Pain Medicine Case Reports

ISSN 2768-5152

Volume 10, Number 2, pp. 157-160

Combined Dorsal and Ventral Spinal Cord Stimulation for Treatment of Refractory Neuropathic Pain After Spinal Cord Injury: A Case Report

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Background: Central neuropathic pain that follows spinal cord injury is often refractory to medical therapy. Spinal cord stimulation (SCS) is an established treatment for chronic neuropathic pain, but conventional dorsal column placement may not capture all pain regions.

Case Report: A 63-year-old man with C6-T2 spinal cord infarction and C7 ASIA C paraplegia experienced severe refractory pain in both feet and the left leg for over a decade. Two dorsal leads provided coverage for the feet but not the leg. An additional ventral lead at T12 captured the buttock and hamstring, reducing pain from 9/10 to 3/10. Permanent implantation yielded >80% relief at 2 years.

Conclusions: This case demonstrated durable relief with ventral SCS lead placement when dorsal stimulation alone was inadequate, underscoring the value of individualized strategies for central neuropathic pain as well as the potential for the role of ventral lead placement.

Key words: Spinal cord stimulation, ventral leads, central neuropathic pain, spinal cord injury, case report

BACKGROUND

Neuropathic pain following spinal cord injury or infarction remains one of the most difficult pain syndromes to manage. Pharmacologic treatments such as tricyclic antidepressants, gabapentinoids, opioids, and lidocaine are often used as first-line agents (1). For patients with refractory pain, spinal cord stimulation (SCS) has emerged as an important therapeutic option. Randomized controlled trials and systematic reviews have demonstrated the efficacy of SCS for conditions such as failed back surgery syndrome, with many patients achieving at least 50% pain reduction (2). There is increasing evidence that SCS may also benefit patients with central pain syndromes. Novel stimulation paradigms, including burst and high-frequency stimulation, are also expanding the potential utility of neuromodulation for refractory central pain (3).

Dorsal column placement has remained the standard for spinal cord stimulation (4). Given the location of anterolateral spinal tracts carrying pain and temperature sensations, early studies suggested that ventral stimulation might provide superior coverage for lumbar and sacral dermatomes (5). Those initial efforts were limited by electrode design that required surgical exposure and manipulation of the spinal cord for the electrodes to be placed ventrally. With modern percutaneous systems, ventral targeting has re-emerged as a feasible approach, allowing for ventral electrode placement without manipulation of the spinal cord as readily as dorsal electrode placement (6). SCS has shown especially limited effectiveness for patients with spinal cord injury, calling for alternative methods in managing their conditions (7).

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Disclaimer: There was no external funding in the preparation of this manuscript.
Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.
Patient consent for publication: Consent obtained directly from patient(s).
This case report adheres to CARE Guidelines and the CARE Checklist has been provided to the journal editor.
Accepted: 2025-12-18, Published: 2026-04-30

This report describes a patient with central neuropathic pain secondary to spinal cord injury who experienced relief with the combination of dorsal and ventral SCS leads.

CASE

A 63-year-old man was referred for evaluation of refractory chronic neuropathic pain in the left leg and both feet. Ten years earlier, he had experienced acute onset bilateral leg weakness, numbness, and tingling. Imaging at that time revealed a C6–T2 spinal cord infarction involving the anterior two-thirds of the cord, consistent with anterior spinal artery territory infarct. He was diagnosed with a spinal cord infarction of unknown etiology and was left with an incomplete spinal cord injury, classified as C7 ASIA C paraplegia.

Since the occurrence of the initial injury, the patient reported persistent, severe burning pain in both feet below the ankles and in the left buttock and lateral hamstring. The leg pain was his most disabling symptom, with average intensity of 9 on a 0–10 visual analog scale (VAS). He was evaluated and managed by neurology, neurosurgery, as well as a spinal cord injury specialist. MRI scans of the cervical, thoracic, and lumbar spines performed within the year prior to referral showed only chronic thinning of the cord from C6 to T12 without new compressive pathology.

His pain management history included topical lidocaine, tricyclic antidepressants, gabapentin, pregabalin, opioids, and transcutaneous electrical nerve stimulation, all of which failed to provide meaningful or lasting relief.

Given the severity and chronicity of his pain, he was offered an SCS trial. Two 16-contact dorsal epidural leads were placed at the T7 level. Paresthesia mapping provided coverage of the feet at mid-T8 but failed to capture the left buttock and leg pain despite adjustments from T7 to T11. A third 8-contact lead was therefore advanced anterolaterally and placed ventrally at the superior T12 vertebra (Fig. 1). This configuration successfully provided paresthesia coverage of the left buttock and lateral leg, where the dorsal leads could not offer relief.

During the 7-day trial, the patient reported pain reduction from 9/10 to 3/10 and overall improvement in excess of 50%. He proceeded to permanent implantation with 3 leads, 2 dorsal and one ventral.

At the 2-year follow-up, he continued to report more than 80% relief and high satisfaction. The ventral lead provides all the relief for his leg pain, while the dorsal leads maintain coverage of the foot pain.

DISCUSSION

The prevailing hypotheses behind the SCS mechanism of action involves both segmental inhibition of nociceptive input via the gate control theory and broader modulation of neurochemical mediators, including GABA, serotonin, and noradrenaline, within the dorsal horn and supraspinal centers (8). Previously, accidental anterior migration of the stimulator was shown to produce analgesic effects (9). While incidental placement of SCS devices has been reported, targeted ventral placement has also been reported with no increased incidence in spinal cord, nerve or vascular damage (6,7,9,10). Reports of successful SCS in patients with spinal cord injury–related pain are also increasing, demonstrating meaningful reductions in pain intensity and improved quality of life (10). The patient in this case report adds to the potential of SCS evidence by demonstrating durable benefit more than 2 years after implantation.

For this patient, standard dorsal column stimulation failed to capture the patient's left leg pain despite attempts with lead placement and mapping. The addition of a ventral lead at T12 provided effective coverage of the buttock and hamstring region, which was otherwise unsuccessful with dorsal leads alone. The use of both dorsal and ventral leads highlights the value of individualized strategies and may suggest a broader role for ventral lead placement in complex pain patterns.

Although SCS has historically targeted the dorsal columns, emerging reports suggest that ventral or anterolateral trajectories may expand coverage for central pain syndromes. It is hypothesized that activation of the anterolateral spinothalamic tracts may relieve pain by overriding abnormal nociceptive firing, effectively replacing pathological signals with those generated by neuromodulation (11). In the past, access to ventral targets was limited by technical constraints. Although paddle leads offer lower incidence of hardware migration, they necessitate invasive procedures such as laminotomy or laminectomy, which increase surgical complexity and risk (12). Traditional paddle systems required invasive approaches, whereas modern percutaneous leads have reduced surgical morbidity. Percutaneous SCS was associated with lower rates of reintervention and fewer explants caused by medical complications and infection (13). These developments

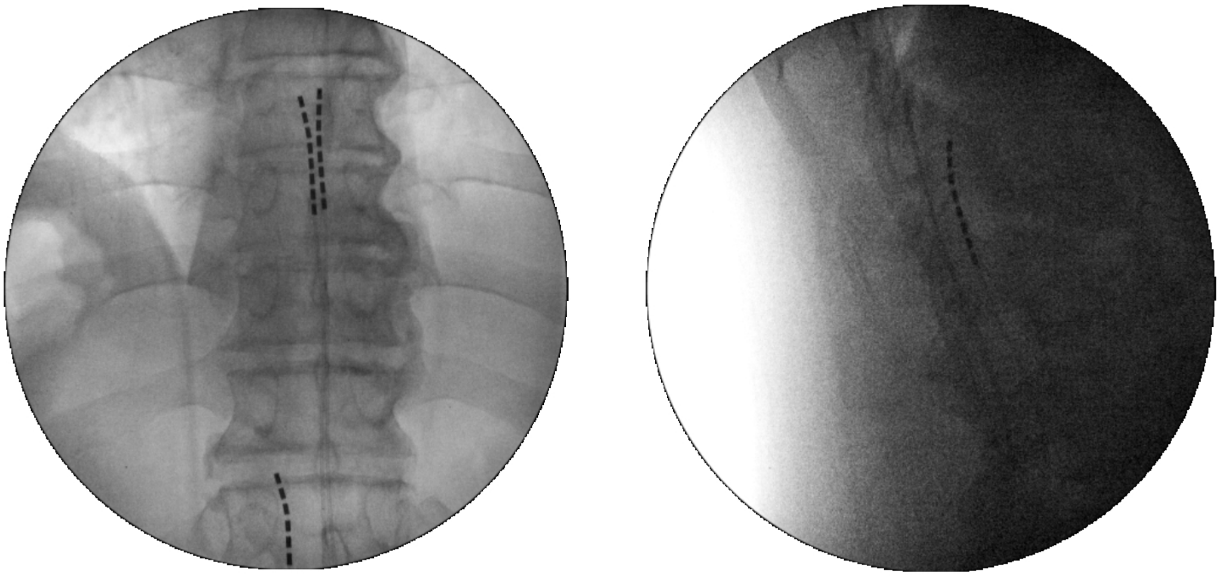

Fig 1. Fluoroscopic images from the spinal cord stimulator implantations.

allow for easier ventral or targeted lead placement, which may have a meaningful role when traditional dorsal stimulation fails to deliver adequate paresthesia to critical pain regions.

The long-term outcome is notable, given that the implantation occurred more than a decade after the onset of symptoms. Prior literature suggests that outcomes are best when SCS is performed early, and relief is inversely proportional to the time elapsed (14).

Overall, this case illustrates the value of lead placement and trial mapping and the potential for SCS for central neuropathic pain after spinal cord infarction. The use of ventral stimulation in combination with dorsal leads expands the therapeutic possibilities of neuromodulation in challenging central pain syndromes and highlights the need for the systemic evaluation of ventral targeting and other less traditional configurations in central neuropathic pain.

Limitations

This case report has several limitations. It describes a single patient, so the findings cannot be generalized or used to compare the effectiveness of dorsal lead strategies to their ventral counterparts. In addition, although the patient reported substantial improvement in pain and daily function, we did not collect objective measures such as activity data, sleep metrics, or standardized functional assessments to support these self-reported outcomes. Finally, we did not obtain post-implantation imaging, preventing us from confirming long-term lead position or assessing whether anatomical factors contributed to the patient's response. Larger studies with objective outcome measures and imaging correlation will be needed to better define the role of combined dorsal and ventral SCS in central neuropathic pain.

CONCLUSIONS

This case demonstrates that SCS can provide durable, clinically meaningful relief for patients who experience central neuropathic pain after spinal cord infarctions. The success of ventral lead placement in conjunction with traditional dorsal leads reiterates the importance of individualized strategies in neuromodulation, as well as the potential for benefit of ventral targeting of the spinal cord. SCS may be considered as a treatment option for refractory central pain syndromes. Further studies are needed to clarify the optimal stimulation targets, paradigms, and lead configurations in this population.

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