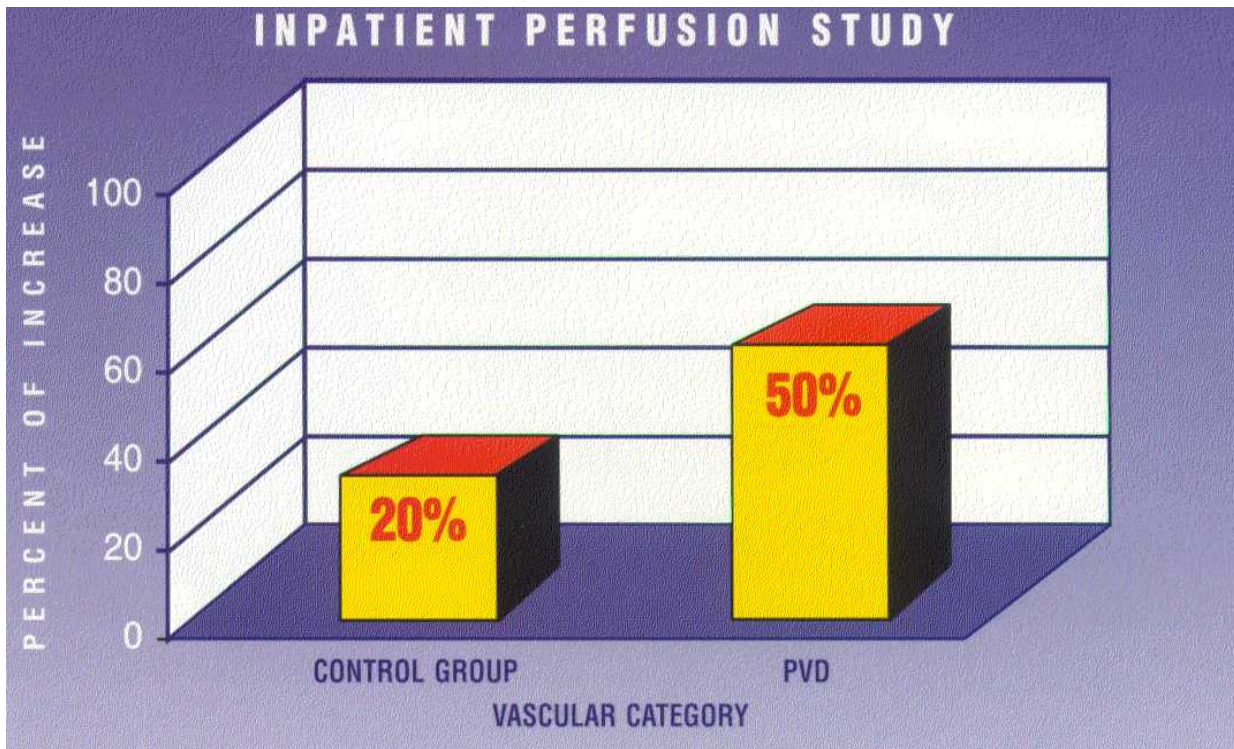


The Benefit of Electrical Stimulation to Enhance Perfusion in Persons with Diabetes Mellitus

Edgar J. G. Peters, MS,^{1,2} David G. Armstrong, DPM,¹ Robert P. Wunderlich, DPM,¹ Jan Bosma, MS,¹ Susan Stacpoole-Shea, BAppSc(Pod), PhDc,^{1,3} and Lawrence A. Lavery, DPM¹

The purpose of this study was to evaluate the effect of galvanic electrical stimulation on vascular perfusion in diabetic patients. Nineteen subjects with diabetes were enrolled. Eleven subjects (57.9%) were diagnosed with impaired peripheral perfusion based upon their initial transcutaneous oximetry values (<40 mm Hg). The subjects were studied over a 2-day period. On the 1st day, one foot was electrically stimulated for four 60-minute periods by an external electrical stimulation device. Vascular perfusion of both feet was assessed before and after the sessions of electrical stimulation. On the 2nd day, no electrical stimulation was applied and noninvasive vascular measurements were repeated. For the 1st hour, transcutaneous oxygen pressure was measured continuously during stimulation at the lateral aspect of the leg. Subsequently, perfusion between the periods of stimulation was measured on the dorsum of the foot with both transcutaneous oximetry and laser Doppler flowmetry after each stimulation period. In the group with impaired peripheral perfusion, a significant rise in tissue oxygenation as compared to the control measurements was measured during the first 5 minutes of stimulation ($p < .040$). For those without vascular disease ($T_c pO_2 > 40$ mm Hg) however, there was not a significant increase compared to baseline ($p = .280$). After the periods of stimulation, the stimulated feet did not show any higher perfusion levels than the control feet. Patterns in perfusion during the day, as measured by laser Doppler flowmetry, were similar in the tested feet and in the controls. These data suggest that external subsensory electrical stimulation induces a transient rise in skin perfusion in persons with diabetes and impaired peripheral perfusion. (The Journal of Foot & Ankle Surgery 37(5):396–400, 1998)

Key words: diabetes, electricity, perfusion, ulceration



Is Electrical Stimulation Effective in Reducing Neuropathic Pain in Patients with Diabetes?

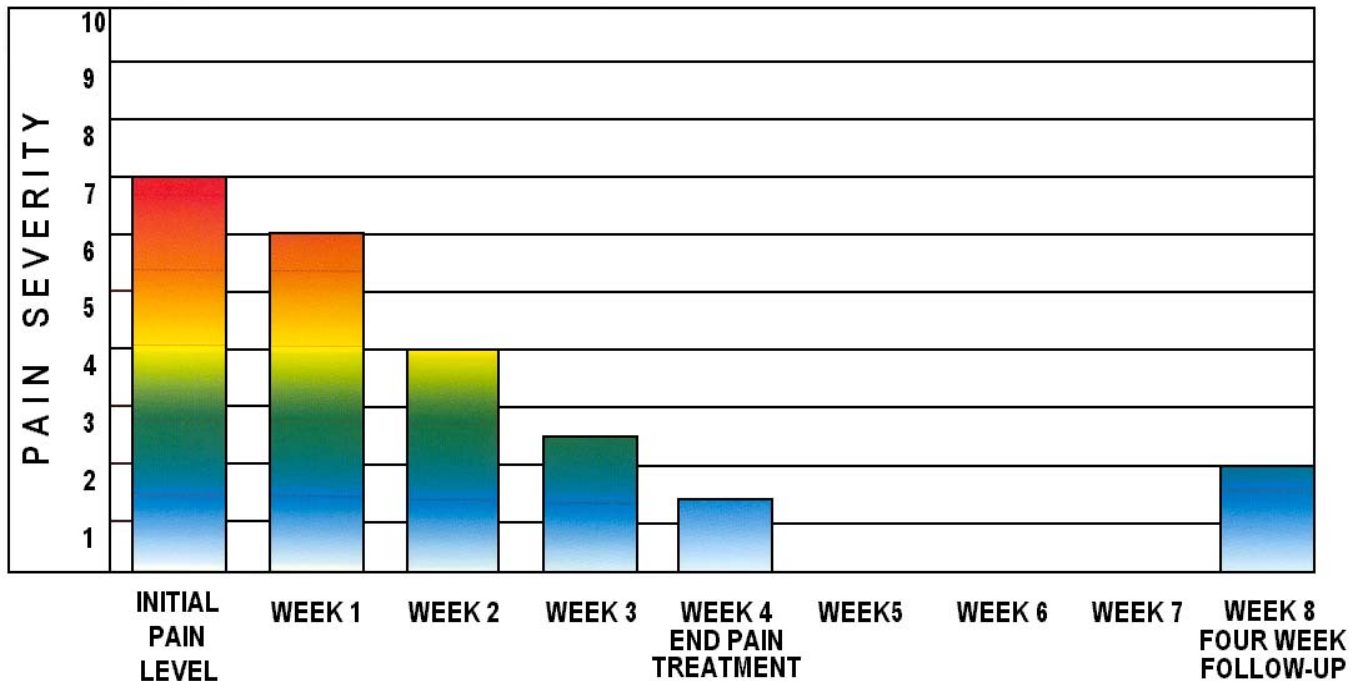
Pulsed-dose electrical stimulation is evaluated as an analgesic modality in patients with painful diabetic neuropathy. Using a knitted silver-plated nylon/dacron stocking electrode, patients were given electrical stimulation over the course of 1 month. Pain was measured weekly, using a 10-cm. visual analog scale. Pain measurements at the end of the 4-week therapy and at 1 month after complete discontinuation of therapy were significantly lower than at the initiation of therapy. The results of this pilot study suggest that nocturnal doses of pulsed-electrical stimulation may be effective in alleviating subjective, burning, diabetic neuropathic pain in a population consisting of patients with grossly intact protective sensation, relatively good distal vascular perfusion and less than ideal glucose control. To the authors' knowledge, this is the first analytic report of pulsed-dose electrical nerve stimulation delivered through a stocking electrode for treatment of symptomatic diabetic neuropathy in medical literature. (The Journal of Foot & Ankle Surgery 36(4):260-263, 1997)

Key words: diabetes mellitus, neuropathy, pain

David G. Armstrong, DPM, AACFAS¹
Lawrence A. Lavery, DPM, MPH, AACFAS²

John G. Fleischli, DPM, AACFAS³
Karry Ann Gilham, DPM⁴

VISUAL ANALOGUE PAIN SCALE



Electric Stimulation as an Adjunct to Heal Diabetic Foot Ulcers: A Randomized Clinical Trial

Edgar J. Peters, MD; Lawrence A. Lavery, DPM, MPH, David G. Armstrong, DPM, John G. Fleischli, DPM

ABSTRACT. Peters EJ, Lavery LA, Armstrong DG, Fleischli JG. Electric stimulation as an adjunct to heal diabetic foot ulcers: a randomized clinical trial. *Arch Phys Med Rehabil* 2001;82:721-5.

Objective: To evaluate high-voltage, pulse-galvanic electric stimulation as an adjunct to healing diabetic foot ulcers.

Design: Randomized, double-blind, placebo-controlled pilot trial.

Setting: University medical center.

Patients: Forty patients with diabetic foot ulcers, consecutively sampled. Twenty patients each assigned to treatment and placebo groups. Five patients (2 treated, 3 placebo) withdrew because of severe infection.

Interventions: Electric stimulation through a microcomputer every night for 8 hours. The placebo group used identical functioning units that delivered no current. Additional wound care consisted of weekly débridements, topical hydrogel, and off-loading with removable cast walkers. Patients were followed for 12 weeks or until healing, whichever occurred first.

Main Outcome Measures: Proportion of wounds that healed during the study period. Compliance with use of device (in hr/wk), rate of wound healing, and time until healing.

Results: Sixty-five percent of the patients healed in the group treated with stimulation, whereas 35% healed with placebo ($p = .058$). After stratification by compliance, a significant difference was identified among compliant patients in the treatment group (71% healed), noncompliant patients in the treatment group (50% healed), compliant patients in the placebo group (39% healed), and noncompliant patients in the placebo group (29% healed, linear-by-linear association = 4.32, $p = .038$). There was no significant difference in compliance between the 2 groups.

Conclusion: Electric stimulation enhances wound healing when used in conjunction with appropriate off-loading and local wound care.

Key Words: Diabetic foot; Diabetes mellitus; Electric stimulation; Rehabilitation; Ulcer; Wound.

© 2001 by the American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation

40 Patients Controlled,
Randomized, Double Blinded

