Treatment of Phantom Pain with Spinal Cord Stimulation of the Dorsal Root Ganglion: A Case Series

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■ **Abstract:** Phantom limb pain is a debilitating chronic pain condition associated with the sensations of the missing or amputated limb. The disease is a common sequel of limb amputation. Treatment modalities include pharmacological, non-pharmacological, and surgical. Efficacy of surgical treatments with current neuromodulation techniques have been anecdotal. We report the findings of a case series exploring the initial clinical outcomes of phantom limb pain treatment with spinal cord stimulation of the dorsal root ganglion. ■

INTRODUCTION

Phantom limb pain (PLP) is pain associated with the sensations of a missing or amputated limb.[1,2,3] Phantom limb pain has been described as throbbing, piercing, tingling, and stabbing sensations,[4] with an onset as early as a few days following amputation to weeks and even months post-amputation.[5,6] PLP also referred to as phantom pain, is distinct from phantom limb (or phantom limb sensation) and stump pain. Phantom limb is the non-painful sensation of the missing or absent limb while stump pain is painful sensation localized in the stump.[5,7] The prevalence of PLP reported across different studies of amputee populations has been variable, ranging from 42-79%,[6] 41-85%,[8] and 60-70%.[9] Some possible explanations for such variability are differences in the study's definition of phantom pain (differentiation from stump pain), assessment methods and intervals, study design, to name a few.[6,8,9] Similarly, different studies have concurred that the duration and frequency of phantom pain attacks also vary, some reporting a decrease over time and others demonstrating either the same level of pain or an increase in painful sensations.[5,6,9,10] Despite the variability in prevalence of phantom pain, its duration and frequency, the figures for amputations remain staggering: in 2012, nearly 2 million Americans have missing limb(s). According to the Amputee Coalition, the leading U.S. organization on limb loss, 28 million people are at risk for amputation whether as a result of accident or disease.[11]

The treatment and management of PLP have been based on the different principles of this condition, and can be categorized as three general modalities: pharmacological, non- pharmacological, and surgical.[5,6,9] Pharmacological treatments have included non-steroidal anti-inflammatory drugs (NSAIDs), opioids, anticonvulsants, antidepressants, sodium channel blockers, and NMDA (N-Methyl-D-aspartate) receptor antagonists.[5,6] Additional pharmacological therapies include use of analgesics and anesthesics.[6] Psychological and cognitive management of pain have been categorized as non-pharmacological treatments including mirror therapy, biofeedback, and transcutaneous nerve stimulation (TENS).[5,6] Efforts are on-going to determine specific treatment guidelines for managing PLP, while combinations of multi-disciplinary therapies continue to be employed.[12]

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In the absence of pain relief or treatment success with conservative methods, the application of invasive procedures, namely surgical interventions, are considered.[13] Some cases have reported the effectiveness of dorsal root entry zone (DREZ) lesioning while others have achieved pain relief in some patients via spinal cord stimulation (SCS).[14,15] SCS of the dorsal root ganglion (DRG) has demonstrated to be safe and effective in the treatment of chronic neuropathic pain. Since the DRG has been implicated as a potential mechanism for PLP, SCS of the DRG may provide relief to patients suffering from phantom limb pain. Here, we report the findings of a case series exploring the initial clinical outcomes of PLP treatment with SCS of the DRG.

METHODS

Patients (n=3) suffering from phantom limb pain refractory to prior treatments were considered candidates for SCS of the DRG. Patients having a successful trial period resulting in significant pain relief were then offered a fully implantable device. Retrospective data collection was performed on all patients after each had signed a data release form.

RESULTS

During the trial phase, stimulation leads were epidurally placed at or near the DRGs at the spinal levels appropriate to obtain sensory paresthesias or pain relief in the correct anatomical region of the patient's pain. Paresthesias could be steered as would normally be completed in patients with intact limbs in the case of the phantom limb patients. Out of the n=3 patients, average pain reduction was 50.0% (using a VAS) with the longest follow-up at 3 months. Average follow-up times were 1.4 months. (Table 1).

Table 1. Summary of Pain Reduction in Phantom Limb Pain Patients with SCS of the DRG

Patient	Longest Follow-up (months)	%Pain Reduction From Baseline
1	3.0	52.4%
2	1.0	40.6%
3	0.25	56.9%
Avg.	1.4	50.0%

CASE HIGHLIGHT

We present an amputee patient implanted with a neurostimulation system for SCS of the DRG to treat phantom limb pain. The patient is a 28 year-old female who has had her left leg amputated above the knee 11 years ago due to a rocket attack in Afghanistan. The patient has phantom limb pain in her left foot and ankle which has escalated in the past 4 years. Her baseline VAS is 84 mm.

Determined a candidate for SCS of the DRG, stimulation leads were epidurally placed at the left L4 and L5 DRGs using an ipsilateral approach (Fig. 1). Intraoperative stimulation resulted in paresthesias in specific areas of her phantom foot. If stimulation was increased too high, the patient perceived 'motor responses' in her phantom foot without any physical movement or contraction of her stump. Paresthesias covered the patient's painful area of her phantom limb.

The patient reported 100% reduction in pain with a VAS score of 0 at the 1-week follow-up (Fig. 2). At the 3-month follow-up, the patient was pregnant and halted all pain medications in a 3-week period leading up to the 3-month visit. Her VAS score increased to 40 mm but she reported no loss in therapy and a significant increase in mobility from baseline (Fig. 3).

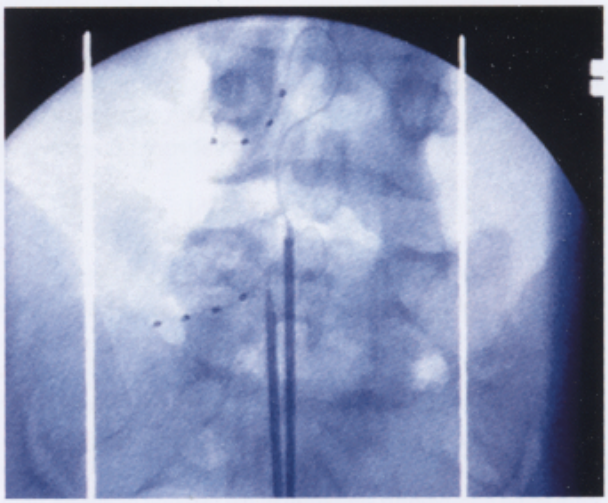

Figure 1. X-ray of DRG stimulation leads epidurally placed on the patient's left L4 and L5 DRGs

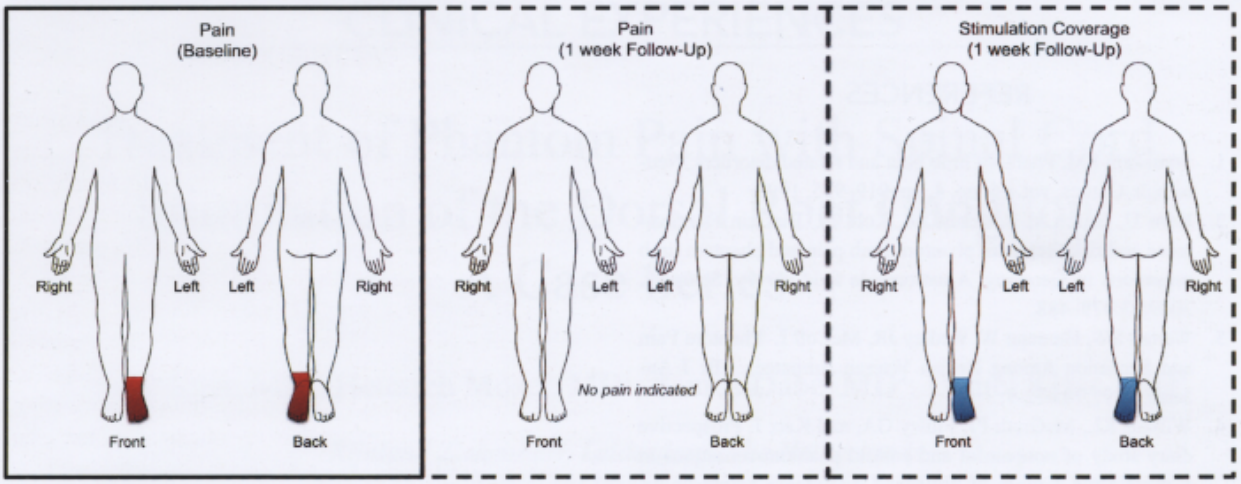

Figure 2. Pain and paresthesia maps at baseline and the 1-week follow-up of a patient with phantom limb pain treated with spinal cord stimulation of the dorsal root ganglion

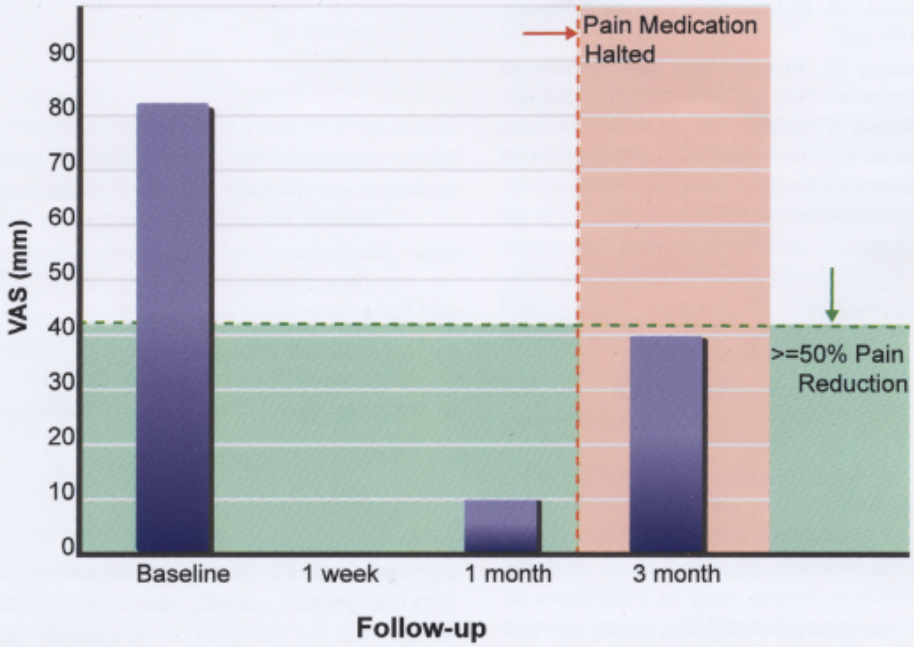

Figure 3. VAS Scores over a 3-month follow-up period of a patient with phantom limb pain treated with spinal cord stimulation of the dorsal root ganglion.

DISCUSSION

Post-amputation pain continues to be a difficult condition to treat. Depending upon the pain location, current neuromodulation technologies may not provide adequate therapeutic effect. This case series demonstrates that spinal cord stimulation of the dorsal root ganglion can provide excellent relief in patients suffering from this condition in the lower extremities. It is interesting to note that regardless of the precise mechanisms responsible for the phantom pain, DRG stimulation could still provide excellent paresthesia coverage and pain relief. Further work is underway to more fully detail the mechanisms behind which DRG stimulation can provide sustained pain relief in post-amputee patients.

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