

# fizjoterapia polska

POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII  
THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 1/2018 (18) KWARTALNIK ISSN 1642-0136

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# Porównanie skuteczności terapii przy użyciu pola elektromagnetycznego wysokiej częstotliwości i terapii falą ultradźwiękową w przebiegu chorób zwyrodnieniowo – przeciążeniowych układu narządu ruchu

*Comparison between the effectiveness of therapy using a high-frequency electromagnetic field and the therapy using ultrasound waves in the degenerative and overload diseases of the locomotor system*

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## Streszczenie

Cel pracy. Celem pracy jest ocena skuteczności leczenia chorób zwyrodnieniowych układu narządu ruchu przy użyciu pola elektromagnetycznego wysokiej częstotliwości w porównaniu do leczenia ultradźwiękami.

Materiał i metody. Do badania zakwalifikowano 77 osób w wieku od 42-84 lat, z zaostrzeniami dolegliwości bólowych i ograniczeniem sprawności ruchowej w przebiegu chorób zwyrodnieniowych. Pacjenci zostali podzieleni na 3 grupy. W grupie I (27 osób) wykonywano zabiegi: krioterapii, laseroterapii i kinezyterapii. W grupie II (27 osób) wykonywano zabiegi: krioterapii, laseroterapii, ultradźwięków, kinezyterapii. W grupie III (23 osoby) wykonywano zabiegi: krioterapii, laseroterapii, pola elektromagnetycznego wysokiej częstotliwości, kinezyterapii. We wszystkich grupach zabiegi prowadzono przez okres 10 dni. Zastosowano ankietę oceny sprawności ruchowej oraz ocenę bólu. Badania przeprowadzono w 1 i 10 dniu zabiegów.

Wyniki. W każdej grupie zastosowane leczenie okazało się skuteczne, co było statystycznie istotne. W grupie III była największa różnica median. Podobnie zmiana bólu była najbardziej istotna w grupie III, terapia przy użyciu pola elektromagnetycznego okazała się najbardziej skuteczna.

Wnioski. Uzyskano istotną różnicę między bólem początkowym, a końcowym w 3 badanych grupach. Wystąpiła istotna różnica w zmianie bólu w 3 badanych grupach. Wykazano większą skuteczność stosowania terapii pola elektromagnetycznego.

## Słowa kluczowe:

rehabilitacja, zmiany zwyrodnieniowe, fizykoterapia

## Abstract

Objective. The objective of this study is to assess the effectiveness of treating degenerative diseases of the locomotor system using a high-frequency electromagnetic field in comparison with ultrasound treatment.

Materials and methods. 77 people aged 42-84 with exacerbation of pain ailments and limitation of motor skills resulting from degenerative diseases, were qualified for the study. The patients were divided into 3 groups. The following procedures were performed in group I (27 persons): cryotherapy, laser therapy and kinesiotherapy. The following procedures were performed in group II (27 persons): cryotherapy, laser therapy, ultrasounds and kinesiotherapy. The following procedures were performed in group III (23 persons): cryotherapy, laser therapy, high-frequency electromagnetic field, kinesiotherapy. The procedures were performed for 10 days in all the groups. There was applied the motor skill assessment survey and pain assessment. The tests were performed on the 1st and 10th day of the procedures.

Results. In each group, the treatment applied occurred to be effective, which was statistically relevant. In group III, the median difference was highest. Similarly, the change in pain was most significant in group III, the therapy using an electromagnetic field occurred most effective.

Conclusions. A significant difference between the initial and final pain was noted in the 3 tested groups. A significant difference in the level of pain appeared in the 3 tested groups. The higher effectiveness of electromagnetic field therapy was demonstrated.

## Key words:

rehabilitation, degenerative lesions, physical therapy

## Introduction

Degenerative diseases of the locomotor system are the most frequent diseases of an aging society. The people affected by degenerative diseases complain about chronic pains and limitation of motor skills, morning stiffness of the joints, inability to perform work and to actively participate in family and social life. The patients are treated in orthopedic, rheumatology, neurology, rehabilitation outpatient clinics. They use nonsteroidal anti-inflammatory drugs, steroidal anti-inflammatory drugs, myorelaxants, antidepressants, sleeping pills. They use the services of chiropractors and bio-energy therapists.

A degenerative-overload disease of the locomotor system is a modern-age disease associated with overweight, sitting lifestyle, insufficient physical activity, the process of aging of joint components, collagen fibers and tendon sheath fibers, as well as degenerative lesions resulting from sports and overload injuries caused by professional activity. Degenerative diseases more and more often end in orthopedic surgeries (joint arthroscopy, complete or partial joint prosthetic arthroplasty), neurosurgeries (ablation of the herniated nucleus pulposus, disc implantation). The patients after orthopedic and neurosurgical procedures are not fully functional and have to "be careful about their new joints". More and more spine surgeries are performed in young and middle-aged people (ca. 30-40 years old). The availability of surgeries is very limited, and the waiting time for surgeries of the hip joint or knee joint is several years. That is why one should use preventive treatment, while in active disease – one should search for the methods that recover the skills (even at the initial stage of a degenerative disease).

The application of cryotherapy, laser therapy, high-frequency electromagnetic field, ultrasounds and kinesiotherapy in the degenerative diseases of the spine and peripheral joints accelerates the process of treatment and skill recovery. The application of an electromagnetic field (through deep overheating of the tissues) accelerates joint regeneration, decreases muscle tone, improves microcirculation and tissue metabolism, thus causing the pain and joint stiffness to disappear.

## Objective

The objective of this study is to assess the effectiveness of treating degenerative diseases of the locomotor system using a high-frequency electromagnetic field in comparison with the treatment using standard physical therapy methods.

## Materials and methods

77 patients aged 42-84 were qualified for the study: 59 women and 18 men, with exacerbation of pain ailments and limitation of motor skills resulting from degenerative diseases.

The group included 32 pensioners, 28 white-collar workers and 17 blue-collar workers.

The patients were randomly divided into 3 groups.

The following procedures were performed in the 1st group, consisting of 27 people (average age of 57): cryotherapy, laser therapy and kinesiotherapy. The procedures were performed for 10 days (2 weeks, with a break on Saturday and Sunday).



The following procedures were performed in the 2nd group, consisting of 27 people (average age of 61): cryotherapy, laser therapy, ultrasounds and kinesiotherapy. The procedures were performed for 10 days.

The following procedures were performed in the 3rd group, consisting of 23 people (average age of 56): cryotherapy, laser therapy, high-frequency electromagnetic field, kinesiotherapy. The procedures were performed for 10 days.

The assessment of the treatment results was based on two questionnaires, filled in during the medical tests on the first and last (tenth) day of the procedures. The questionnaires included, among others, questions regarding assessment of motor skills and of pain. The questionnaire assessing motor skills and everyday activities applied the scale of 0-4 (0 – full motor skills, 1 – small limitation of skills, 2 – average limitation of skills, 3 – significant limitation of skills, 4 – very significant limitation of skills).

The pain assessment survey applied the scale of 0-10.

The study used the Scanlab 25 Bodywave device that generates a high-frequency electromagnetic field using the capacitor method (frequency of 1 MHz, wavelength of 300 m), procedure time: 5-10 minutes.

The ultrasound wave was generated using a Sonaris S device (4 cm<sup>2</sup> head, radiation frequency of 1 MHz, maximum power of 10W), procedure time: 5-10 minutes.

Before the exercises, there was also applied laser therapy, using Polaris 2, low-energy device (IR probe 400 mW/808 nm).

Local cryotherapy using fumes of liquid nitrogen was performed using a Kriopol R15 device, for 3 minutes. All the patients were subject to standard kinesiotherapy, the purpose of which was to increase the muscle strength and the range of joint movements.

The statistical analysis was performed using a STATISTICA 12 PL statistical package and covered descriptive and comparative statistics. Descriptive statistics: for measurable variables – determination of the minimum and maximum values, median, arithmetic mean and standard deviations, and for qualitative variables – determination of the number (%) of the contingencies in the tables. The average values in three populations were compared using the ANOVA analysis of variance. At first, the assumptions of the ANOVA test were verified: the compliance between the variable distribution and the normal distribution using the Shapiro-Wilk test and the variance uniformity using Bartlett's test. For the variables from the qualitative scale, the median values in three populations were compared using the non-parametric Kruskal-Wallis ANOVA test. A non-parametric Wilcoxon signed-rank test was used to compare the variables in the qualitative scale at the beginning and at the end. The threshold of statistical relevance of  $p < 0.05$  was selected for all the comparative analyses.

### Test Results

In each group, capacity before and after the treatment was assessed. In group I (control), the median amounted to 2 before the test, and 1 after. In group II, the median amounted to 3 before the test, and 2 after. In turn, in group III, the initial value of the median was 3, and final – 1. In that group, the median difference was highest. In each method, the treatment proved effective, and the differences were statistically relevant. Similarly, the change in pain was most significant in group III, the

therapy using an electromagnetic field occurred most effective. The application of high-frequency electromagnetic field therapy seems to be sensible in degenerative diseases, due to the faster improvement in joint mobility and faster reduction in pain in comparison with standard therapies. The ages in all three groups were compared and the difference was statistically irrelevant ( $p = 0.224$ ). In each group, capacity before and after the treatment was assessed. In group I (control), the median amounted to 2 before the treatment, and 1 after. In group II, the median amounted to 3 before the treatment and 2 after, while in group III (patients treated with “diathermy”), the initial value of the median was 3, and the final one – 2. In that group, the median difference was highest. In each method, the treatment proved effective, and the differences were statistically relevant ( $p < 0.05$ ). Table 1 presents the results of pain assessments in the respective groups.

**Table 1. Medians and average results before and after the treatment – assessment of motor skills**

Motor skills	group I		group II		group III	
	before	after	before	after	before	after
average	2.37	1.44	2.93	1.85	2,52	1,13
median	2.00	1.00	3.00	2.00	3,00	1.00
	$p = 0.000040$		$p = 0.000027$		$p = 0.000027$	

The assessment of changes in the level of pain were presented in table 2. The biggest change in pain appeared in group III, but pain intensity was significantly reduced in all the groups.

**Table 2. Medians and average results before and after the treatment – assessment of pain**

Pain	group I		group II		group III	
	before	after	before	after	before	after
average	5.37	3.59	6.14	4.11	6.04	3.09
median	5.00	4.00	6.00	4.00	6.00	3.00
	$p = 0.00018$		$p = 0.000012$		$p = 0.000040$	

Further analysis was subject to assessment of change in the level of pain as a result of treatment. In the whole sample examined, the treatment caused the average pain assessment to drop by 2.22 ( $\pm 0.28$ ). The average change in pain assessment in the control group was 1.78 ( $\pm 0.13$ ), in group II (treated with ultrasounds) 2.04 ( $\pm 0.18$ ) and in the group treated with diathermy 2.96 ( $\pm 0.26$ ) (the standard error was presented in the brackets).

The significant change in the level of pain occurred in group III. The average change in the level of pain was 2.96. Over the 14 days of therapy, the average level of pain decreased by half (by about 3

scale units), while in the remaining groups, the average changed similarly only about 0.67 times (table 2). The group treated with diathermy is statistically significantly different through the difference in assessment of pain, in comparison with the average from the other groups. with group I  $p = 0.0026$  and with group II  $p = 0.024$ . The comparison results are demonstrated in table 3. The differences studied are presented in fig. 1.

**Table 3. Average values of change in the level of pain as a result of therapy**

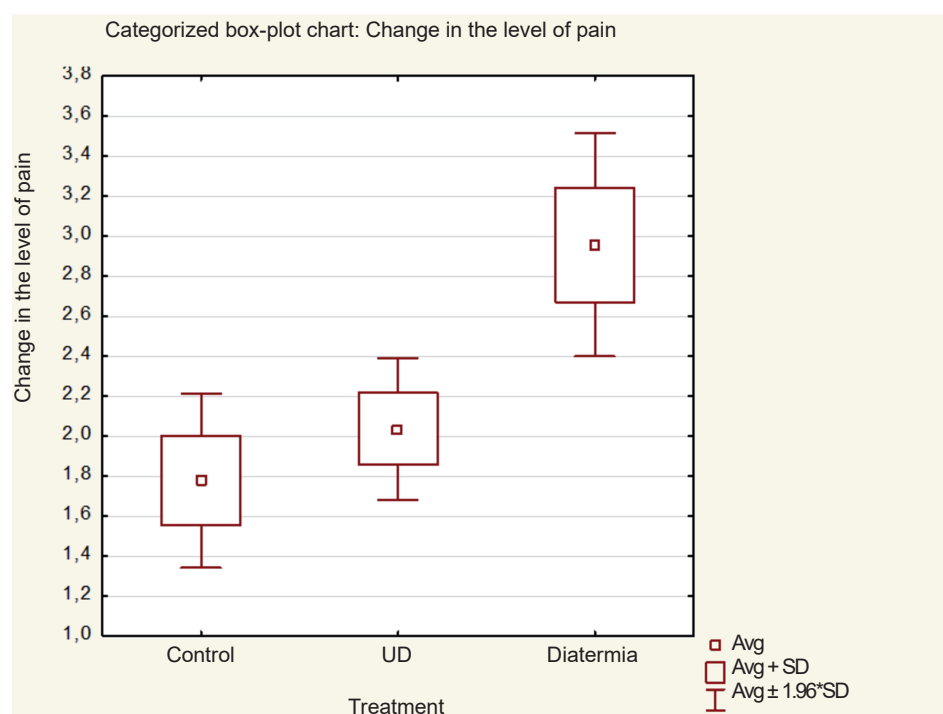
Pain	change as a result of therapy		
	group I	group II	group III
average	1.78	2.03	2.96

(Anova test)  $p = 0.0016$ , multiple group comparison tests:

I i II  $p = 0.712$

II i III  $p = 0.024$

I i III  $p = 0.0026$



**Fig. 1. Changes in the level of pain**

Similarly, the next analysis was subject to assessment of the change in motor skills as a result of treatment. In the whole examined sample, the average skill assessment increased by  $1.11 (\pm 0.07)$ . The average improvement in skill assessment in the control group was  $0.93 (\pm 0.11)$ , in group II (treated with ultrasounds)  $1.07 (\pm 0.12)$  and in the group treated with diathermy  $1.39 (\pm 0.12)$ .

The most significant change in motor skills also appeared in group III.

The average difference in skill assessment before and after the treatment with diathermy was only statistically different from the control group  $p = 0.023$ . The comparison results are demonstrated in table 4 and fig. 2.

**Table 4. average changes in motor skills as a result of therapy**

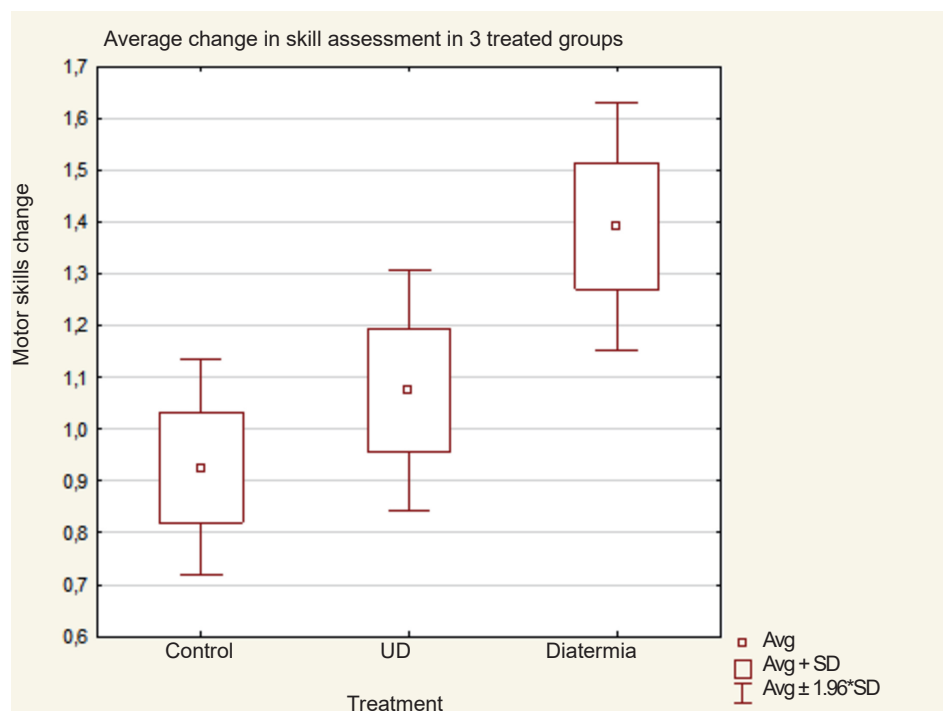
Motor skills	change as a result of therapy		
	group I	group II	group III
average	0.93	1.07	1.39

(Anova test)  $p = 0.02$ , multiple group comparison tests:

I i II  $p = 0.649$

II i III  $p = 0.167$

I i III  $p = 0.023$



**Fig. 2. Results of change in motor skills**

The difference between the initial and final skill assessment was significant (Friedman ANOVA test) in all the 3 groups

1. A significant difference between the initial and final pain was noted in the 3 tested groups
2. The change in the level of pain was significant in the 3 tested groups (definitive decrease in the level of pain in group III – i.e. the patients subject to high-frequency electromagnetic field treatment).
3. In comparison with the persons treated only with laser therapy or ultrasounds, the persons treated with electromagnetic field demonstrated faster recovery of motor skills and decrease in pain, which means the electromagnetic field therapy was more effective.

### Discussion

Degenerative disease is one of the modern-age diseases. As a result, contemporary medicine and rehabilitation must look for better methods of preventing and treating that disease.

The treatment of degenerative lesions may apply a wide range of the therapeutic methods [1-5]. In clinical practice, there are applied physical pain-killing and anti-inflammatory procedures as well as the procedures to improve the blood flow in tissues and reduce muscle tone. Numerous research studies are devoted to ultrasound therapy [6-12] and high-frequency electromagnetic field therapy [13-17]. Most authors demonstrate the positive effects of the therapies applied. An interesting study was presented by Yildirim et al. [9] who compared the ultrasound therapy in patients with degenerative lesions of knee joints of 4 minutes and 8 minutes. The patients in both groups benefited from functional improvement and lower level of pain, but the 8 minute group demonstrated a statistically higher improvement in functional capacity assessed based on the WOMAC scale and a decrease in the level of pain assessed based on the Lequesne Index. In another study, Yildiz et al. [10] assessed the effectiveness of treatment of gonarthrosis with ultrasounds using continuous and pulse waves. In comparison with the placebo group, both treated groups demonstrated a statistically significant improvement in function, quality of life and a decrease in the level of pain. The treatment effects were assessed based on the VAS scale, movement range assessment, Lequesne index, Sf-36 scale. Of all the studies assessing the effects of electromagnetic field, the study of Fukuda et al. [16] assessing the impact of short-wave diathermy depending on the dose applied, deserves particular attention. The authors applied a thermal dose and, for comparison purposes, had a placebo group. No differences were noted for the doses used, but higher doses proved to be more effective over a long period of time – 12 months. Another interesting article was presented by Cetin et al. [3] who compared such therapies as diathermy, ultrasounds, TENS currents and warm compress. The treatment effects were assessed using the VAS scale and the Lequesne Index. All the groups demonstrated reduced pain and improved function, but the best results were recorded in the group treated with short-wave diathermy and TENS currents.

In the literature there are numerous studies examining the effects of physical factors on the treatment of degenerative lesions of the joints, but there are few studies that compare the effectiveness of treatment with a high-frequency electromagnetic field and with ultrasounds.

The objective of this study was to compare the effectiveness of therapy using a high-frequency electromagnetic field and the therapy using ultrasound waves in the degenerative and overload diseases of the locomotor system. The electromagnetic field therapy proved more effective. To assess the permanence of the therapy results, another assessment should be performed after 10 months.

### Conclusions

1. The application of cryotherapy, laser therapy, high-frequency electromagnetic field, ultrasounds and kinesiotherapy seems to be effective in treating the degenerative diseases of the spine and peripheral joints.
2. All the forms of therapy significantly reduced the pain and increased the motor skills of the patients.
3. The high-frequency electromagnetic field proved to be most effective in treating pain and improving the motor skills.



4. The application of physical procedures may result in longer remission periods (improved the microcirculation, the flow of body fluids, better cell oxygenation, electrolyte exchange), and so it would be justified to conduct a follow-up examination of those patients in order to assess their effectiveness after 10 months of the therapy.

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