

# Porównanie skuteczności terapii falą akustyczną i jonowym rezonansem cyklotronowym w chorobie zwyrodnieniowej kręgosłupa lędźwiowego. Część I

*Comparison of effectiveness of the acoustic wave therapy and ion cyclotron resonance in degenerative vertebral freed column disease. Part I*

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## Streszczenie:

Wiele metod fizjoterapeutycznych jest stosownych w terapii choroby zwyrodnieniowej kręgosłupa, co dowodzi, że brak jest metody idealnej dla wszystkich pacjentów. Kolejne nowe metody w tym zakresie są dowodem na poszukiwanie *personal treatment*, czyli leczenia spersonalizowanego. Metody te, co oczywiste, wymagają weryfikacji. Celem pracy jest ocena przydatności stosowania fali akustycznej i jonowego rezonansu cyklotronowego oraz ich łącznego stosowania w terapii choroby zwyrodnieniowej kręgosłupa lędźwiowego.

**Materiał i metody.** Badaniami objęto grupę 80 chorych, mężczyzn i kobiet w wieku 35-75 lat (średnia wieku 50,6 lat) z chorobą zwyrodnieniową kręgosłupa lędźwiowego. Pacjenci zostali losowo przydzieleni do czterech grup terapeutycznych. K – grupa leczona pozorowaną falą akustyczną i kinezyterapią wg. zmodyfikowanych ćwiczeń Meina, FA – grupa leczona falą akustyczną i kinezyterapią wg. zmodyfikowanych ćwiczeń Meina, JRC – grupa leczona jonowym rezonansem cyklotronowym i kinezyterapią wg. zmodyfikowanych ćwiczeń Meina, FA+JRC – grupa leczona falą akustyczną i jonowym rezonansem cyklotronowym. Przed i po trzytygodniowej terapii oceniano: ruchomość kręgosłupa-w płaszczyźnie strzałkowej w teście Schobera, w płaszczyźnie czołowej w teście Molla i Wrighta.

**Wyniki.** Test Schobera pokazał podobny poziom różnicy ruchomości przed i po terapii dla grupy JRC 2,8 cm  $\pm$  0,84 i gr. FA+JRC 2,83 cm  $\pm$  1,1 przy  $p < 0,001$ . Procent zmian względem gr. K dla gr. JRC wyniósł 56% poprawy dla gr. FA+JRC 70% poprawy. W teście Molla i Wrighta różnica ruchomości w płaszczyźnie czołowej przed i po terapii w gr. FA to 1,15 cm, w gr. JRC 2,47 cm, gr. FA+JRC 2,90 cm przy  $p < 0,001$

**Wnioski.** Jonowy rezonans cyklotronowy i fala akustyczna z jonowym rezonansem cyklotronowym zwiększają zakres ruchomości kręgosłupa w chorobie zwyrodnieniowej odcinka lędźwiowego kręgosłupa.

## Słowa kluczowe:

fala akustyczna, jonowy rezonans cyklotronowy, choroba zwyrodnieniowa kręgosłupa lędźwiowego

## Abstract

*Many physiotherapy methods are appropriate in spine osteoarthritis treatment, which proves, that there is not an ideal method for all patients. Another new methods in this area are evidences in search of 'personal treatment'. It means personalized treatment. These methods, what is obvious, need to be verified. The aim of the study was to evaluate the utility of the acoustic wave and ion cyclotron resonance, and their combined use in the treatment of osteoarthritis of the lumbar spine.*

**Material and methods.** *The study group involved 80 patients, both men and women aged 35-75 years (average age 50.6 years) with osteoarthritis of the lumbar spine. Patients were randomly assigned to four treatment groups. K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercises, FA – group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JCR – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA +JRC – group treated with acoustic wave and ion cyclotron resonance. Before and after three weeks of therapy there was an assesment of: the mobility of the spine in the sagittal plane in Schober test and the frontal plane in Moll and Wright test.*

**Results.** *Schober test showed a similar level of mobility difference before and after treatment for a ICR group 2.8 cm  $\pm$  0.84 and thickness. ICR+AW + 2.83 cm  $\pm$  1.1 at  $P < 0.001$ . According to group K, 56% percentage changes of improvement gained ICR group, group AW+ICR gained 70% of improvement. In the Moll and Wright test mobility difference in the frontal plane before and after treatment in AW group is 1.15 cm in thickness. ICR 2.47 cm thick. AW+ICR 2.90 cm at  $p < 0.001$*

**Conclusions.** *Ion cyclotron resonance and acoustic wave with ion cyclotron resonance increase the range of motion for osteoarthritis of the lumbar spine.*

## Key words:

acoustic wave, ion cyclotron resonance, degenerative disease of the lumbar spine

## Introduction

Osteoarthritis (OA) is a group of disorders that despite having different etiology lead to similar structural and functional pathologies in joints.

Clinically, OA is manifested by spontaneous joint pain, pressure tenderness, limited mobility, crepitus and morning stiffness of joints. The pathological process most commonly involves lumbar spine region. Since causal treatment is unavailable in a vast majority of cases, the objectives of therapeutic management of OA include elimination or minimization of risk factors, reduction of pain, conservation or improvement of joint function and reduction of disability [1].

The progress in physical medicine leads to novel methods for treatment of articular disorders so as to meet today's requirements regarding the quality of life of the patients. Therefore, the study assesses the usefulness of acoustic waves as physical factors in the treatment of lumbar OA as compared to the standard treatment using ion cyclotron resonance magnetic fields.

Acoustic waves are longitudinal mechanical waves that may propagate in solids, liquids and gases. The physical phenomenon of acoustic waves consists in transient changes in the density of the medium leading to momentary differences in pressure. The speed of acoustic wave propagation depends on elastic properties of the medium in which the phenomenon occurs. Thus, variable force (pressure) may be exerted on the tissue, leading to a significant restoration effect as well as potential analgesic effect by interaction with hydroxyapatite crystals. Acoustic wave therapy makes use of microvibrations of the amplitude and frequency of vibrations approximately resembling similar movements of muscle filaments due to the physiological muscle tone. The source of vibrations in the acoustic wave therapeutic instrument consists in microvibrations of elastic membranes stimulated by an electromagnet. The frequency of vibrations generated by the device changes over time to prevent the effect of tissue adaptation to a constant stimulus [2, 3]. The mechanical effect of microvibrations are accompanied by acoustic vibrations coupled with microvibrations of the applicators.

Simultaneously, the variable magnetic field absorption system used in the Viofor JPS device makes use of the magnetomechanic and electrodynamic effect of the cyclotron resonance of cations and anions contained within the bodily fluids that can be expressed using the following formula. Ion cyclotron resonance (ICR) is achieved when the following condition is met:  $T = 2\pi m/Bq$  where  $T$  – Resonance period [s],  $m$  – mass of the ion [kg],  $q$  – charge of the ion [c], and  $B$  – magnetic induction [T]. This leads to a change in distribution of ions within the extra- and intracellular spaces. This leads to changes in the resting potentials both within the

membranes of organelles as the cellular membranes of living biological systems. As a result, bioelectric, biochemical and bioenergetic effects of the treatment are achieved.

The objective of this study was to assess the usefulness of acoustic wave and ion cyclotron resonance as well as combination of both of these methods in the treatment of lumbar osteoarthritis.

### Material and Methods

The study was conducted in a group of 80 patients, both male and female, aged 35-75 (mean age of 50.6 years) suffering from lumbar osteoarthritis diagnosed according to the criteria of the Polish Society of Rheumatology treated in the Clinic of Internal Diseases, Angiology and Physical Medicine in Bytom. The study was approved by the Bioethics Committee of the Medical University of Silesia in Katowice, resolution no. KNW/0022/KB1/100/13.

Patients were randomized into four therapeutic groups with the exception of the kinesitherapy group K, which included patients who did not work professionally. Patients in this group were not aware of the Sham (simulation) mode activated on the equipment during the procedures.

All patients in four groups of 20 individuals were subjected to a three week therapeutic session with 10-minute physical procedures performed one after the other for the total time of 20 minutes involving acoustic waves and/or ion cyclotron resonance magnetic field being delivered from flat and coil applicators, respectively, for 5 days a week, no treatment being delivered on weekends. Mein's kinesitherapeutic exercises were used in kinesitherapy group K, acoustic wave group AW and ion cyclotron resonance group ICR. No kinesitherapy was applied following physical procedures in the AW+ICR group. Following parameters were assessed before and after the three-week therapy: spinal mobility – sagittal plane mobility measured by Schober test, frontal plane mobility measured by Moll and Wright test, pain intensity measured by visual analog scale (VAS) and modified Latinen questionnaire, quality of life measured by Euro QoL(EQ5D) questionnaire in 5 dimensions of mobility, self-care, usual activities, subjective pain and anxiety, and the intensity of NSAID use.

Statistical analyses were performed using 10.0 PL software. Changes were considered statistically significant at the significance level of  $p < 0.05$ .

**Table 1. Characteristics of people with division into groups**

	Group K (n=20)		Group FA (n=20)		Value p	Group JRC (n=20)		Value p	Group FA+JRC (n=20)		Value p
	Mean	SD	Mean	SD		Mean	SD		Mean	SD	
Age	62.2	5.64	49.4	12.1	<0.001	50.2	11.3	0.001	50.0	11.5	0.001
Weight	74.4	13.3	77.9	12.5	0.365	79.8	9.79	0.072	83.2	14.3	0.072
Height	1.65	0.10	1.70	0.10	0.087	1.71	0.12	0.057	1.72	0.11	0.057
BMI	27.2	3.65	27.1	3.89	0.579	27.5	2.68	0.365	28.2	3.40	0.365
Time of pain syndromes (months)	6.70	3.18	3.70	1.45	0.001	4.63	2.49	0.031	4.68	2.22	0.031
Sex (% men)	30%		60%		0.062	60%		0.062	65%		0.030

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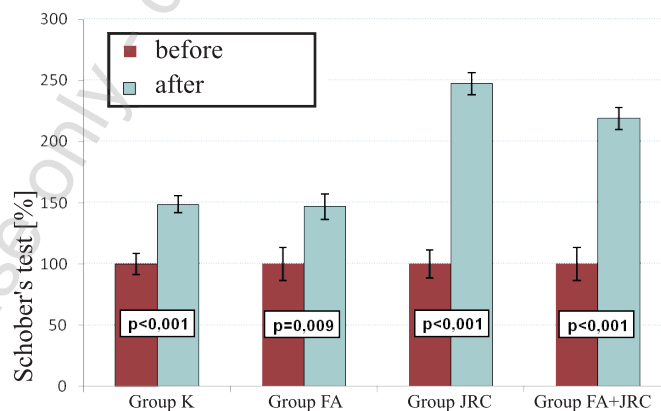
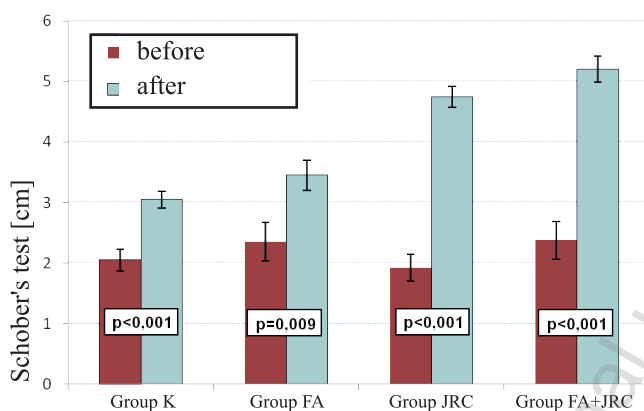
### Results

The studies revealed that application of physical therapy afforded an improvement in spinal mobility and subjective perception of pain. The assessment of therapeutic methods on the basis of sagittal plane mobility of the spine measured by means of Schober test revealed similar mobility levels before and after treatment in the ICR group (2.8 cm ±0.84) and AW+ICR group (2.83 cm ± 1.1), with statistical significance (p<0.001) being achieved in both groups. The percentage change in relation to group K was 56% improvement in ICR group and 70% improvement in AW+ICR group. According to the Moll and Wright test, the difference in mobility within the frontal plane was 1.15 cm in group AW, 2.47 cm in group ICR, and 2.90 cm in group AW+ICR, with the two latter groups achieving statistical significance at the level of p<0.001. The percentage change in relation to K was 28% of improvement in group ICR, 46% of improvement in group AW+ICR at statistical significance level of P<0,001. Subjective pain as assessed in the visual analog scale changed in all groups, with most favorable results being obtained in the ICR group: 59 mm (p<0,001) and in the AW+ICR group: 65 mm (p<0,001). Modified Latinen questionnaire pain scores were reduced in group AW by 7.65 ± 2.60 points, group ICR by 8.90 ±2.02, and group AW+ICR by 9.25 ±2.36 points with statistical significance at the level of p<0.01.

**Table 2. Results of the lumbar spine mobility in the sagittal plane in Schober test in each therapeutic group before and after 3 weeks treatment with statistical assesment according to group K – kinesitherapy**

Schober's test [cm]	Group K (n=20)		Group FA (n=20)		% changes in rel. to K	Value p	Group JRC (n=20)		% changes in rel. to K	Value p	Group FA+JRC (n=20)		% changes toward K	Value p	ANOVA value p
	Mean	SD	Mean	SD			Mean	SD			Mean	SD			
Before	2.05	0.81	2.35	1.42	15%	0.485	1.92	0.99	-6%	0.658	2.38	1.41	16%	0.420	0.560
After	3.05	0.63	3.45	1.10	13%	<b>0.041</b>	4.75	0.77	56%	<b>&lt;0.001</b>	5.20	0.95	70%	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Difference	1.00	0.54	1.10	1.07		0.648	2.83	0.84		<b>&lt;0.001</b>	2.83	1.10		<b>&lt;0.001</b>	<b>&lt;0.001</b>

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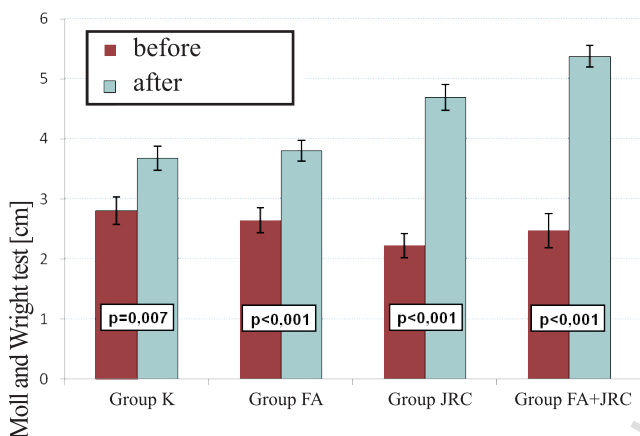
**Fig. 1. Results of the lumbar spine mobility in the sagittal plane in Schober test with osteoarthritis of the lumbar spine before and after three weeks of treatment with statistical assesment in each treatment group**

**Fig. 2. The average percentage changes of mobility of the lumbar spine in the sagittal plane in Schober Test's patients evaluated with osteoarthritis of the lumbar spine**

**Tab. 3. Results of the lumbar spine mobility in the frontal plane in the Moll and Wright test in each treatment group before and after three weeks of treatment according to statistical assessment of K – kinesis.**

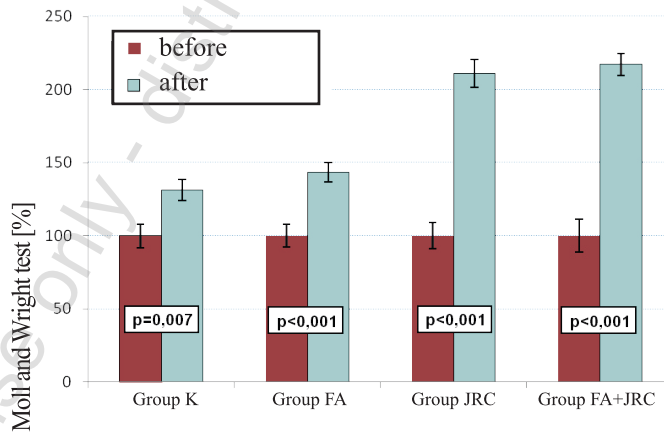
Moll and Wright test [cm]	Group K (n=20)		Group FA (n=20)		% changes in rel. to K	Value p	Group JRC (n=20)		% changes toward K	Value p	Grupa/Group FA+JRC (n=20)		% changes in rel. to K	Value p	ANOVA value p
	Mean	SD	Mean	SD			Mean	SD			Mean	SD			
Before	2.80	1.02	2.65	0.93	-5%	0.644	2.23	0.91	-21%	0.090	2.48	1.26	-12%	0.592	0.343
After	3.68	0.91	3.80	0.77	3%	0.616	4.70	0.97	28%	<b>0.002</b>	5.38	0.83	46%	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Difference	0.88	0.84	1.15	0.67		0.204	2.47	1.08		<b>&lt;0.001</b>	2.90	1.51		<b>&lt;0.001</b>	<b>&lt;0.001</b>

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**Fig. 3. The results of the assessment of mobility of the lumbar spine in the frontal plane in Moll and Wright test's patients with osteoarthritis of the lumbar spine before and after three weeks of treatment with statistical assessment in each therapeutic group**



**Fig. 4. The average percentage changes for each treatment group of mobility evaluation of the lumbar spine in the frontal plane in Moll and Wright test's patients with osteoarthritis of the lumbar spine**

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**Wnioski.** Jonowy rezonans cyklotronowy i fala akustyczna z jonowym rezonansem cyklotronowym zwiększają zakres ruchomości kręgosłupa w chorobie zwyrodnieniowej odcinka lędźwiowego kręgosłupa.

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**Results.** *Schober test showed a similar level of mobility difference before and after treatment for a ICR group 2.8 cm  $\pm$  0.84 and thickness. ICR+AW + 2.83 cm  $\pm$  1.1 at  $P < 0.001$ . According to group K, 56% percentage changes of improvement gained ICR group, group AW+ICR gained 70% of improvement. In the Moll and Wright test mobility difference in the frontal plane before and after treatment in AW group is 1.15 cm in thickness. ICR 2.47 cm thick. AW+ICR 2.90 cm at  $p < 0.001$*

**Conclusions.** *Ion cyclotron resonance and acoustic wave with ion cyclotron resonance increase the range of motion for osteoarthritis of the lumbar spine.*

## Key words:

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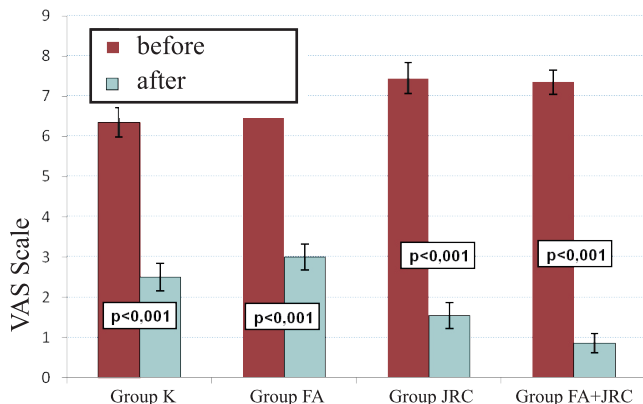
As already shown in part I, the use of acoustic waves and ion cyclotron resonance in the treatment of lumbar osteoarthritis had a beneficial effect consisting in increased mobility of the lumbar spine. Further findings suggested reduced perception of pain within the lumbar spine. Pain reduction was observed following the three-week treatment in all therapeutic groups. The most significant pain reduction as measured by VAS was achieved in the ICR group (5.90 at  $p < 0,001$ ) and the AW+ICR group (6.50 at  $p < 0,001$ ). Results in the modified Latinen score showed a 23% improvement in group ICR and a 42% improvement in group AW+ICR as compared to group K receiving simulated physical (sham) treatment;  $p < 0,01$ .

**Tab. 4. The results of the perception of pain in VAS (mm) scale of patients with osteoarthritis of the lumbar spine before and after three weeks of treatment with statistical evaluation in each of the treatment groups according to statistical assessment of K – kinesis.**

VAS Scale	Group K (n=20)		Group FA (n=20)		% changes in rel. to K	Value p	Group JRC (n=20)		% changes in rel. to K	Value p	Group FA+JRC (n=20)		% changes in rel. to K	Value p	ANOVA value p
	Mean	SD	Mean	SD			Mean	SD			Mean	SD			
Przed Before	6,35	1,66	7,95	1,50	25%	0,005	7,45	1,70	17%	0,045	7,35	1,39	16%	0,058	0,016
Po After	2,50	1,54	3,00	1,45	20%	0,306	1,55	1,43	-38%	0,044	0,85	1,09	-66%	0,001	<0,001
Różnica Difference	-3,85	0,93	-4,95	1,28		0,009	-5,90	1,33		<0,001	-6,50	1,47		<0,001	<0,001

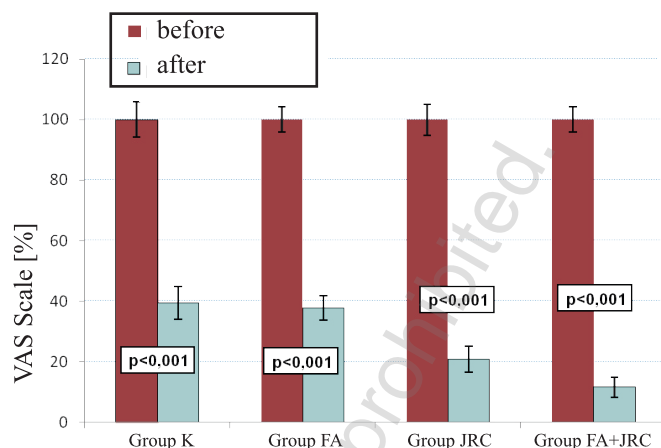
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**Fig. 5. Comparison of changes in pain intensity in VAS (mm) scale before and after the three-week treatment in therapeutic groups patients with osteoarthritis of the lumbar spine with statistical assessment in each treatment group**

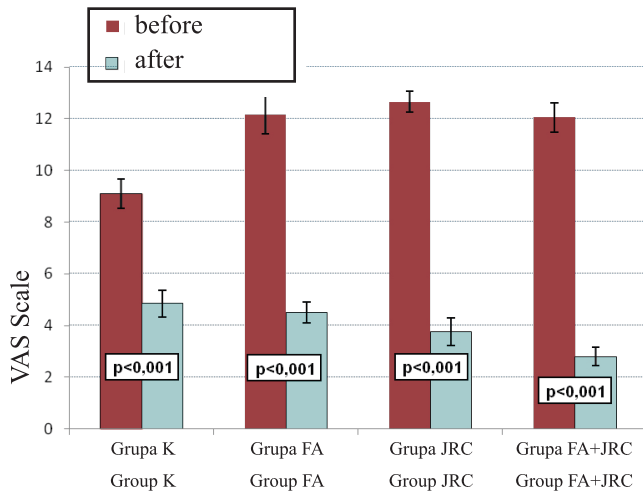


**Fig. 6. The average percentage changes for individual therapeutic groups in pain intensity in VAS (mm) scale before and after the three-week treatment in therapeutic group with Mein's modified exercises, AW+ICR – group treated with acoustic wave and ion cyclotron resonance with osteoarthritis of the lumbar spine**

**Tab. 5. The results of the perception of pain based on Pain Questionnaire by Laitinen patients with osteoarthritis of the lumbar spine in each treatment group before and after three weeks of treatment with respect to statistical assessment according to K – kinesis group**

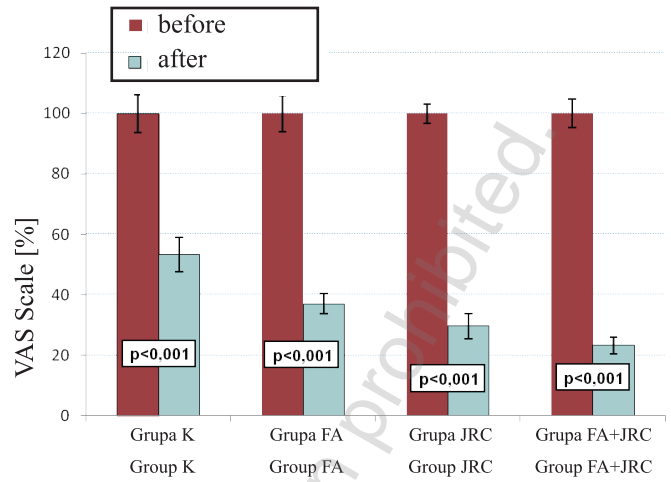
Pain Questionnaire by Laitinen [points]	Group K (n=20)		Group FA (n=20)		% changes in rel. to K	Value p	Group JRC (n=20)		% changes in rel. to K	Value p	Group FA+JRC (n=20)		% changes in rel. to K	Value p	ANOVA value p
	Mean	SD	Mean	SD			Mean	SD			Mean	SD			
Przed Before	9,10	2,55	12,15	3,27	34%	0,004	12,65	1,81	39%	<0,001	12,1	2,54	32%	0,001	<0,001
Po After	4,85	2,28	4,50	1,79	-7%	0,547	3,75	2,36	-23%	0,095	2,80	1,54	-42%	0,005	0,010
Różnica Difference	-4,25	2,22	-7,65	2,60		<0,001	-8,90	2,02		<0,001	-9,25	2,36		<0,001	<0,001

K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercises, FA group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JRC – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA+JRC – group treated with acoustic wave and ion cyclotron resonance, p Anova indicates statistical significance at the level of significance – according to groups among themselves



K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercise, FA – group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JRC – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA+JRC – group treated with acoustic wave and ion cyclotron resonance

**Fig. 7. Comparison of pain intensity conducted by Questionnaire pain by Laitinen before and after the three-week in treatment group in therapy patients with osteoarthritis of the lumbar spine with statistical assessment in each treatment group**



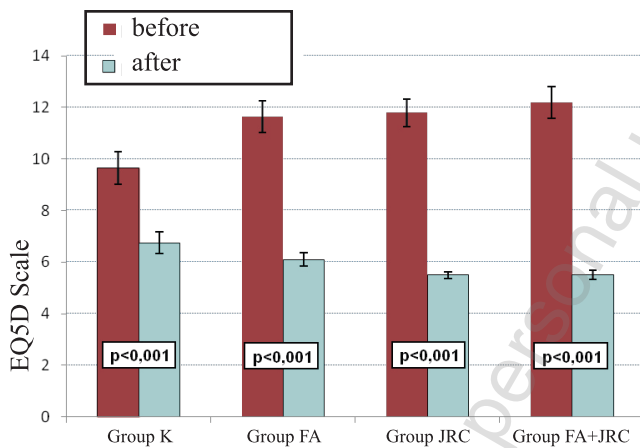
**Fig. 8. Mean percentage changes in pain intensity in individual study groups as determined using the modified Laitinen questionnaire in patients with lumbar osteoarthritis**

The quality of life of patients with lumbar osteoarthritis as assessed on the basis of EURO QoL (EQ5D) is characterized by the differences in scores before and after treatment, i.e.: 5.55 ±2.44 in the AW group; 6.30 ±2.20 in the ICR group; and 6.7 ±2.66 in the AW+ICR group.

**Table 6. Results of the evaluation of the difference of quality of life before and after the three-week treatment with Euro QoL (EQ5D) by 5 criteria: mobility, self-reliance, daily activities, pain and anxiety in the individual treatment groups of patients with osteoarthritis of the lumbar spine with an assessment of statistical terms – K – kinesis**

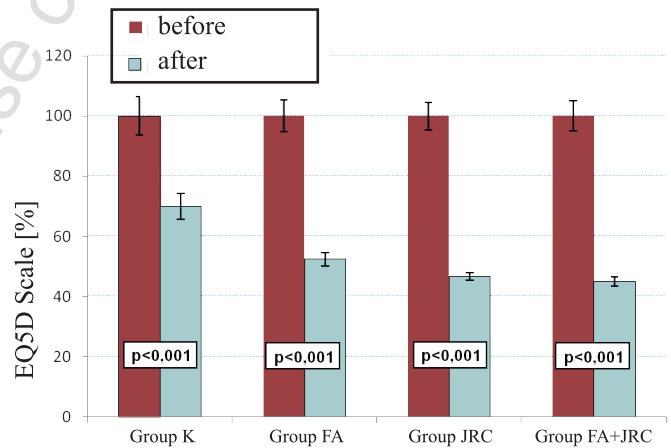
Life quality questionnaire EQ5D [points]	Group K (n=20)		Group FA (n=20)		% changes in rel. to K	Value p	Group JRC (n=20)		% changes in rel. to K	Value p	Group FA+JRC (n=20)		% changes in rel. to K	Value p	ANOVA value p
	Mean	SD	Mean	SD			Mean	SD			Mean	SD			
Przed Before	9.65	2.78	11.65	2.78	21%	0.037	11.80	2.40	22%	0.020	12.20	2.76	26%	0.007	0.017
Po After	6.75	1.86	6.10	1.12	-10%	0.419	5.50	0.61	-19%	0.009	5.50	0.83	-19%	0.009	0.003
Różnica Difference	-2.90	1.97	-5.55	2.44		0.001	-6.30	2.20		<0.001	-6.70	2.66		<0.001	<0.001

K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercises, FA group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JRC – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA+JRC – group treated with acoustic wave and ion cyclotron resonance, p Anova indicates statistical significance at the level of significance – according to groups among themselves



K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercise, FA – group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JRC – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA+JRC – group treated with acoustic wave and ion cyclotron resonance

**Fig. 9. Comparing the quality of life before and after the three-week treatment with Euro QoL (EQ5D) by 5 criteria: mobility, self-reliance, daily activities, pain and anxiety in the individual treatment groups**



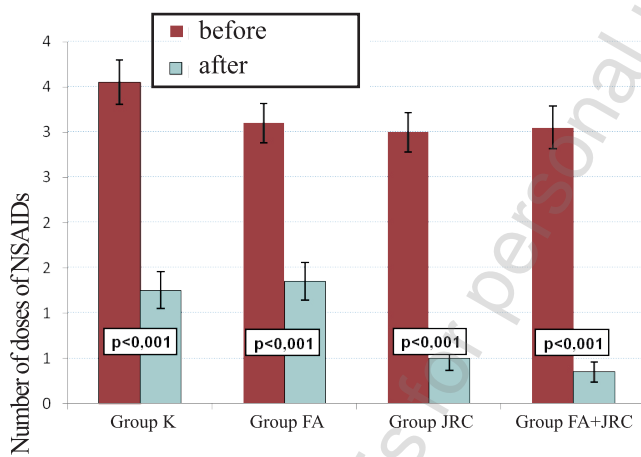
**Fig. 10. The average percentage changes for each treatment group evaluation of the quality of life using the Euro QoL (EQ5D) according to five criteria: mobility, self-reliance, daily activities, pain and anxiety in the different treatment groups**

In the assessment of the dynamics of NSAID intake in patients with lumbar osteoarthritis, positive effects of treatment were demonstrated in group ICR, with reduction in medication intake of 60% as compared to group K where sham exposure was used. Likewise, reduction NSAID intake was achieved in group AW-ICR by 72% as compared to group. K. The respective p values were  $p < 0.006$  and  $< 0.001$ .

**Table 7. Comparison of the dynamics of NSAID intake – the number of tablets taken a day before and a day after the three-week treatment by the patients with lumbar osteoarthritis in individual study groups together with differences in the dynamics of medication intake as compared to kinesitherapy group K**

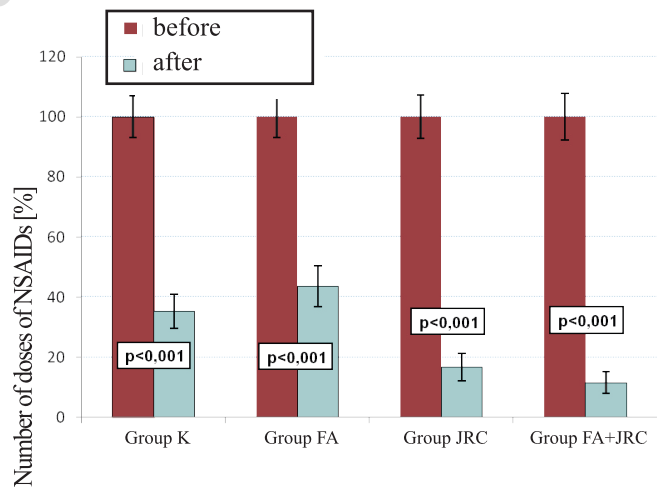
number of doses of NSAID	Group K (n=20)		Group FA (n=20)		% changes in rel. to K	Value p	Group JRC (n=20)		% changes in rel. to K	Value p	Group FA+JRC (n=20)		% changes in rel. to K	Value p	ANOVA value p
	Mean	SD	Mean	SD			Mean	SD			Mean	SD			
Przed Before	3,55	1,10	3,10	0,97	-13%	0,197	3,00	0,97	-15%	0,103	3,05	1,05	-14%	0,130	0,307
Po After	1,25	0,91	1,35	0,93	8%	0,700	0,50	0,61	-60%	0,006	0,35	0,49	-72%	<0,001	<0,001
Różnica Difference	-2,30	0,92	-1,75	1,12		0,124	-2,50	0,95		0,504	-2,70	1,08		0,273	0,058

K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercises, FA group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JRC – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA+JRC – group treated with acoustic wave and ion cyclotron resonance, p Anova indicates statistical significance at the level of significance – according to groups among themselves



K – group treated with simulated acoustic wave and kinesitherapy according to modified Mein's exercise, FA – group treated with acoustic wave and kinesitherapy according to modified Mein's exercises, JRC – group treated with ion cyclotron resonance and kinesitherapy according to modified Mein's exercises, FA+JRC – group treated with acoustic wave and ion cyclotron resonance

**Fig. 11. The average percentage changes for each treatment group in consumption of non-steroidal anti-inflammatory drugs (NSAIDs) in patients with osteoarthritis of the lumbar spine**



**Fig. 12. The average percentage changes for each treatment group in consumption of non-steroidal anti-inflammatory drugs (NSAIDs) in patients with osteoarthritis of the lumbar spine**

### Discussion

Numerous methods are available for the treatment of lumbar osteoarthritis; the disorder is also very widespread, affecting 40% of the population [4]. Although the natural history may be acute, it is usually insidious and chronic, significantly affecting patient's quality of life. Despite the availability of established treatment methods, innovative methods that would bring relief to the constantly suffering group of patients are still being explored [5]. The assessment of the efficacy of methods used in this study, i.e. acoustic wave and ion cyclotron resonance, consisting in evaluation of spinal mobility within the sagittal plane using the Schober test and within the frontal plane using the Moll and Wright test as well as the visual analog scale (VAS) and modified Latinen pain questionnaire demonstrated the relevance of this direction for the treatment of lumbar spinal pain. Ion cyclotron resonance has been successfully used in restoration of peripheral nerves. The authors report significant promotion of restoration of radial nerve following a complicated fracture of humerus [6, 7]. Reports were also published regarding restoration of facial nerves following idiopathic damage or mechanical trauma [8]. Stenosis of the spinal canal or its lateral recesses affords a clinical presentation of lumbar dysfunction with pain and limited mobility [9]. This allows to associate the degenerative lesions within the lumbar pain with neurological symptoms in the region of the outlet of the sciatic nerve from the spinal canal and thus to use a similar method for the treatment of the neuralgic segment of the lumbar spine. Osteoarthritis requires a comprehensive treatment approach [10, 11]. In order to verify the efficacy of treating lumbar OA using acoustic wave and ion cyclotron resonance, the study involved combination of physical procedures such as exposure to acoustic waves with Mein's exercises; ion cyclotron resonance with Mein's exercise; as well as combination of acoustic waves, and ion cyclotron resonance. Verification of results included comparison with the group treated by sham acoustic wave and Mein's exercises on the lumbar spine. In line with the results of the cited papers, clear improvement was achieved in groups receiving comprehensive treatment, i.e. AW, ICR, and AW+ICR for all exploratory tools used. The lowest results were obtained in the kinesitherapy group K which receiving exercises as monotherapy due to the "Sham" function being activated during physical procedures, thus confirming the advisability of comprehensive treatment. We attribute the high results obtained in the AW+ICR group to the synergic effect of the acoustic wave and ion cyclotron resonance. The beneficial effects of acoustic waves add to the established biological effects of ion cyclotron resonance including cell nutrition and growth, regeneration and normalization of cell membrane potentials, and increased enzymatic activity. Acoustic waves have impact on muscle relaxation and increased circulation of blood and lymph. It also positively affects the autonomic nervous system. Studies conducted by Russian researchers confirmed the usefulness of acoustic waves in the treatment of bone fractures, injuries, contusions, hematomas, wounds and pains of rheumatic or degenerative origin [12, 13].

### Conclusions

1. Ion cyclotron resonance and acoustic wave combined with ion cyclotron resonance reduce the perception of pain and increase the range of motion within the lumbar spine. Combined application of ICR and AW exerts a stronger analgesic effect as compared to other treatments of patients with lumbar OA.
2. In the quality of life assessments, combination of ion cyclotron resonance and kinesitherapy is comparable to the combination of cyclotron resonance, acoustic wave and kinesitherapy.
3. The use of ion cyclotron resonance as well as the use of the combination of acoustic wave and ion cyclotron resonance reduces the demand for non-steroidal anti-inflammatory drugs.
4. Combination of acoustic wave and ion cyclotron resonance in lumbar OA treatment has a synergistic effect of maximizing therapeutic benefits.

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