

Peripheral Nerve/Field Stimulation for Chronic Pain



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KEYWORDS

- Peripheral nerve stimulation • Peripheral nerve field stimulation • Neuropathic pain
- Neuromodulation

KEY POINTS

- Peripheral nerve stimulation (PNS) offers a reversible, adjustable, and testable means of treating focal neuropathic pain.
- Peripheral nerve field stimulation (PNfS) provides a similar treatment of painful areas that may involve fine branches of terminal nerves.
- The number of clinical conditions that may benefit from PNS or PNfS continues to increase.
- Studies are ongoing to develop further evidence in support of PNS and PNfS.

INTRODUCTION: NATURE OF THE PROBLEM

Patients with refractory severe chronic, focal neuropathic pain (eg, posttraumatic neuropathy, complex regional pain syndromes, postherpetic neuralgia affecting 1 or 2 dermatomes) may benefit from peripheral nerve stimulation (PNS), a low morbidity treatment modality for patients who have failed medical management. PNS involves the placement of a stimulating electrode over a named peripheral nerve (eg, occipital, genitofemoral) to elicit paresthesias along the innervated territory. This technique was first described in 1966 by Wall and Sweet¹ and then used in selected centers worldwide, but it did not gain traction as a treatment option until the description by Weiner and Reed² of a percutaneous PNS technique in 1999 when it was used in a series of patients with occipital neuralgia. The lower invasiveness (as compared with an open exploration of the nerve and direct application of an electrode) resulted in an easier trial for

patients. This percutaneous technique led to an expansion of the number of physicians offering the procedure beyond surgeons (neurosurgeons, orthopedic surgeons, and plastic surgeons) to include anesthesiologists and other pain management specialists. The introduction of an ultrasound-guided technique further advanced the accessibility of the procedure, translating the common use of ultrasound localization for regional anesthesia to electrode placement technique.³ PNS has been applied to various named nerves throughout the body, including occipital, supraorbital, infraorbital, radial, ulnar, median, tibial, peroneal, and sciatic nerves.

Peripheral nerve field stimulation (PNfS), sometimes referred to as subcutaneous neurostimulation or targeted subcutaneous stimulation,⁴ involves positioning of one or more electrodes within the region of maximal pain, where small distal branches of nerves are targeted within the subcutaneous space. Field stimulation produces

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paresthesias along a diffuse painful area that may not correlate with one specific dermatome or otherwise be well defined. Body regions rather than nerves are used to describe the PNfS (eg, low back, trunk, joint).

The use of spinal cord stimulation (SCS) combined with PNfS has been referred to as “hybrid” stimulation,⁵ spinal-peripheral neurostimulation,⁶ and triangular stimulation.⁷ This technique has been shown to achieve broader coverage of axial back pain than either SCS or PNfS individually.⁸

INDICATIONS

Many of the conditions addressed by PNS also respond with other neuromodulation techniques, including spinal cord stimulation. However, because of the relatively simple nature of the procedure and its low invasiveness, PNS and/or PNfS may be preferable to more central neuromodulatory procedures. It should be noted that the devices used for PNS or PNfS are those approved for other interventions, such as spinal cord stimulation, and are used “off-label” in the United States, although in many other countries both PNS and PNfS are among approved uses for these devices. Current indications for PNS/PNfS include the following:

- Neuropathic pain disorders
 - Posttraumatic neuralgia
 - Postsurgical neuropathic pain
 - Occipital neuralgia or cervicogenic occipital pain
 - Postherniorrhaphy inguinal neuralgia
 - Genitofemoral neuralgia
 - Postherpetic neuralgia
 - Coccygodynia
- Complex regional pain syndrome, especially type II
- Cephalgias
 - Migraine, both chronic and transformed
 - Hemispheric headaches
 - Cluster headaches
 - Chronic daily headaches
 - Cervicogenic and occipital headaches
- Axial pain syndromes
- Emerging indications
 - Musculoskeletal pain
 - Fibromyalgia

SURGICAL TECHNIQUE

PNS can be performed using either an open or a percutaneous technique. In most cases, fluoroscopy is being used to guide electrodes in relation to bony landmarks. Because fluoroscopy does

not visualize the nerves and vessels, other means of image guidance, such as ultrasound, may be a useful adjunct to ensure optimal electrode positioning and help to avoid nearby vessels.⁹ In PNfS, a careful identification of the region of pain guides placement of the electrodes. Marking the region based on the patient report before electrode placement facilitates the optimal position at the site of maximal pain and also serves as an avenue to discuss pain improvement expectations for the procedure. The optimal number and type of leads to use vary based on location and dimensions of painful area.

A choice of cylindrical electrodes and paddles is available to the implanting surgeon. Cylindrical leads are conducive to placement through a percutaneous approach. Narrow paddle electrodes may also be introduced percutaneously as anatomy allows. An open approach permits the direct application of either a cylindrical or a paddle electrode along the target nerve. Because the open approach may be associated with a higher risk of perineural fibrosis, it is performed less frequently.¹⁰

Preoperative Planning

Patients may experience suboptimal results from PNS if the therapy is used in a pain syndrome that has low likelihood of response. A thorough history and physical examination including a detailed pain history should confirm the patient’s diagnosis and prior treatments attempted and their outcomes. A scale of disability such as the Pain Disability Index¹¹ can assess the degree to which the patient’s quality of life is affected. The distribution of the pain should be clearly defined.

Inclusion criteria

- Patients should have chronic, severe, disabling neuropathic pain refractory to other treatments, including medications, nerve blocks, trigger point injections, physical therapy, and so on.
- Sensory aberrations or loss in the distribution of pain may increase the chances of a trial failure.
- Local anesthetic block may confirm which nerve is affected, but is not predictive of PNS success.
- Similarly, transcutaneous electrical nerve stimulation (TENS) use may suggest a region amenable to PNfS, but TENS does not have a clear predictive value.¹²
- Focal areas within the territory of a single peripheral nerve are most amenable to PNS,

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