

## CLINICAL EXPERIENCES

# Flexibility in Lead Placement for the Treatment of Failed Back Surgery Syndrome with Spinal Cord Stimulation of the Dorsal Root Ganglion: A Case Series

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■ **Abstract:** A number of patients who have undergone lumbosacral spine surgery for back and/or leg pain often experience recurrent neuropathic pain. This painful, chronic condition that persists following spinal surgery is commonly known as Failed Back Surgery Syndrome or FBSS. Many structures that are involved in the initiation and maintenance of chronic FBSS pain in the low back have neural innervations that pass through the dorsal root ganglion (DRG). Spinal cord stimulation (SCS) of the DRG has demonstrated relief in patients with pain associated with FBSS. Placement of stimulating electrodes at or near the DRGs may create greater options for establishing effective & sustainable pain coverage in a distribution that is clinically relevant for the individual patient. Here, we report the findings of two case studies exploring the clinical outcomes of and surgical flexibility in placing leads for FBSS treatment with SCS of the DRG. ■

## INTRODUCTION

Of the patients who have undergone lumbosacral surgery to treat neuropathic pain, up to 40% experience persistent or recurrent pain.<sup>1</sup> This painful often chronic condition that results following spinal surgery is commonly known as Failed Back Surgery Syndrome or FBSS.<sup>2</sup> Typically, FBSS can cause disabling pain to the back and/or legs.<sup>3</sup>

Many structures that are potentially involved in the initiation and maintenance of chronic FBSS pain in the low back have neural innervations that pass through the DRG. Human neural pathways through the lumbar dorsal rami and their muscular innervations were described through metic-

ulous dissection in 1982. Additionally, it was observed that the passage of the medial branches of the dorsal rami across transverse vertebral processes made them prime targets for interventional techniques for low back pain.<sup>4</sup> DRG neurons directly innervate lumbar facet joints and their capsules and ligaments; these cells are mechanosensitive, which suggests one mechanism for nociception.<sup>5,6</sup> There is also considerable evidence of the direct innervation of intervertebral discs by DRG neurons that may traverse the intrinsic spinal nerves.<sup>7</sup> Dorsal portions of intervertebral discs are innervated multisegmentally via DRGs that can pass through sympathetic trunks.<sup>8</sup>

Animal models have confirmed that disc injuries or compression can result in increases in neuropeptides and inflammatory responses in the associated DRGs.<sup>9</sup> Calcitonin gene-related peptide-positive primary sensory neurons of the DRG, some of which have been identified as giving rise to A-delta and C fibers, also innervate lumbar vertebral bodies,<sup>10</sup> non-specific connective tissue in the low back,<sup>11</sup> and the lumbar dura mater itself.<sup>12</sup> The sympathetic nervous system is also affected in FBSS,<sup>13</sup> and evidence exists to suggest that DRGs and paravertebral sympathetic ganglia may innervate the same tissues.<sup>6</sup>

Early pain treatments utilizing dorsal rhizotomies were found to achieve pain control after surgeons performed rhizotomy at multiple levels.<sup>14</sup> This suggests that sensory afferents from a region of the body, or a single spinal nerve, may innervate multiple segments of the spinal cord. In animal models, various labeling tracer techniques were utilized to demonstrate the involvement of lumbar dorsal roots in multi-level somatic innervations.<sup>15</sup>

Spinal cord stimulation (SCS) of the DRG has demonstrated relief in patients with pain associated with FBSS.<sup>16</sup> Leveraging the multiple innervations of single spinal nerves suggest that the placement of stimulating electrodes outside



of the FBSS surgical site may create greater options for establishing coverage of pain related to the FBSS site that is clinically relevant for the individual patient. Here, we report the findings of two case studies exploring the clinical outcomes and flexibility in lead placement in patients diagnosed with FBSS and suffering from chronic pain.

## METHODS

Two patients diagnosed with FBSS refractory to prior pain treatments were considered candidates for SCS of the DRG. Following a successful trial period resulting in significant pain relief (at least 50% pain reduction on the Visual Analog Scale (VAS)), the patients were then offered a fully implantable device. Data collection was performed on all patients after each had signed a data release form.

## RESULTS – FBSS PATIENT 1

Patient 1 is a 38 year-old male who reports 16 years of pain in his lower back and right leg following herniotomy of the back to treat a L4-L5 herniated nucleus pulposus (HNP) (Fig. 2). Subsequent epidural injections have only provided temporary relief. Overall VAS score pre-treatment was 80 mm.

Determined a candidate for SCS of the DRG, two leads were epidurally placed to stimulate the left and right L2 DRGs two levels above the back surgery site (surgery site at L4-L5) (Fig. 1). No complications were noted.

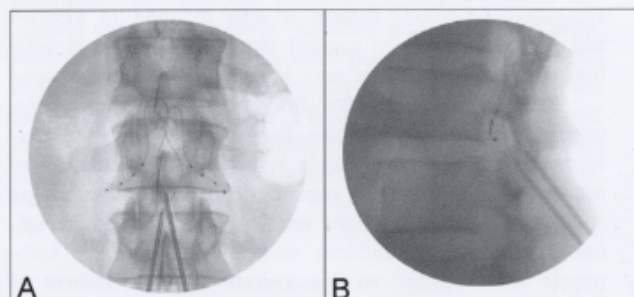


Figure 1. (a) Anterior-posterior and (b) lateral X-rays of FBSS Patient 1 implanted with stimulation leads at left and right L2 DRGs for SCS of the DRG.

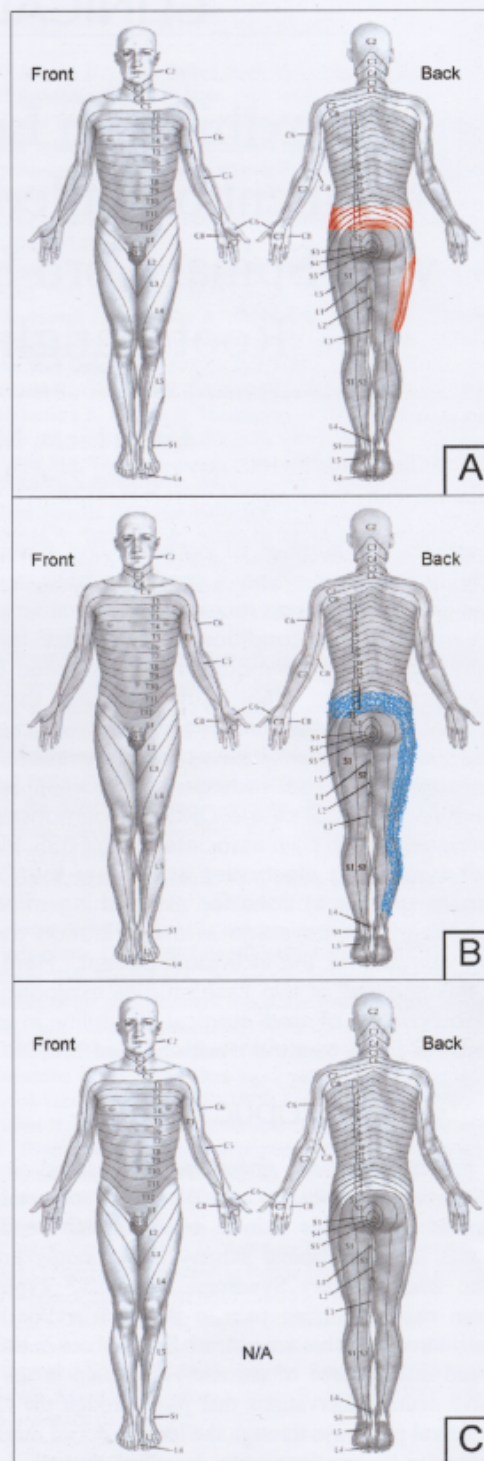


Figure 2. (a) Pre-treatment pain map, (b) paresthesia map, and (c) 1-month follow-up pain map of FBSS Patient 1 treated with spinal cord stimulation of the dorsal root ganglion.



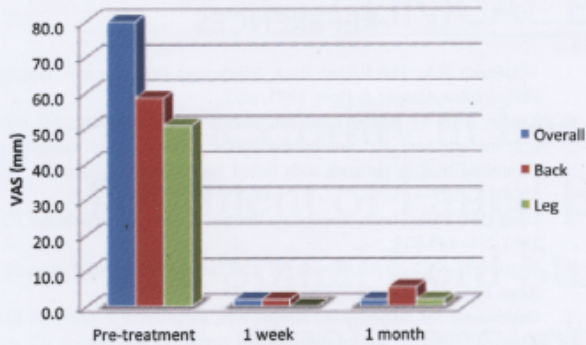


Figure 3. VAS Scores over a 1-month follow-up period of FBSS Patient 1 treated with spinal cord stimulation of the dorsal root ganglion.

Stimulation results in 100% coverage of his pain area with minimal extraneous stimulation in non-painful areas (Fig. 2). The patient reports no significant changes in perceived stimulation level while standing up and/or lying down. At his 1-month follow-up visit, Patient 1 reported an overall pain reduction of 97.5% (Fig. 3).

### RESULTS – FBSS PATIENT 2

Patient 2 is a 72 year-old male who reports pain on the posterior side of his left leg including the plantar side of his foot (Fig. 5). The patient has had three herniotomies over the span of 14 years to treat a L4-L5 HNP. Most recently, the patient has had acupuncture with no lasting effects. Overall VAS score pre-treatment was 78 mm.

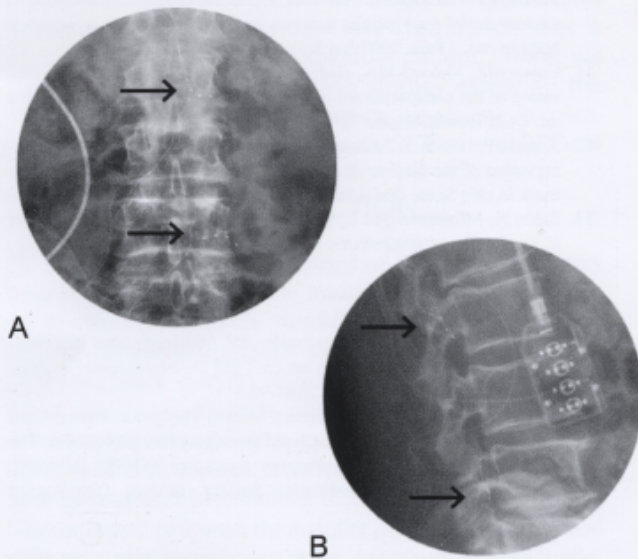


Figure 4. (a) Anterior-posterior and (b) lateral X-rays of FBSS Patient 2 implanted with stimulation leads at left L2 and L4 DRGs for SCS of the DRG.

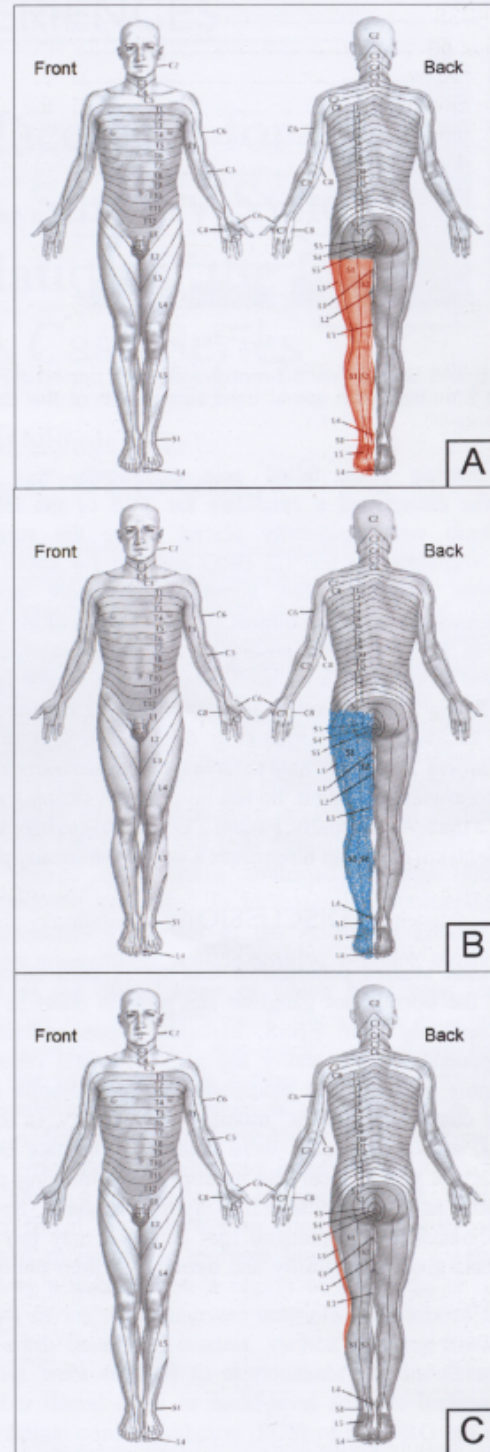


Figure 5. (a) Pre-treatment pain map, (b) paresthesia map, and (c) 3-month follow-up pain map of FBSS Patient 2 treated with spinal cord stimulation of the dorsal root ganglion.



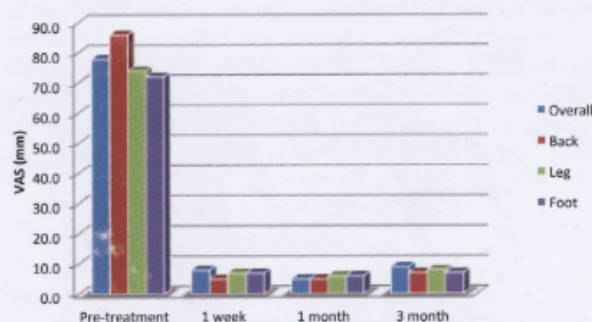


Figure 6. VAS Scores over a 3-month follow-up period of FBSS Patient 2 treated with spinal cord stimulation of the dorsal root ganglion.

Following prior failed pain treatments, this patient was determined a candidate for SCS of the DRG. Two leads were epidurally placed above the surgery site to stimulate the left L2 DRG and left L4 DRG, respectively (Fig. 4). No complications were noted.

Stimulation results in almost 100% coverage of his pain area (Fig. 5). The patient reports no significant changes in perceived stimulation level while standing up and/or lying down. At his 3-month follow-up visit, Patient 2 reported an overall 88.5% pain reduction (Fig. 6). Prior to SCS of the DRG, Patient 2 was only able to sit in a car for ten minute periods; following treatment, he has no problem sitting for an hour at a time. Additionally, Patient 2 is now able to bike with his wife 50 km distances three times a week without any pain.

## DISCUSSION

These case studies demonstrate that spinal cord stimulation of the dorsal root ganglion can provide relief in patients suffering from FBSS, including those containing a component of back and/or leg pain. The pain relief is sustainable and the lead placement is stable despite significant changes in patient mobility and activity. In these patients, stimulation leads were placed at alternate DRG levels above the surgical site appropriately relieving pain associated to a particular FBSS spinal segment. Spinal cord stimulation of the dorsal root ganglion may provide physicians greater flexibility and options for their patients.

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