

Effectiveness of diadynamic currents and transcutaneous electrical nerve stimulation in disc disease lumbar part of spine

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Abstract. *Background:* Back pain has multi-factorial etiology and is modified by environmental influences, character of work, and individual predispositions.

Objective: The aim of this study was to compare the efficiency of analgesic DD current therapy and TENS in low back discopathy.

Material and methods: Eighty patients (age, 45–60 years) with diagnosed low back pain syndrome due to discopathy were subjected to therapy. In the first group (DD) of 40 people, DD current therapy was applied. In the second group (TENS) of 40 people, TENS was applied. The third group of 40 people was a control group in which a functional fitness test was performed for comparison purposes. The control group was in this case an equivalent to a norm. Before the beginning and on the completion of therapy in all patients, a pain level measurement and functional fitness test were performed.

Results: On the basis of research conducted it was stated that both therapies reduce pain level effectively. Obtained analyzed results conclude that both therapies applied have an analgesic effect.

Conclusions: DD current and TENS therapies in low back discopathy have an analgesic impact and improve functional fitness. The applied therapies have a comparable impact on researched parameters.

Keywords: Electrotherapy, pain, lumbar spine

1. Introduction

Low back pain (LBP) syndrome has multi-factorial etiology and is modified by environmental influences, character of work, and individual predispositions. Most often, it results from statodynamic balance disorders and degenerative changes within invertebrate discs in the spine. Pains may be divided into non-specific and specific ones. A non-specific pain is called a nociceptive pain, whereas a specific (neuropathic) pain appears as a result of stimulation, damage of peripheral nerves, spinal nerve roots, spinal cord or brain area injury.

A definition of non-specific pain of lower back part according to Waddell assumes: 'A clinical term con-

cerns most commonly patients between 20–55 year, it appears in lower back parts, loins and thighs, the pain is mechanical as it is dependant on mechanical activity and changes in time; the condition of patients is good'. Only in 10% cases it is possible to define a specific physical cause, e.g. nerve root compression, damage, infection or tumor, in 90% of cases it is thus a non-specific pain.

It is considered that the nature of LBP is a gradual deterioration of the parts of the spine caused by over-straining that overwhelms both spinal adaptability and endurance. Psychogenic factors play a significant role in LBP occurrence especially when pain becomes chronic and is defined by its chronic character. Fear of being permanently disabled leads to depression and states of anxiety. Nowadays, all of these ailments have been related to our developing civilization, and a concept of disease of civilization has been used in rela-

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tion to changes resulting from overstressing the lumbar spine. The blame is laid on a sedentary lifestyle, spending one's leisure time in a passive way, and lack of effective preventive action [1–3].

Physical medicine has a wide range of analgesic anti-inflammatory and muscle stimulating treatment methods. Both diadynamic and TENS currents have become the most frequently implemented electrotherapeutic methods. The impact of diadynamic currents consists of analgesic effects and specific dynamics during the formation of physiological processes in tissues. They occur during the administration of the current and lasts up to a few hours after the treatment has been terminated. Even an electric current of small voltages has an impact on sensory and motor nerves. One of the theories explaining the analgesic effect of diadynamic currents is the gate control theory of pain by Wall and Melzack. Recently, another theory has become very popular. It explains the analgesic effect provoked by bodies characterized as polypeptides called endorphins. Electric stimulation using diadynamic currents generates an increase in the amount of endorphins in a system. Alternatively, dynamogenic and inhibitory action of diadynamic currents has been used in treating many different ailments [4–6]. In transcutaneous electrical nerve stimulation, a small frequency current and a square, rectangular, triangular or sinusoidal shape is applied. The currents may have monophasic, biphasic, symmetrical, or asymmetrical courses. Devices presently produced are capable of generating biphasic current, containing positive and negative phases. It allows the avoidance of permanent polarization and electrochemical reactions connected with it [7,8]. Transcutaneous electrical nerve stimulation is mostly used in acute and chronic pain treatment. It is also successfully applied to the treatment of some peripheral circulation diseases, treatment of bone synostosis dysfunction, hardly healing wounds, and in muscle atrophy. This method is not an effective form of therapy in the treatment of pain that is not clearly situated, e.g. extensive splanchnodynia and psychogenic [4,5,8–11]. The purpose of this study was to compare the effectiveness of analgesic diadynamic currents and transcutaneous electrical nerve stimulation therapies in lumbar spine discopathy treatment.

2. Material and methods

The assent of the Bioethical Commission of the Academy of Medicine in Wrocław No KB – 1051/2002

for conducting blinded research was obtained. The research material included patients that were referred by their family doctors. Eighty patients aged 45 to 60 with the diagnosis of LBP syndrome caused by discopathy were subjected to physiotherapeutic treatment for two weeks. The patients were randomly divided into two equal groups. In the first 40 patients (DD group) diadynamic therapy was applied. The group comprised 30 women and 10 men with the average age of 52.2. In the second group of 40 patients (TENS group), transcutaneous electrical nerve stimulation (TENS) was applied. This group comprised 27 women and 13 men with the average age of 50.8. During the therapy and research, none of the patients was subjected to pharmacological treatment or any other form of therapy. A third group was formed consisting of 40 randomly selected healthy people, not suffering from low back pain. This group comprised 24 women and 16 men with the average age of 51.3. As a control group, it was subjected to a functional fitness test for comparison purposes and it constituted an equivalent of a norm.

In group I (DD) diadynamic current therapy was applied. DF current was chosen as the first because it is the fastest one to overcome the skin's resistance and it is known for its analgesic effect. MF current followed. It delays inhibition and preserves anesthetization. LP and CP currents are typical analgesic currents which lower both secondary inhibition effect and muscle tightness. Ten interventions were performed every day with a weekend break. The treatment was performed with the use of a Stymat S-210 apparatus. Stationary plate electrodes measuring 4×9 cm were put in trigger points typical of LBP. The duration of the treatment amounted to 10 minutes and was a sequence of different diadynamic currents: DF 2 minutes, MF 3 minutes, LP 3 minutes, and CP 2 minutes. The intensity depended on the patient's individual reactions and on average amounted to 15 mA. The duration of the treatment was established conforming to the methodology of Bernard's current. Due to secondary inhibition, the maximum duration was 10 minutes.

In group II (TENS) transcutaneous electrical nerve stimulation was applied. Ten interventions were performed every day with a weekend break. The treatment was performed with the use of an apparatus for electrotherapy Ionoson made by Physiomed. For this treatment, stationary plate electrodes measuring 6×12 cm were used and arranged in a paravertebral column at points where pain in the lower back occurred. The apparatus generated a bidirectional impulse, symmetrical and rectangular. The intensity depended on the

patient's individual reactions and on average amounted to 30 mA. The duration of the treatment, which conformed to generally accepted methodology, amounted to 30 minutes. During the first 10 minutes, current frequency amounted to 10 Hz, and during the following 20 minutes it amounted to 100 Hz. All patients were subjected to an interview comprising basic personal data: name and surname, age, sex, duration and type of disease.

Before and after therapy, all the patients were subjected to the following examinations: measurement of pain intensity, range of movement, and functional fitness tests. Measurement results were recorded in VAS (Visual Analog Scale). The results were analyzed with the use of a research interpretation rule where 1 millimeter on the pain intensity scale was equivalent to 1 point [12,13]. Assessment of functional fitness was carried out by a diagnostic poll method on the basis of evaluation of life quality according to the functional pain index by Lequesne (the EULAR criteria). Pain or quantitative discomfort, maximum walk distance and daily activities were assessed. A maximum of 24 points was possible and anything over 24 reflected a worsened physical condition. The results obtained were referenced with the healthy people group constituting an equivalent of a norm [13–15]. Means and standard deviations were calculated for each of the examined variables and comparisons were made for before and after treatment between different subgroups with the aid of the T-Student test ($p < 0.05$).

3. Results

On the basis of the results of the research it can be stated that before therapy the level of pain was similar in both researched groups (Table 1).

In the group of patients in which diadynamic currents were applied the average pain level before therapy equaled 6.55, whereas after therapy it was 4.10. At the same time in the group in which TENS therapy was applied the average pain level before therapy was 7.07 whereas after treatment it equaled 3.35. On the basis of T-test one can clearly state that a significant statistic efficacy of both therapies was on the level of $p < 0.05$.

Afterwards, the results of a functional fitness test were assessed. Table 2 depicts descriptive statistics and differences assessment (T-Student test) of a functional fitness test in both researched groups before and after the therapy. In the group in which diadynamic currents were applied the average fitness test value was on the

level of 10.72, whereas after therapy it was on 7.12. At the same time in the group of patients in which TENS therapy was applied it was 9.97 and 4.92 adequately.

In order to evaluate the efficacy of diadynamic current therapy and transcutaneous electrical nerve stimulation in disc disease lumbar part of spine a T-Student test was applied. The results showed that both therapies had an impact on the improvement of a fitness on the significant level (Table 2).

The assessment of a functional fitness of patients treated with diadynamic current therapy and transcutaneous electrical nerve stimulation was compiled with the results achieved with reference to the results achieved from tests performed on healthy people (Table 3).

Referring the results of the functional fitness test of patients with pains in lumbar part of spine resulting from disc disease treated with diadynamic current therapy and transcutaneous electrical nerve stimulation to the results of healthy people it can be stated that before therapy the difference between the two groups was on a visible level. After the application of the treatment this difference was still substantial in comparison to the group of healthy people.

In order to define the differences in efficacy of DD and TENS therapy a T-Student test was applied. The results achieved have, however, a comparable impact on decreasing the level of pain and improving the functional fitness (Table 4).

4. Discussion

In LBP due to discopathy, the most frequently occurring ailment is pain formed as a result of irritating nociceptors distributed in the area of innervation territories of the spine or as a result of pressure on nerve roots in the spinal canal. The question of pain is looked into as a complex multi-directional developing process in which psychological factors are of big significance. The choice of an appropriate corresponding treatment is no easy task. Even if there are many electrotherapeutic analgesic methods, various types of research have been conducted in order to determine the efficiency of those methods in treating various ailments. TENS was introduced to electrotherapy in the 1960's and has spread very fast and become a standard analgesic procedure applied in treating both chronic and acute pain [16]. It is one of the most frequently applied techniques of neuromodulation, with significant efficiency (40%–60%) especially in treating chronic pain.

Table 1
Descriptive statistics of pain level in DD and TENS groups before and after therapy and differences assessment (T- Student test)

Group	Stage	Average	Standard deviation	Minimum	Maximum	p	T- Student test
DD	before therapy	6.55	2.24	2.00	10.00	0.00	12.10
	after therapy	4.10	2.31	0.00	8.00		
TENS	before therapy	7.07	1.89	2.00	10.00	0.00	11.42
	after therapy	3.35	2.10	0.00	9.00		

$p < 0.05$.

Table 2
Descriptive statistics and differences assessment (T-Student test) of a functional fitness test in DD and TENS groups before and after the therapy (points)

Group	Stage	Average	Standard deviation	Minimum	Maximum	p	T-Student test
DD	before therapy	10.72	6.43	0.00	21.00	0.00	10.16
	after therapy	7.12	6.12	0.00	20.00		
TENS	before therapy	9.97	4.27	4.00	21.00	0.00	10.54
	after therapy	4.92	4.68	0.00	19.00		

$p < 0.05$.

Table 3
Assessment of differences in a functional fitness evaluation test in the DD and TENS groups with reference to the healthy people group before and after the therapy (T-Student test) (points)

Group	Stage	Average	Standard deviation	Minimum	Maximum	p	T-Student test
DD HEALTHY	before therapy	10.72	6.43	0.00	21.00	0.00	7.77
		2.40	2.10	0.00	9.00		
DD HEALTHY	after therapy	7.12	6.12	0.00	20.00	0.00	4.61
		2.40	2.10	0.00	9.00		
TENS HEALTHY	before therapy	9.97	4.27	4.00	21.00	0.00	10.18
		2.40	2.10	0.00	9.00		
TENS HEALTHY	after therapy	4.92	4.68	0.00	19.00	0.00	3.10
		2.40	2.10	0.00	9.00		

$p < 0.05$.

Table 4
Comparison of the efficacy of therapy DD and TENS (T-Student test)

Variable	Average DD	Standard deviation DD	Average TENS	Standard deviation TENS	T-test	df	p
pain before therapy	6.55	2.24	7.07	1.89	-1.13	78	0.26
pain after therapy	4.10	2.31	3.35	2.10	1.51	78	0.13
functional fitness before therapy	10.72	6.43	9.97	4.20	0.61	78	0.53
functional fitness after therapy	7.12	6.12	4.92	4.68	1.80	78	0.07

$p < 0.05$

Dobrogowski adds that TENS is a very important kind of therapeutic action in a complex treatment of chronic pain. In his opinion, it should be often applied as the first choice therapy [17]. It has been proven that in 30% of chronic pain cases hostile to any other form of analgesic therapy, TENS was very efficient in reducing pain level [18]. Blind research allowed observing that both therapies helped in reducing pain level and in

enhancing functional fitness. Applied test comparing the efficacy of carried out electrotherapeutical methods showed that they have a similar impact.

Tests applied to compare the efficiency of electrotherapeutic methods showed more manageable results in case of TENS, efficiency of that method was evaluated by Janiszewski and Bittner-Czapińska [9]. They treated 85 patients with degenerative changes in

the lumbar section of the spine and they stated that in the group of patients, who underwent kinezitherapy and TENS, the range of spinal movement improved and the pain level was reduced. The same results were not obtained in the group of patients who underwent kinezitherapy alone. Similar results were reached by Kwasucki and Talar [10] when they applied TENS therapy to treat patients suffering from sciatica. They confirmed the positive effect of the electrostimulation of nerves in the antinociceptive process. The clinical proof was receding or reducing the pain in 65% of patients with sciatica. In his analysis Taradaj [11] states that, contrary to some voices from critics, TENS method is worth trying and its long-lasting results in receding or reducing pain levels are beyond doubt. Clinical research based on scientific proofs shows a procedure of treating patients with acute and low back pain. In cases of patients with chronic low back pain, it has been proven that no method applied separately has been efficient enough. It is recommended to apply a more complex treatment including all physiotherapeutic methods as well as psychotherapy. The goal of which is the improvement in quality of life [19].

5. Conclusion

1. In the research groups, both diadynamic current therapy and TENS in lumbar spine discopathy have an analgesic effect and improved functional fitness.
2. The applied therapies have a comparable impact on researched parameters.

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