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HF-10 Stimulation for a Patient With Severe Scoliosis Who Is Not a Candidate for Deformity Correction: Case Report

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Background: Patients with chronic degenerative spinal deformity such as scoliosis often suffer from refractory pain and mechanical limitations which impact their quality of life. After trying conservative therapy, they commonly proceed with surgical intervention which has the potential for postoperative complications and failure. Patients with failed back surgery syndrome (FBSS) often pursue spinal cord stimulator therapy for their symptoms. However, there is a paucity of literature available regarding including neuromodulation as a treatment option for spinal deformity surgery. The patient provided HIPAA compliant consent for the inclusion of their clinical information in this report.

Case Report: This case report highlights a patient with severe scoliosis with no prior surgeries who failed conservative therapies and overall had a high surgical risk due to her comorbidities, including severe osteoporosis. The patient responded well to HF-10 stimulation. Her EQ-5D-3L showed notable improvement in self-care and anxiety depression, and she subjectively indicated significant improvement in her mobility, usual activities (housework, socializing), and pain/discomfort. Her Visual Analog Scale (VAS) scores showed improvement in lower back pain from 8 to 1 and leg pain from 3 to 1 at her 3-month follow-up.

Conclusion: Overall, the patient had 90% relief in her back and 100% improvement in her leg pain. This case demonstrates how neuromodulation, specifically HF-10, should be included in the treatment protocol when managing spinal deformity patients who are high risk for surgery.

Key words: Spinal cord stimulator, virgin back, failed back surgery syndrome, scoliosis

BACKGROUND

Patients with chronic degenerative spinal deformities such as scoliosis suffer from refractory pain and mechanical limitations and experience a significant impact on quality of life due to their condition. Typically, after failing conservative therapies, these patients are referred for surgical evaluation, which may involve complex surgery that typically requires a lengthy recovery period. Complex spine surgery is not without complications and may include a myriad of undesired postoperative consequences. Bone structure and quality are vital for ensuring a successful outcome but are often poor in the elderly population who suffer from degenerative bone diseases such as osteoporosis. Additionally, even after surgery, pain may persist up to 4-50% of the time (1). Failed back surgery syndrome (FBSS), a commonly documented diagnosis for patients who have continued back or leg pain after surgery, has recently become the most common indication in select patients for spinal cord stimulation (SCS) in the US (1). SCS is a less invasive

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method of achieving improvement in radicular pain via direct neural inhibition in the dorsal horn (2) and dorsal column stimulation, and has been shown to have about a 50% success rate (reduced pain, improved quality of life) in patients with FBSS (3). However, because surgery has historically been the first invasive intervention offered, there is a paucity of literature documenting success after placement of SCS in a patient who never underwent spinal surgery ("virgin back") (4).

We present a case of significantly improved pain, function, and quality of life after placement of SCS in a patient with severely symptomatic spinal scoliosis and a virgin back. This case suggests that SCS should be considered in the treatment algorithm for spinal deformity, especially for patients who may be poor surgical candidates due to age, extent of deformity, or medical comorbidities, including osteoporosis.

CASE REPORT

The patient provided HIPAA compliant informed consent for the inclusion of their clinical information in this report.

A 78-year-old female with past medical history significant for recently treated breast cancer, bicuspid aortic valve, frequent premature ventricular contractions, and osteoporosis with severe spinal scoliosis presented initially to the neurosurgery clinic for evaluation of back pain which progressively worsened to a 7/10 over the last year. She also had chronic leg pain thought to be associated with peripheral neuropathy following cancer treatment. The back pain was described as a sharp, shooting, constant burning pain located primarily in the middle lower back and radiating posteriorly down her left leg. She also reported paresthesia of the left leg. The pain was worsened by prolonged standing or sitting, increased activity, bending forward, and lower back extension. Her disability (characterized by use of the EQ-5D-3L tool) increased as the pain worsened, affecting her ability to ambulate or sleep comfortably.

The patient failed conservative management, including consistent physical therapy for > 6 weeks, resting muscles, a trial of heat and ice, NSAIDs, acetaminophen, gabapentin, muscle relaxants, tramadol, and multiple spinal joint injections which gave her insignificant improvement and no lasting relief. Examination of her spine via lumbar magnetic resonance imaging (MRI) showed severe stenosis from L2 to S1 with Grade 1 spondylolisthesis at L4/5 with severe facet hypertrophy, and chronic compression fractures at L1 and L2. The patient was found to have a coronal lumbar deformity in the supine position on MRI, a 39-degree curve from T12 to L5, with a fractional curve of 25 degrees, and asymmetric disc collapse at L5.

Neurosurgery evaluated the patient and recommended surgical intervention; however, she declined surgery at the time due to understandable concern of potential operative and postoperative complications associated with comorbidities, including her advanced age and severe osteoporosis. She was referred to the interventional pain clinic for evaluation of a potential SCS trial. Nevro SCS trial was placed with greater than 80% relief in lower back pain and 60% relief in leg pain during the trial. SCS was successfully implanted without complications. At 1 month follow-up, she reported 90% relief in her back and 100% improvement in her leg pain. On her EQ-5D-3L, the patient showed notable improvement in self-care and anxiety depression, and she subjectively indicated significant improvement in her mobility, usual activities (housework, socializing), and pain/discomfort. Her VAS scores showed improvement in lower back pain from 8 to 1 and leg pain from 3 to 1 by the time of her 3-month follow-up (Table 1).

Table 1. Visual Analog Scale and percent relief data obtained from a Nevro spinal cord stimulation representative.

	VAS Score				
Follow-Up	**Back Pain**	**Leg Pain**	**% Relief Overall**	**% Relief Back Pain**	**% Relief Leg Pain**
Baseline	8	3			
After Trial	1	1	90%	80%	60%
1 Month Post-Implant	1	0	90%	90%	100%
3 Months Post-Implant	1	1	90%	90%	90%

DISCUSSION

Traditional SCS is used to treat neuropathic pain, typically from failed back syndrome or complex regional pain syndrome. Traditional SCS uses paresthesia by stimulating A-beta fibers to inhibit pain A-delta and C-fibers. Paresthesia mapping and placement of electrodes corresponding to the patient's pain symptoms are crucial in providing adequate coverage and pain relief. There is a paucity of literature on utilizing spinal cord stimulation for spinal deformities and especially spinal deformities such as degenerative scoliosis, without prior surgical correction.

Scoliosis presents a challenge to stimulator placement as physiological and anatomical midline may be difficult to determine by identifying the midline of the spine using landmarks and radiography (5). In 40% of patients, there is a difference of 1-2 mm between the radiographic and electrophysiologic midline of the spine due to rotation of the spinal cord and scoliosis. Though the difference of 1-2 mm is small, it is significant enough to result in failure of the procedure. This suggests that fluoroscopic confirmation of placement is often not sufficient in patients with severe deformities and may require additional paresthesia mapping with traditional SCS (6). There are a few case reports documented that describe successful pain relief after placement of SCS in patients with severe deformities such as kyphoscoliosis (5) and spinopelvic imbalance (7). However, the procedure is currently not used consistently in the algorithm for the treatment of degenerative spine diseases such as scoliosis in patients who have failed conservative therapies but may be poor surgical candidates due to either their intrinsic health risks or the absence of specific indications for surgery such as sagittal imbalance (8).

As traditional SCS utilizes low frequency for neuromodulation, high-frequency stimulation uses paresthesia-free, lead placement not dependent on the physiologic midline, and intraoperative mapping is not required. This is often referred to as HF10-SCS (9). The SENZA-RCT study showed high frequency stimulation was superior to traditional SCS and primarily used for axial low back and leg pain (10).

Our patient had a history of spinal deformity without surgical correction causing severe low back and leg pain as well as a history of chemotherapy-induced peripheral neuropathy. Surgical correction of her scoliosis was not ideal given concerns for surgical complications due to advanced age and severe osteoporosis. Given her decrease in daily function, we elected to proceed with neuromodulation as a treatment option. In current practice, there are many neuromodulation techniques available. High frequency stimulation was selected as the optimal choice for her spinal deformity, given our inability to adequately determine paresthesia mapping and physiological midline. As anticipated, there was difficult epidural access given the severity of the patient's spinal deformity. At follow-up she reported sleeping better, ambulating more, and minimizing the use of NSAIDs and opioids. Her husband agreed that he had not seen her this comfortable since her symptoms began to progress. The patient continues to report complete resolution of back pain and mild residual leg pain, which is being treated with gabapentin and does not limit her daily activities. She and her husband have continued to emphatically describe the drastic improvement in her pain and overall quality of life at each follow-up appointment. This case illustrates why neuromodulation, specifically high frequency stimulation, should be considered in the treatment algorithm in patients where surgical intervention poses significant perioperative and postoperative risks.

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