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Aikaterini Bairaktaridou
Department of Physiotherapy,
Faculty of Health Sciences
International Hellenic University -
Alexander Campus P.O. Box 141,
57400 Sindos, Thessaloniki, Greece

Dimitrios Lytras
Department of Physiotherapy,
Faculty of Health Sciences
International Hellenic University -
Alexander Campus P.O. Box 141,
57400 Sindos, Thessaloniki, Greece

Ioannis Kottaras
PhD, Department of
Physiotherapy, Faculty of Health
Sciences International Hellenic
University - Alexander Campus
P.O. Box 141, 57400 Sindos,
Thessaloniki, Greece

Paris Iakovidis
Department of Physiotherapy,
Faculty of Health Sciences
International Hellenic University -
Alexander Campus P.O. Box 141,
57400 Sindos, Thessaloniki, Greece

Anastasios Kottaras
PhD, Department of
Physiotherapy, Faculty of Health
Sciences International Hellenic
University - Alexander Campus
P.O. Box 141, 57400 Sindos,
Thessaloniki, Greece

Georgios Chasapis
MSc, Department of
Physiotherapy, Faculty of Health
Sciences International Hellenic
University - Alexander Campus
P.O. Box 141, 57400 Sindos,
Thessaloniki, Greece

Corresponding Author:
Dimitrios Lytras (PT, PhD)
Department of Physiotherapy,
Faculty of Health Sciences
International Hellenic University -
Alexander Campus P.O. Box 141,
57400 Sindos, Thessaloniki, Greece

The role of electrotherapy in the treatment of symptoms of diabetic peripheral neuropathy

Aikaterini Bairaktaridou, Dimitrios Lytras, Ioannis Kottaras, Paris Iakovidis, Anastasios Kottaras and Georgios Chasapis

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Abstract

Background: Diabetic Peripheral Neuropathy (DPN) is considered the most common form of neuropathy with symptoms such as pain, decreased sensation, leg ulcers and can even lead to lower limb amputation. The inclusion of electrotherapy in the treatment program can significantly contribute to the rehabilitation of these individuals and then reduce or even eliminate symptoms of DPN, thus improving their quality of life. The aim of this review is to gather recent research data on the efficacy of electrotherapy in the rehabilitation of people with DPN. The Google Scholar, PubMed and PEDro databases were searched with the following.

Keywords: Diabetic peripheral neuropathy, electrotherapy, rehabilitation. This review included both clinical trials and systematic reviews. The results of this review show that electrotherapy, in combination with other treatments, can significantly contribute to the management and improvement of the symptoms of DPN and consequently the quality of life of these individuals.

Keywords: Diabetic peripheral neuropathy, electrotherapy, rehabilitation

Introduction

Diabetic peripheral neuropathy (DPN) is considered the most common form of neuropathy worldwide. It is usually symmetrical peripheral polyneuropathy (approximately 75% of all peripheral neuropathies). It is characterized by symptoms such as pain, leg ulcers and may result in lower limb amputation. More specifically, 50% of people with DPN develop foot ulcers at least once in their lifetime. Symptoms such as pain and loss of sensation can lead to falls, related injuries such as sprains, restrictions on daily activities, depression and consequently a poorer quality of life [1].

Its prevalence is estimated between 6% and 51% in adults and is influenced by factors such as age, length of time a person has diabetes, glucose control and type of diabetes (type 1 versus type 2). In the USA, the estimated prevalence is 28%. On the contrary, there is evidence to suggest that Asian populations are less affected by DPN [1].

Electrotherapy is the use of electricity for therapeutic purposes. With proper use, it achieves pain management (acute and chronic), improvement of acute and chronic edema, joint mobility, muscle dysfunction and tissue repair [2]. It is used to relax muscle spasms, increase blood circulation, prevent and delay muscle atrophy, help in muscle recovery, maintain and improve range of motion, aid in injury healing and administer medication. Improper use may not have any positive effect on the patient, or worse, may have harmful effects [3,4]. The aim of this review is to collect recent research data on electrotherapy applications in patients with DPN.

Method

The Google Scholar, PubMed and PEDro were searched in English and Greek with the following keywords: diabetic peripheral neuropathy, electrotherapy, rehabilitation. This review included clinical trials and systematic reviews. Below are the main findings of the included articles.

Literature review

Serry *et al.* [5] studied the efficacy of Transcutaneous Electrical Nerve Stimulation (TENS) in people with DPN and compared it with aerobic exercise and daily pharmacotherapy. The sample consisted of 60 patients with a history of DPN for at least five years, who were divided into three groups. All three groups received regular medication, with group A applying TENS three times a week to both lower limbs, group B doing aerobic exercise and group C receiving only medication. According to a follow-up measurement, only groups A (41.67%) and B (16.67%) showed a statistically significant difference in the intensity of pain before and after treatment. The researchers concluded that applying TENS (for 30 minutes, three times a week) is more effective in relieving pain than aerobic exercise, while neither method showed a significant effect of improving plantar nerve conduction velocity.

Regarding TENS, Jin *et al.* [6] also investigated its efficacy in treating DPN and compared it with standard therapies, pharmacological interventions or virtual devices (placebo effect) in patients with DPN symptoms. The researchers observed that there was a significant improvement in pain reduction in the TENS group compared with the placebo group in the 4- and 6-week follow-ups, but not in the 8-week follow-up. During the 12 weeks that the participants were monitored, a significant improvement in the overall neuropathic symptoms was observed and at the same time, no adverse reactions were recorded. For this reason, treatment with TENS has been described by the authors as an effective and safe method for the treatment of symptomatic DPN. However, the researchers note that more research with a larger sample and longer duration is needed to further assess the long-term impact of TENS on DPN.

In the study of Kumar *et al.* [7], the efficacy of the combination of TENS electrotherapy with the use of amitriptyline in chronic painful DPN in patients with type 2 diabetes was evaluated. The 23 patients who, after using amitriptyline for four weeks, saw little to no effect were divided into two groups, the control group, which used non-functional portable devices, and the electrotherapy group, which used functional portable devices, for 12 weeks. The control group observed a reduction in pain, which the researchers attributed to a placebo effect. On the other hand, in the electrotherapy group five out of the 14 patients became asymptomatic, while a significant reduction of pain was observed, compared to the control group. The researchers concluded that the use of TENS is effective in reducing pain caused by peripheral neuropathy and that electrotherapy, in combination with the use of medication, is a useful method for pain relief.

Furthermore, Pieber *et al.* [8] studied the effect of different electrotherapy methods in patients with painful DPN. They included 15 studies in their systematic review, the results of which showed that long-term use of TENS has beneficial effects, as well as the use of pulsed and static electromagnetic fields. However, in one of the included studies, which used pulsed electromagnetic fields, no analgesic effect was found. The included studies that applied other types of current had a small sample size and therefore the authors concluded that there was a need for more research, with a larger sample and treatment time, complemented by long-term follow-ups.

The study of Najafi *et al.* [9] concerns the motor deficits of people with DPN, which are mainly due to the reduced plantar sensation. The authors investigated the efficacy of the application of Neuromuscular Electrical Stimulation (NMES) in the plantar nerve to improve mobility. The sample consisted of 28 individuals, who were randomly divided into an intervention

group (17 participants) and a control group (11 participants). Both groups used identical plantar nerve stimulation devices daily for six weeks, but only those in the intervention group were actually functional. At the end of the study, the center of mass improved significantly at the ankles, as did the gait parameters (e.g., speed). The study concludes that daily home use of NMES in the plantar nerve can enhance motor performance and the feeling of plantar pressure in people with DPN.

The aim of the randomized controlled trial of Weintraub *et al.* [10] was to assess whether repetitive and cumulative exposure to Pulsed Electromagnetic Fields (PEMF) in legs with pain can reduce neuropathic pain, affect sleep and nerve regeneration. The participants were randomly assigned identical PEMF devices, some of which did not work (placebo effect), to use them twice a day for three months. A tendency of symptom reduction was observed, such as itching, in the PEMF group. However, there was no significant difference in the improvement of pain and sleep between the groups. In this study, the use of PEMF was not shown to be effective in reducing pain; however, due to the reduction of other symptoms, future research is needed to increase the dosage (3000-5000G) and duration of exposure to determine whether PEMF usage can help reduce pain and regenerate nerves.

Anju *et al.* [11] in order to evaluate the effectiveness of the use of low-level laser therapy (LLLT) in the treatment of painful DPN conducted a systematic review with six studies. Randomized and non-randomized studies were included, while the difference in pain score and quality of life was assessed and a nerve conduction velocity test was performed. Research showed that the use of LLLT has a positive effect on the management of diabetic neuropathic pain.

In another systematic review, Robinson *et al.* [12] attempted to evaluate the efficacy of Monochromatic Infrared Energy (MIRE) in neuropathic pain and plantar sensitivity. In the six studies they included, MIRE use was not associated with plantar sensitivity. In contrast, study subgroups with short-term follow-ups (approximately two weeks), showed a significant improvement in plantar sensitivity. In addition, pain was significantly increased in patients who used MIRE and thus, the researchers concluded that while there is evidence of short-term improvement in sensitivity due to MIRE use, the results may not be maintained in the long run. They also found that MIRE does not provide relief from neuropathic pain. They considered, however, that the quality of the evidence was low and therefore future research could change the data.

Lastly, Clift *et al.* [13] conducted a study to evaluate the effect of MIRE on the plantar sensation of people with DPN. Active or virtual (placebo) MIRE treatment was applied to 39 participants for four weeks, three times a week for 30 minutes, while the sensation was examined in the follow-up after four weeks without treatment. No significant differences were observed between the two groups. The researchers concluded that the active application MIRE did not provide more benefits than the virtual one and therefore is not effective in improving the sensation in people with DPN.

Discussion–Conclusions

These studies highlight the benefits that certain types of electricity, such as TENS, can offer in the rehabilitation of people with DPN, mainly due to their analgesic properties. However, as research has shown, not all current types are suitable for this purpose (e.g., MIRE). For this reason, it is important to choose the right current, so as to provide the

optimal treatment.

As previously mentioned, the results were ambiguous. The application of TENS was assessed under many parameters and compared with other methods of treatment, such as exercise and pharmacotherapy, showing its efficacy in improving pain, without side effects or other adverse reactions^[5-6, 8]. NMES was also effective in improving motor and sensory performance^[9]. Additionally, current types such as pulsed and static electromagnetic fields showed positive effects, not on analgesia, but on other symptoms of DPN, such as itching^[10]. LLLT also has an analgesic effect, while MIRE application was not shown to be effective in managing neuropathic pain and plantar sensitivity^[11].

The results of this review show that electrotherapy, in combination with other treatment methods, can significantly contribute to the management and improvement of the symptoms of DPN, mainly pain, and consequently the quality of life of these individuals. In addition, it should be noted that the literature on the effect of electrotherapy and in particular the various current types in DPN is still limited. Therefore, further research is needed to determine the efficacy of different types of current.

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