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DORSAL ROOT GANGLION INTERVENTIONS FOR PHANTOM LIMB PAIN: TWO CASE REPORTS

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Background: Phantom limb pain (PLP) is a common and disabling complication after amputation that may persist despite treatment. Dorsal root ganglion (DRG)-targeted interventions may offer focused treatment for refractory PLP.

Case Report: We report 2 patients with refractory PLP treated with distinct DRG-targeted interventions. A 38-year-old man with prior complex regional pain syndrome developed PLP after transfemoral amputation despite spinal cord stimulation. L5 DRG stimulation reduced pain from a baseline VAS score of 9–10/10 to 2–3/10 at the initial postimplant assessment. Approximately 80% pain relief was reported at the 15-day follow-up. A 25-year-old woman developed focal PLP after fifth-toe amputation. Endocanal pulsed radiofrequency at the L5 DRG was associated with complete pain relief at 4- and 8-week follow-up and cessation of analgesics.

Conclusions: DRG stimulation and endocanal pulsed radiofrequency may be options for selected patients with refractory PLP. Given the limited follow-up of 15 days in Case 1 and 8 weeks in Case 2, longer follow-up and controlled studies are needed to assess durability and patient selection.

Key words: Phantom limb pain; dorsal root ganglion; neuromodulation; dorsal root ganglion stimulation; pulsed radiofrequency

BACKGROUND

Postamputation pain is common and can persist for months or years. It includes residual limb pain (RLP), phantom limb pain (PLP), and nonpainful phantom sensations, such as paresthesia or perceived movement of the missing limb (1).

Peripheral, spinal, and supraspinal mechanisms contribute to postamputation pain. Treatments include tricyclic antidepressants, gabapentinoids, opioids, physical therapy, mirror therapy, transcutaneous electrical nerve stimulation (TENS), spinal cord stimulation (SCS), and regional blocks. Some patients continue to experience refractory pain despite multimodal treatment (2,3).

Dorsal root ganglion (DRG) stimulation offers focused, anatomically targeted neuromodulation for painful areas that can be difficult to cover with conventional SCS, such as the foot, groin, or hand. Potential advantages include less postural variation in stimulation and reduced activation of nonpainful areas.

Pulsed radiofrequency targeting the DRG has also been explored as a nonimplantable intervention. We report 2 patients with refractory PLP treated with DRG-targeted interventions: implantable stimulation

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in one case and endocanal pulsed radiofrequency in the other (4,5).

Informed Consent: Written informed consent was obtained from both patients for publication of these case details.

CASE PRESENTATION

Case 1

A 38-year-old man had a history of depression, deep vein thrombosis (DVT), and pulmonary thromboembolism. After an injury to his right knee in 2007, he had persistent pain and underwent posterior cruciate ligament reconstruction and meniscal surgery in 2008. Chronic pain in the right knee and leg was accompanied by sudomotor, vasomotor, and cutaneous trophic changes consistent with type I complex regional pain syndrome (CRPS).

Epidural catheters for continuous local anesthetic infusion and sympathetic blocks provided only partial, transient relief. Without opioids, baseline pain was 9–10/10 on the visual analog scale (VAS). The patient reported marked impairment in quality of life and emotional well-being, especially physical functioning and role limitations. The severity of pain affected his mental health and contributed to a suicide attempt.

An SCS system was implanted in 2009 after conservative treatment failed. Pain improved by approximately 30%, but he continued to require high-dose opioids.

CRPS subsequently worsened, with marked vasomotor changes and recurrent DVT without further thromboembolism. In September 2014, persistent thrombosis, severe pain, and deteriorating tissue quality led to a supracondylar amputation of the right lower limb.

A few weeks after amputation, the patient developed PLP perceived on the dorsum of the missing foot and lateral aspect of the leg. The existing SCS did not adequately control the pain. He attempted to use a prosthesis but stopped after persistent pain and multiple falls that worsened the PLP.

In 2024, the SCS generator stopped functioning. Because SCS had provided limited analgesia and had not adequately controlled PLP, revision alone was considered unlikely to improve outcomes. Explantation and conversion to DRG stimulation were proposed. In April 2025, after a positive stimulation test performed to assess the clinical response to DRG stimulation, a quadripolar lead was implanted at the right L5 DRG. Intraoperative mapping showed coverage of the painful area with a single DRG lead; a planned S1 lead was therefore not implanted (Fig. 1).

Three programs targeting the right L5 dermatome used the same group of contacts (9–12). Frequency anged from 16 to 30 Hz and amplitude from 0.175 to 0.750 mA. Therapy was continuous, and sensory coverage of the right leg was documented (Fig. 2).

At the initial postimplant assessment, the patient reported a VAS score of 2–3/10 compared with a baseline of 9–10/10, corresponding to approximately 70%–80% pain relief. At the 15-day follow-up, after outpatient programming adjustments, he reported approximately 80% relief of PLP, reduced analgesic use, and improved function.

Case 2

A 25-year-old woman sustained a crush injury to the left foot in a motorcycle accident in 2019 (Fig. 3). She underwent more than 20 reconstructive procedures, including osteotomies, bone grafting, and ligament reconstruction (Fig. 4), but reported persistent pain of 8–10/10 on the VAS. Because of dysfunction of the fifth toe and pain that prevented her from wearing shoes, the toe was amputated in August 2024.

After amputation, she developed pain perceived in the missing digit, with dysesthesia and allodynia consistent with PLP. Cold worsened the pain, which interfered with sleep and daily activities. Examination showed no vasomotor or sudomotor abnormalities. Acetaminophen, tramadol, pregabalin, and lidocaine patches provided only partial relief.

In December 2024, the left L5 DRG was treated with pulsed radiofrequency through an endocanal approach under fluoroscopic guidance and epidural navigation. A 66-cm Boston Scientific RCE™ RF electrode (model RCE-E661519-P) was used.

Three cycles of pulsed radiofrequency were delivered, each lasting 120 seconds at 65 V, with the temperature controlled at a maximum of 42 °C.

At 4- and 8-week follow-up, the patient reported complete relief of PLP and a return to daily activities without additional analgesic medication.

Discussion and Conclusions

Phantom limb pain places a substantial emotional and functional burden on patients after amputation. Peripheral, spinal, and supraspinal mechanisms contribute to its complex pathophysiology (6). Neuroma formation, ectopic peripheral activity, altered ion channel expres-

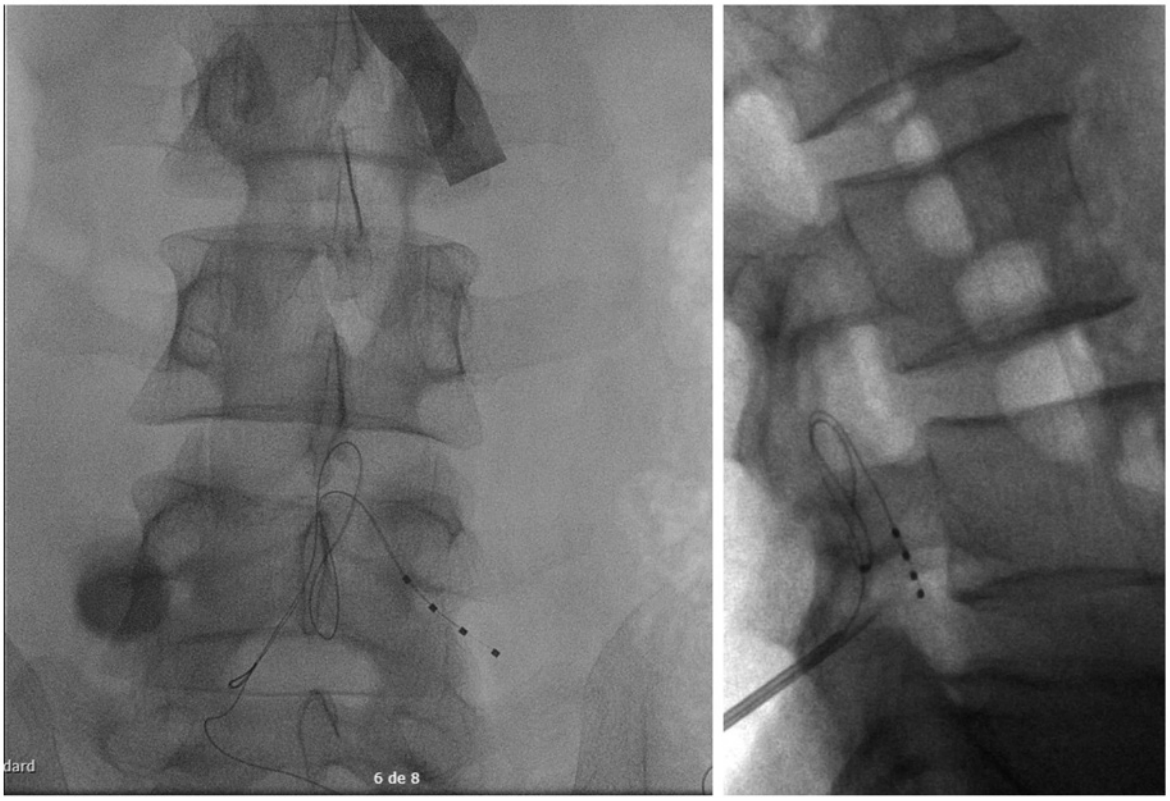


Fig. 1. (A) Anteroposterior fluoroscopic view of the Abbott tetrapolar electrode at the L5 DRG. (B) Lateral fluoroscopic view of the same Abbott electrode at the L5 DRG.

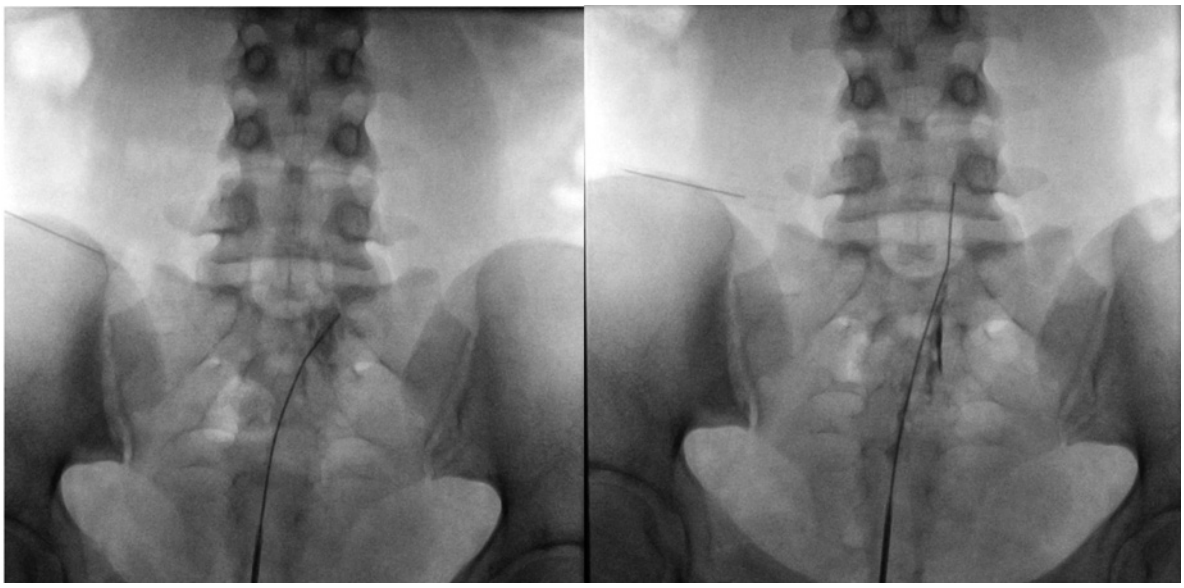


Fig. 2. Anteroposterior fluoroscopic view of the Boston Scientific electrode near the L5 DRG. Sensory stimulation at 0.5 V covered the painful area; no motor response occurred below 0.6 V. Epidural placement was confirmed with contrast.



Fig. 3. Crush injury of the left foot.



Fig. 4. Reconstruction of the left foot after the initial crush injury.

sion, and DRG hyperexcitability may generate aberrant afferent impulses. Deafferentation and central sensitization amplify spinal pain signaling, while cortical reorganization may contribute to PLP (7–11). DRG changes, including spontaneous activity and altered sodium channel expression, have also been implicated in neuropathic pain (12).

The DRG links peripheral and central sensory pathways. Targeted modulation may alter pathologic afferent signaling while limiting stimulation of adjacent structures, a potential advantage for localized pain such as PLP (13,14). Both DRG stimulation and pulsed radiofrequency have been explored.

DRG stimulation can provide more focused coverage than conventional SCS, with less postural variability and fewer unwanted paresthesias in selected patients (15). Evidence for PLP remains limited. Srinivasan et al. (4) found that reports of DRG stimulation for PLP largely consisted of case reports and case series. Eldabe et al. (5) reported outcomes in a small series of patients with PLP, underscoring the need for longer-term data.

In Case 1, intraoperative mapping confirmed coverage at L5, followed by marked improvement in reported pain. In Case 2, endocanal pulsed radiofrequency at L5 was followed by complete reported pain relief through 8 weeks. Evidence for DRG-directed pulsed radiofrequency as an analgesic treatment for PLP remains limited. Hunter et al. (16) described radiofrequency stimulation as a mapping technique to identify DRG targets for subsequent neuromodulation in patients with postamputation pain. Anatomical variation in DRG location, described by Acevedo-González et al. (17), may be relevant when planning access. Electrolocalization can help confirm coverage of the painful area.

These cases suggest that DRG stimulation and DRG-directed pulsed radiofrequency warrant further study for refractory PLP. The short follow-up in Case 2 and the small number of patients preclude conclusions about comparative efficacy, long-term safety, and durability. Larger prospective studies are needed.

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