance will need to have the deformity corrected and stabilized. These are generally complex major procedures with significant risks and a prolonged recovery. In some medically fragile patients, the risks of surgery to correct deformity are simply too high for it to be a viable option.

Many spine surgeons were taught that limited surgery has no role in cases of deformity and that an all-or-nothing approach is needed. I no longer believe this, as I see a role for limited surgery in certain appropriate situations. In a patient with a balanced spine in whom the pain generator can be localized, there is a role for focal surgery to address just this problem. For example, in a patient with spinal stenosis, a degenerative spondylolisthesis and a balanced degenerative scoliosis, treatment of just the stenosis and spondylolisthesis may be a very good option.

Surgical Technique: Tailoring the Multiple Options

Surgery to correct spinal deformity is a highly complex undertaking that many spine surgeons opt not to offer as part of their practice. These operations generally involve long incisions and extensive instrumentation to correct and stabilize the spine. Many different techniques can be used, with no single technique appropriate for all situations. Anterior, posterior, combined and minimal-access approaches may be used, and each surgeon should employ the techniques that he or she performs best for the given clinical situation. Outcomes studies show that as long as a balanced, stable spine is achieved, outcomes are equivalent regardless of technique.

Less-invasive surgical techniques have attracted much interest in recent years, and some show a lot of promise. In other cases, less-invasive techniques have produced inferior results compared with standard techniques and are no longer in use. No studies have directly compared newer approaches to traditional procedures. Overall, it appears that minimal-access techniques shorten recovery time but have not shown a benefit over the longer term. These techniques are often a very good option in selected patients, and their role in the treatment of spinal deformity continues to evolve.

Stakes of Proper Management Are High

There is a wide range of treatment options for spinal deformity in adults, and no single approach works for all problems. Patients with symptomatic spinal deformity should seek a clinician with experience in treating these problems — ideally one who can provide the full range of options. An inappropriate initial surgical choice carries a significant risk of worsening the deformity. It is not uncommon for patients to undergo multiple procedures to treat a deformity even at the most experienced centers. While spinal deformity can lead to debilitating pain, its successful treatment can dramatically change patients’ quality of life.

Case study

A 75-year-old man presented eight years after an L2-3 posterior fusion with increasing axial back pain, neck pain, L5 radiculopathy and inability to stand upright. Pain had progressed over five years to the point that he could not stand for more than a few minutes and was unable to walk more than 50 yards using a walker.

Preoperative lumbar X-rays (Figure 1) showed a degenerative scoliosis and a focal kyphosis above the fusion. Sagittal CT imaging (Figure 2) showed solid fusion from L2 through L5 and a vacuum effect change in the disc spaces at L1-2 and L5-S1.

The patient underwent an anterior interbody fusion at L5-S1, a pedicle subtraction osteotomy at L2 (Figure 3) and a T10-ilium posterior instrumentation and fusion. Good balance was achieved, as shown in Figure 4. Six months after surgery he had no pain in his back or neck and his radiculopathy had resolved.
Over the past several years, less-invasive (i.e., minimally invasive) surgical techniques have been a dynamic area in spine surgery. Less pain, shorter hospitalizations, smaller scars and better outcomes are among the potential benefits that have fueled enthusiasm for the concept of less-invasive spine surgery. As with all new technologies, however, time and research are necessary to validate, or refute, its efficacy and overall value to patients.

Conceptually, less-invasive surgery of the spine accomplishes the same surgical goals (e.g., neurological decompression, fusion) as do traditional open techniques, but it does so through smaller incisions and with less tissue dissection. Clearly, this has appeal for patients, and many surgeons have buttressed their skill sets to offer less-invasive procedures. But do these procedures offer better clinical outcomes? Let’s consider the evidence in each of the two broad categories of spine operations.

Neurological Decompression

Decompression is the most common type of spine operation, and removing neurological compression through microdiscectomy, laminotomy or laminectomy offers a very predictable benefit for patients through traditional open techniques. Over the past decade an increasing number of studies, offering a heterogeneous collection of levels of evidence, have been published on the various less-invasive decompressive techniques. Two randomized controlled trials (Ruetten et al, Spine. 2008;33:931-939, and Hermantin et al, J Bone Joint Surg Am. 1999;81:958-965) have demonstrated better short-term outcomes with less-invasive lumbar microdiscectomy compared with its open counterpart in terms of less narcotic use and shorter hospital stays. However, there has been no definable clinical difference between the two procedures at longer-term follow-up. Moreover, one randomized trial (Arts et al, JAMA. 2009;302:149-158) reported superior back and leg pain scores with open microdiscectomy compared with less-invasive surgery. There is a paucity of comparative evidence on less-invasive and open single- and multilevel laminectomy. The evidence that does exist does not suggest superiority of less-invasive over traditional open procedures in the long term.

With a limited number of comparative trials of fusion techniques and no level I evidence, more research is needed to further define the merits and drawbacks of less-invasive approaches.
Lumbar Fusion

Less-invasive lumbar fusion techniques have evolved remarkably over the past decade. Direct lateral interbody fusion, transforaminal lumbar interbody fusion (TLIF) and posterior lumbar interbody fusion (PLIF) are all common open fusion procedures that are now performed less invasively. When performed for proper indications, open lumbar fusion can provide substantial and measurable improvement in a patient’s quality of life. However, open fusion procedures are associated with certain morbidity from the surgical approach. Less-invasive fusion procedures were designed to improve on the open approaches and, in theory, should lessen morbidity. Over the past several years, several comparative trials have been published evaluating less-invasive and open fusion surgeries. Notably, however, there is no level I evidence on this topic.

In 2010, Müller and colleagues (Minim Invasive Neurosurg. 2010;53:21-24) retrospectively compared less-invasive PLIF and open PLIF for degenerative lumbar spondylolisthesis in 40 patients. While there was a statistically significant advantage in Oswestry Disability Index and visual analogue scale (VAS) scores at three months in favor of less-invasive PLIF, there was no difference in these outcomes at 12 months. Conversely, in a prospective trial that compared the same techniques, Park and Ha (Spine. 2007;32:537-543) reported a statistically significant advantage in VAS back pain scores at 12 months in favor of less-invasive surgery. Finally, in 2009 Peng and colleagues (Spine. 2009;34:1385-1389) published a prospective trial comparing less-invasive and open TLIF in 58 patients with two-year follow-up. They found better short-term outcomes with less-invasive surgery (i.e., shorter hospitalization, less operative blood loss and less narcotic use), but there was no difference in VAS back or leg pain scores at six-month and two-year follow-up.

Conclusions and Recommendations

It appears that less-invasive surgical decompressive and fusion techniques have benefit over open techniques in the short term. Longer-term (one- and two-year) clinical outcomes for fusion techniques are mixed but generally do not demonstrate a difference between open and less-invasive procedures. With a limited number of comparative trials of fusion techniques and no level I evidence, more research is needed to further define the merits and drawbacks of less-invasive approaches.

At Cleveland Clinic, the Center for Spine Health routinely performs traditional open and less-invasive spine surgery procedures. However, less-invasive procedures are not indicated for all patients, and it is critical for patients to understand this very important point. At Cleveland Clinic, each patient is evaluated individually to ensure selection of the specific procedure that is best suited to his or her case and likely to yield the best outcome.

It’s important for patients to understand that less-invasive procedures are not indicated for all patients.
As advances are made in interventional techniques for low back pain, the role of the medical spine specialist has become more vital in treating complex back pain. This article reviews the general approach taken by Cleveland Clinic’s Center for Spine Health for patients presenting with low back pain. Although there are newer techniques (interventions such as minimally invasive lumbar decompression [the MILD procedure]) aimed at treating lower limb symptoms consistent with pseudo-claudication from one-level spinal stenosis secondary to ligamentum flavum thickening, this discussion focuses on techniques used in treating low back pain.

Taking Care to Identify the Right Candidates

When speaking with patients about their concerns, we aim to answer two main questions: (1) What is the problem? (diagnosis) and (2) What can we do for the problem? (treatment). Spinal injections can be both diagnostic and therapeutic. A patient's response to sacroiliac joint injection may help determine his or her candidacy for certain surgical techniques to address pathology in the area of the injected joint, and response to selective nerve root injection (Figures 1 and 2) may provide insight on the appropriate operative level. Both of these procedures — as well as others, such as facet joint injections and medial branch blocks — may help to define the pain generator. Although these procedures are not technically new, their judicious use, with attention to detail, safety and the application of strict criteria when interpreting response, is a novel idea to some.

Despite perceptions among some patients and physicians, not every patient with low back pain needs an injection or surgery. We advise patients that time, exercise and medications are the mainstays of treatment. Injections and surgery are like relief pitchers in a baseball game — to be called on only if needed. But when interventional techniques are used appropriately on properly selected patients, they can be very successful.

Tips on Select Interventions

Intra-articular injections of the facet joint, hip joint (Figure 3) and sacroiliac joint can be extremely useful to the spine practitioner in defining the cause of pain and in facilitating the patient’s participation in an active exercise or physical therapy program. These injections are not administered in isolation or in a series but as part of a comprehensive rehabilitation process. Evaluation of patients in the immediate post-injection period (the anesthetic phase) in the recovery room is important to the success of treatment. By performing maneuvers or special tests during this phase that would typically be bothersome or provocative, the physician and patient can determine the effectiveness of the injection. The post-procedure pain diary is reviewed at the scheduled follow-up visit.

We advise patients that time, exercise and medications are the mainstays of treatment. Injections and surgery are like relief pitchers in a baseball game — to be called on only if needed.
Medial branch blocks are used to help determine a patient’s candidacy for an advanced intervention such as radiofrequency ablation. The likelihood of successful radiofrequency ablation increases with the degree of pain improvement following injection, with 75 percent improvement often being a useful threshold.

Steps for Making Safety Paramount

The use of fluoroscopy is standard of care for the previously mentioned procedures as well as for epidural steroid injections and selective nerve root injections, which are more useful in diagnosing and relieving radicular or pseudoclaudicatory limb pain. The safety of patients is paramount. Patients undergo one procedure and are re-evaluated rather than getting a series of injections before being evaluated again. This minimizes any potential harmful effects from accumulated steroid doses as well as risks from repeated procedures and the risk of an unnecessary procedure being performed. Our clinicians are also cautious about the type of steroid or anesthetic injected.

Digital images or printed copies should be stored as part of the patient’s record for reference that the correct procedure was done on the correct patient in a correct and safe manner. Digital subtraction angiography is an additional safety measure that can be taken beyond fluoroscopic imaging.

Recent Meningitis Outbreak

Epidural steroid injections have gained national attention as a result of the recent meningitis outbreak. These procedures carry risks including (but not limited to) bleeding, infection, dural puncture and nerve damage. As of this writing (mid-October 2012), the meningitis outbreak appears to be of fungal origin, to be noncontagious and to stem from a single pharmacy’s distribution of three contaminated lots of the steroid methylprednisolone acetate. Physicians in Cleveland Clinic’s Center for Spine Health use various types of steroids, and none are from the compounding pharmacy that distributed the contaminated steroids. For carefully selected patients, epidural steroid injections continue to be a part of our comprehensive efforts in managing low back pain.
Although acupuncture has been practiced for more than 2,000 years and was endorsed by an NIH consensus conference more than a decade ago, its role in the management of spinal pain remains somewhat controversial. While numerous recent studies have uncovered multiple physiologic effects of acupuncture needling that may provide analgesia, clinical studies in patients with back pain using validated measures of symptoms and functional outcomes offer conflicting results. A recent analysis of clinical outcomes data from patients treated with medical acupuncture in Cleveland Clinic’s Center for Spine Health demonstrates marked improvement in mood, global health and pain measures.

A Mix of Central and Peripheral Effects

Although acupuncture’s precise mechanism of action remains uncertain, needling produces several potentially beneficial physiologic effects both centrally and peripherally. Central effects include activation of endogenous opioids (endorphins) and other neurotransmitters. Consistent with this finding is the observation that acupuncture effects can be reversed with the opioid antagonist naloxone. Studies using fMRI have demonstrated that acupuncture needling can deactivate limbic areas in the brain that are involved in central pain processing. Peripheral effects are also notable. Recently, release of adenosine, an anti-nociceptive local neuromodulator, was shown to increase after acupuncture in mice.

Clinical studies in patients with back pain have generally demonstrated that acupuncture needling is superior to treatment without needling. However, some studies comparing “real” acupuncture with nonspecific or “placebo” needling have found little difference.

Our findings are of particular interest because many patients who are offered acupuncture have been unable to achieve adequate response to usual care.
Our Approach and Recent Outcomes

For selected patients in the Center for Spine Health, acupuncture is offered as an adjunct to comprehensive medical management for chronic spinal pain. Currently, all patients treated with acupuncture complete a regular progress assessment that measures global health, pain and mood using a set of validated instruments. Regular analysis of these prospectively collected data has found that patients who completed more than six acupuncture treatments in 2011 had clinically significant improvements in pain (Figure 1) with important gains in mood scores (Figure 2) and global health/quality-of-life scores (Figure 3) as well. Moreover, the benefit was widespread, as large majorities of patients who completed more than six acupuncture treatments showed some degree of improvement in all these measures (Figure 4).

These findings are of particular interest because many patients who are offered acupuncture have been unable to achieve adequate response to usual care. Improvement in mood scores with acupuncture has been observed in other chronic disease states, such as severe chronic obstructive pulmonary disease and headache. Ongoing assessment of clinical outcomes should allow us to better define the role of acupuncture in spinal pain management.
Herbal medicine — also known as herbalism or botanical medicine — involves the use of natural plant products to treat illness. Approximately 40 percent of U.S. adults use some form of complementary or alternative medicine (CAM), according to a 2007 survey by the National Center for Health Statistics,\(^1\) and natural products are the most commonly used forms of CAM. The same survey led the National Center for Health Statistics to estimate that U.S. consumers spent about $15 billion on non-vitamin, nonmineral herbal supplements and other natural products for health in 2007. The survey found that herbal products are most commonly used for musculoskeletal issues such as neck and back pain. Therefore, spine specialists need to be aware of these products and the reality that many of our patients may be using them.

Five Points Patients Should Understand Before Taking Supplements

Individuals take herbal supplements for any number of reasons, including perceived safety and efficacy as well as a sense that supplement use gives them greater control over their health or treatment. Yet there are at least five interrelated facts about supplement use that all patients should be informed of:

- **“Natural” does not necessarily mean safe.**
- **Herbal and botanical products are not required to undergo premarket testing for safety and efficacy.** The Dietary Supplement Health and Education Act of 1994 reclassified herbs as dietary supplements, allowing them to be regulated separately from (and far less stringently than) drugs and food.
- **Contaminants are common.** A 2010 report from the U.S. Government Accountability Office\(^2\) revealed that 37 of 40 herbal dietary supplements tested by the agency had traces of potentially hazardous contaminants.
- **Interactions with medications, including over-the-counter therapies, are possible.**
- **Because of potential drug interactions and other effects of herbal supplements, it is critical that patients tell their healthcare providers about supplement use and maintain an open dialogue on the subject.**

Essentials on Some Commonly Used Supplements

It is beyond the scope of this article to cover all available supplements, so the focus here is on some of the most commonly used supplements, particularly those that may be used for spine pain. Because some widely used supplements can have important drug interactions or perioperative effects, a few supplements without purported analgesic effects are included as well, as vigilance about their potential use can be critical in patients undergoing spine surgery or injections. Additionally, the table outlines common drug interactions for these and a few other widely used herbal supplements.

**Devil’s claw (Harpagophytum procumbens)**

Potential uses: Analgesic, antipyretic, digestive aid

Precautions/potential side effects:
- Can affect heart rate, given its chronotropic and inotropic effects (possible bradycardia reported)
- May interfere with the action of ticlopidine and warfarin (increased activity)
- Should not be taken by patients with gallstones or ulcers (promotes gastric secretion)

**Ginger**

Potential uses: Anti-inflammatory, antipyretic, anti-emetic

Precautions/potential side effects:
- Abdominal discomfort, heartburn, diarrhea
- May interfere with blood-thinning medications, as it can inhibit thromboxane formation and platelet aggregation (increasing the risk of bleeding)
- May cause additive reduction in blood glucose (use with caution with hypoglycemics/insulin)

**Turmeric**

Potential uses: Analgesic, anti-inflammatory, digestive aid

Precautions/potential side effects:
- Can act as a blood thinner at high doses
- In animals, high doses resulted in liver disease
- Can cause stomach upset
Echinacea
Potential uses: Anti-infective (prevention/treatment of colds and flu)
Precautions/potential side effects:
• Potential for immunosuppression with long-term use (> 8 weeks), with potential for poor wound healing
• Hepatotoxic
• May decrease effectiveness of corticosteroids

Ginseng
Potential uses: Multiple (“adaptogenic”), energy-level enhancer, stress reducer
Precautions/potential side effects:
• Hypoglycemia
• Tachycardia, hypertension
• Antiplatelet effects (increases bleeding)
• May cause manic-like symptoms when combined with monoamine oxidase inhibitors
• May increase hypoglycemic effect of insulin and sulfonylureas
• May potentiate effect of corticosteroids

Garlic
Potential uses: Antihyperlipidemic, antihypertensive
Precautions/potential side effects:
• Antiplatelet/antithrombotic: increased fibrinolytic activity and diminished platelet aggregation
• Hypoglycemic effects
• Interferes with effectiveness of the antiretroviral drug saquinavir
• May inhibit cyclosporine, potentially causing transplant rejection

Ginkgo (Ginkgo biloba)
Potential uses: Memory improvement, protection against Alzheimer disease
Precautions/potential side effects:
• Antiplatelet effects; long-term use associated with spontaneous subdural hematoma
• Reduced seizure threshold

Potential Issues — and Practical Management — for the Spine Specialist

The review above yields a few precautions that are particularly pertinent for the spine specialist. The first is the need to be vigilant about potential anticoagulation effects from patients’ use of herbal products, given how many herbal supplements can have such effects and the potential consideration of surgical interventions and injections for spine pain. Similarly, vigilance for perioperative hypertension is indicated. Additionally, some herbal supplements may increase the sedative effects of prescribed medications. Vigilance is likewise required concerning the potential immunosuppressive effects of herbs such as Echinacea.

How can spine specialists adequately factor their patients’ potential use of herbal supplements into their practice? Below are a few principles that guide my practice in this area:

• Simply ask patients if they’re taking herbals. This may be the only way to identify some patients who are taking them, as studies have shown that as many as 44.4 percent of patients taking herbal supplements did not consult their family physician.3
• Stop all herbals at least one week before surgery or other spine interventions, such as injections.
• Consider herbals’ potential contribution to noted side effects in patients taking tramadol, tricyclic antidepressants and selective serotonin reuptake inhibitors, given the many noted herb-drug interactions.
• Caution patients about the potential for contamination.

Table. Common Herb-Drug Interactions

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<tr>
<th>Herb</th>
<th>Anticoagulants</th>
<th>Antidiabetics</th>
<th>Steroids</th>
<th>SSRIs</th>
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SSRIs = selective serotonin reuptake inhibitors

References
Getting the Most out of Spinal Cord Stimulation for Failed Back Surgery Syndrome

By Andre Machado, MD, PhD

Spinal cord stimulation (SCS), also called dorsal column stimulation, is a nonablative neuromodulatory treatment routinely used to manage patients with chronic neuropathic pain. The most common indication in the United States is postlaminectomy syndrome, also known as failed back surgery syndrome. SCS can alleviate axial and radicular pain, but it is especially effective for patients whose pain is located predominantly in the leg or arm. At Cleveland Clinic’s Center for Neurological Restoration, we have found that the best candidates for this treatment are generally patients who experience persistent pain with neuropathic characteristics (constant pain, often described as burning or aching) despite having undergone adequate decompressive surgery or fusion.

A New Look at an Established Treatment

While SCS has been approved by the FDA for the management of chronic pain for many years, some large clinical trials have been conducted recently to re-evaluate its safety and efficacy for postlaminectomy syndrome. Kumar et al studied 100 patients with postlaminectomy syndrome who presented with leg pain as their predominant symptom. These patients were randomized to undergo either SCS or conventional medical management. At six months of follow-up, 48 percent of patients in the SCS group reported a more than 50 percent reduction in pain, compared with only 9 percent of those in the medical management group ($P < .001$). In addition, patients in the SCS group reported significantly better quality of life, functional capacity and treatment satisfaction.

Our experience in the Center for Neurological Restoration indicates that the effects of SCS seem to be long-lasting, as does patient satisfaction. We recently surveyed patients who received an implantable SCS device at our center after a mean follow-up of 3.8 years. Approximately 70 percent of patients indicated satisfaction by reporting that they would undergo the procedure again for the same outcome.

Placing the Device

The level of implantation depends on the topography of the chronic pain. The leads are typically implanted in the mid or lower thoracic spine for patients with leg pain (with or without back pain) and in the middle or upper cervical areas for those with upper-extremity pain. Prior to permanent implantation of an internal SCS system, most patients undergo a psychological evaluation and a trial of externalized stimulation. During a trial, the leads are connected to an external pulse generator for approximately one week. Patients who experience a satisfactory response during the trial are more likely to benefit in the long term.
The SCS system consists of one or more epidurally placed leads connected to a rechargeable or non-rechargeable implanted pulse generator that is similar to a pacemaker. We prefer to use rechargeable generators because of their greater longevity. Nonrechargeable pulse generators are offered to patients who have difficulty recharging the system periodically. Recharging is done at home, with the charging device placed on the skin overlying the implanted generator. The frequency of recharging depends on the battery size and on the individual electrical settings for each patient. The timing of recharging typically ranges from once every two weeks to two or three times per week.

SCS systems can be implanted with either percutaneous leads or paddle leads. Percutaneous leads are implanted via larger Tuohy needles, and paddle leads (Figure) are implanted via an open laminectomy or laminotomy. While percutaneous implantation is less invasive, paddle leads are often preferred because they are more stable and provide more efficient stimulation of the spinal cord.

Cleveland Clinic Experience

At the Center for Neurological Restoration, we routinely implant SCS systems in patients with postlaminectomy syndrome as well as in those with other chronic pain conditions such as complex regional pain syndrome. Our primary goal is to reduce pain-related disability and allow patients to be as active as possible. Our preference is to offer paddle leads for eligible patients in order to reduce the risk of migration and to enhance lead stability during work, physical therapy and other activities. However, some patients may be better candidates for percutaneous leads. We have established a program for pain neuromodulation and have two specialized neurosurgeons and two full-time physician assistants dedicated to this program.

We strongly believe in a multidisciplinary approach to these complex disorders, and we routinely partner with primary care, pain management, and physical medicine and rehabilitation physicians to care for patients over the long term. Although we encourage patients to continue medical care with their referring physicians, we recommend periodic evaluations in our clinic for hardware maintenance and for programming optimization.

SCS can be an effective modality for managing patients with treatment-refractory pain conditions, including postlaminectomy syndrome. Like other treatment options, however, it is not curative and should be combined with other modalities, particularly physical therapy.

We have found that the best candidates for SCS are patients who experience persistent pain with neuropathic characteristics despite having undergone adequate decompressive surgery or fusion.

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ccfcmee.org/Summit13

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Course Directors: Lilyana Angelov, MD; Sam Chao, MD; Gene Barnett, MD; Edward Benzel, MD; and John Suh, MD

Disney’s Grand Floridian Hotel and Resort  
Lake Buena Vista, Fla.

July 10-16, 2013

2013 Cleveland Spine Review

Course Directors: Edward Benzel, MD; Doug Orr, MD; Richard Schlenk, MD; Marc Eichler, MD; and Greg Trost, MD

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