

# Medical PEMF Studies



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## PAIN

### Pulsed magnetic field therapy in refractory neuropathic pain secondary to peripheral neuropathy: electrodiagnostic parameters--pilot study.

#### Spinal Cord Stimulation for Refractory Neuropathic Pain of Amyotrophic Neuralgia

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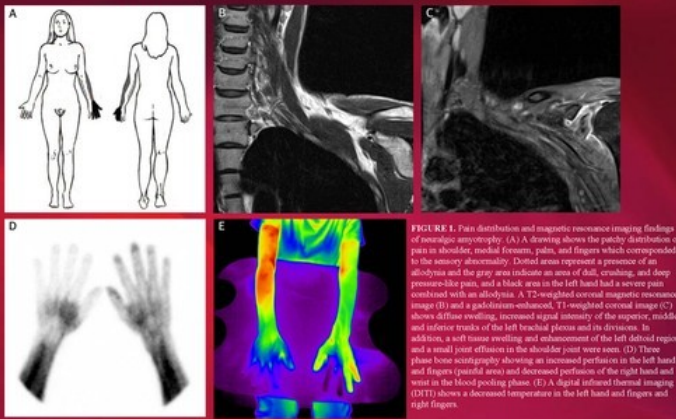
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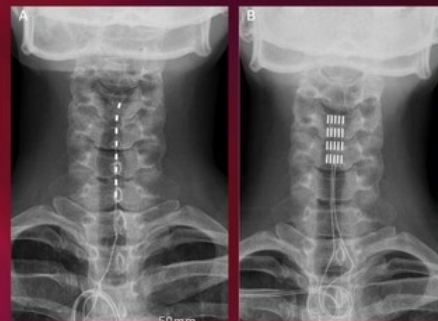
**Objective:** The aim of this paper was to report the effect of temporary and chronic spinal cord stimulation for refractory neuropathic pain in neuralgic amyotrophy.

**Patient and Methods:** A 35-year-old female presented with two-months history of a severe, relentless neuropathic pain of the left shoulder, forearm, palm, and fingers. The neuropathic pain was refractory to various medical treatments, including nonsteroidal anti-inflammatory drugs, opiates, and blocks and typically unrelenting. The diagnosis of neuralgic amyotrophy was made with the characteristic clinical history and magnetic resonance imaging. The patient underwent a temporary spinal cord stimulation to achieve an adequate pain relief because her pain was notoriously difficult to control and lasted longer than the average duration of a painful phase of neuralgic amyotrophy.

**Results:** During the 14 day temporary spinal cord stimulation, the patient reported a significant relief with about more than 50% pain relief. After the temporary stimulation of 2 weeks, she decided on chronic spinal cord stimulation on her own initiative with sufficient understanding of the natural history of neuralgic amyotrophy. Chronic stimulation was given with paddle lead. The neuropathic pain in her neuralgic amyotrophy persisted and she continued using the spinal cord stimulation with 12 months after development of neuralgic amyotrophy.



**FIGURE 1.** Pain distribution and magnetic resonance imaging findings of neuralgic amyotrophy. (A) A drawing shows the patchy distribution of pain in shoulder, medial forearm, palm, and fingers which corresponded to the sensory abnormality. Dotted areas represent a presence of an allodynia and the gray area indicate an area of dull, crushing, and deep pressure-like pain, and a black area in the left hand had a severe pain combined with an allodynia. A T2-weighted coronal magnetic resonance image (B) and a gadolinium-enhanced, T1-weighted coronal image (C) shows diffuse swelling, increased signal intensity of the supraventricular, middle, and inferior trunks of the left brachial plexus and its divisions. In addition, a soft tissue swelling and enhancement of the left deltoid region and a small joint effusion in the shoulder joint were seen. (D) Three phase bone scintigraphy showing an increased perfusion in the left hand and fingers (painful area) and decreased perfusion of the right hand and wrist in the blood-pooling phase. (E) A digital infrared thermal imaging (DIRTI) shows a decreased temperature in the left hand and fingers and right fingers.



**FIGURE 2.** Spinal cord stimulation for the pain of a neuralgic amyotrophy. A: The X-ray film shows the location of a cylindrical lead at C3-5 level for temporary spinal cord stimulation. B: The X-ray film shows the location of the paddle lead for the chronic stimulation in the neuropathic pain of a neuralgic amyotrophy.

**Conclusion:** The temporary spinal cord stimulation was effective in a patient with an extraordinary prolonged, acute painful phase of neuralgic amyotrophy attack, and the subsequent chronic stimulation was also useful in achieving an adequate analgesia during the chronic phase of neuralgic amyotrophy.

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**CONTEXT:** Neuropathic pain (NP) from peripheral neuropathy (PN) arises from ectopic firing of unmyelinated C-fibers with accumulation of sodium and calcium channels. Because pulsed electromagnetic fields (PEMF) safely induce extremely low frequency (ELF) quasirectangular currents that can depolarize, repolarize, and hyperpolarize neurons, it was hypothesized that directing this energy into the sole of one foot could potentially modulate neuropathic pain.

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**OBJECTIVE:** To determine if 9 consecutive 1-h treatments in physician's office (excluding weekends) of a pulsed signal therapy can reduce NP scores in refractory feet with PN.

**DESIGN/SETTING/PATIENTS:** 24 consecutive patients with refractory and symptomatic PN from diabetes, chronic inflammatory demyelinating polyneuropathy (CIDP), pernicious anemia, mercury poisoning, paraneoplastic syndrome, tarsal tunnel, and idiopathic sensory neuropathy were enrolled in this nonplacebo pilot study. The most symptomatic foot received therapy. Primary endpoints were comparison of VAS scores at the end of 9 days and the end of 30 days follow-up compared to baseline pain scores. Additionally, Patients' Global Impression of Change (PGIC) questionnaire was tabulated describing response to treatment. Subgroup analysis of nerve conduction scores, quantified sensory testing (QST), and serial examination changes were also tabulated. Subgroup classification of pain (Serlin) was utilized to determine if there were disproportionate responses.

**INTERVENTION:** Noninvasive pulsed signal therapy generates a unidirectional quasirectangular waveform with strength about 20 gauss and a frequency about 30 Hz into the soles of the feet for 9 consecutive 1-h treatments (excluding weekends). The most symptomatic foot of each patient was treated.

**RESULTS:** All 24 feet completed 9 days of treatment. 15/24 completed follow-up (62%) with mean pain scores decreasing 21% from baseline to end of treatment ( $P=0.19$ ) but with 49% reduction of pain scores from baseline to end of follow-up ( $P<0.01$ ). Of this group, self-reported PGIC was improved 67% ( $n=10$ ) and no change was 33% ( $n=5$ ). An intent-to-treat analysis based on all 24 feet demonstrated a 19% reduction in pain scores from baseline to end of treatment ( $P=0.10$ ) and a 37% decrease from baseline to end of follow-up ( $P<0.01$ ). Subgroup analysis revealed 5 patients with mild pain with nonsignificant reduction at end of follow-up. Of the 19 feet with moderate to severe pain, there was a 28% reduction from baseline to end of treatment ( $P<0.05$ ) and a 39% decrease from baseline to end of follow-up ( $P<0.01$ ). Benefit was better in those patients with axonal changes and advanced CPT baseline scores. The clinical examination did not change. There were no adverse events or safety issues.

**CONCLUSIONS:** These pilot data demonstrate that directing PEMF to refractory feet can provide unexpected shortterm analgesic effects in more than 50% of individuals. The role of placebo is not known and was not tested. The precise mechanism is unclear yet suggests that severe and advanced cases are more magnetically sensitive. Future studies are needed with randomized placebo-controlled design and longer treatment periods.

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