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Physical activity as a remedy for "cheerful" aging which prevents from chronic diseases

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Abstract

Purpose. According to GUS, only 3.6% of the elderly declare active leisure activities. The objective of this study was to evaluate the effect of motor function improvement program implemented in sanatorium on functional condition and functional status of patients suffered from spinal degenerative diseases.

Methods. The studies were carried out once in a group of 46 patients aged above 60 in Solanki Inowrocław health resort. The assessment was made based on a questionnaire. Moreover, assessment of pain in the lumbar spine according to thee VAS was made along with evaluation of lumbar spine mobility using Zebris MLS.

Results. Evaluation of patients in terms of free time spending have showed that more than half of patients spent their free time actively (57%). The intensity of pain according to the VAS, during flexion, extension, rotation in both direction and lateral flexion of the spine, was decreased at the end of therapy.

Flexion, extension and rotation in the right sight increase when Zebris MLS was used before and after therapy. Rotation to the left and lateral flexion to the left were not change.

Conclusion. Rehabilitation in sanatorium mobilizes physical activity of patients. It improves the physical activity by significant increase in the motion range of the spine. It exerts a significant analgesic effect.

Keywords: physical activity, elderly, prevention

Introduction

Elderly are characterized by reduced level of physical activity. Regular physical activity results in an increase in the tolerance of exercises and resistance to fatigue [1]. Benefits of physical activity are positively reflected in the peripheral blood flow, biochemical and structural parameters of skeletal muscles, heart and central hemodynamic parameters. During physical activity, systolic blood pressure is reduced along with a difference between the systolic and diastolic blood pressure in sitting and standing position [2].

Moreover, physical activity slows down the aging process, reduces the risk of chronic diseases and consequently limits disability in the elderly population. It is therefore a preventive factor, generating lower costs in public health care, as lesser disability entails lesser costs associated with the treatment and rehabilitation of elderly [3, 4, 5, 6, 7].

The physiotherapy constitutes a complementary activity to pharmacological treatment [8]. It covers a set of actions, in particular motor, psychological, along with social efforts in order to achieve the highest possible level of functioning, improvement in the quality of life and social integration [9].

The-above mentioned activities improve the quality of life in geriatric population by improving physical condition and self-functioning. The elderly who undergo movement improvement have more "control" over their own life, more vigor and vitality [8, 10].

The objective of the study was to assess the program of movement improvement in sanatorium on the functional status and the quality of life of patients as well as the assessment of the impact of training and rehabilitation carried out in sanatorium.

Materials and Methods

The study included 46 patients aged 60 and above diagnosed from spinal osteoarthritis staying in "Solanki" Inowrocław sanatorium. Patients were enrolled in the study based on the diagnosis of the medical expert and X-ray.

Patients participating in the study underwent 21-day therapy during which they performed physical activity six days a week. The study excluded individuals with cognitive impairment. Participation in the study was voluntary. Patients were provided with appropriate information designed for patients. The study was approved by the Bioethics Committee of L. Rydygier Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun. The study was conducted twice on the 1 and 21 day of therapy.

The study was based on evaluating movement of the lumbar spine, assessment of spine pain intensity on the 1 and 21 day of treatment. The study using the physiotherapeutic questionnaire was only performed on the 1 day of therapy.

Examination of the mobility of the lumbar spine was carried out using the 3D movement analysis device Zebris MLS with WinSpine 2.2 program for Windows system, assessing the lumbar spine (Figure 1). The above-mentioned study aimed at determining the range of movement of the lumbar spine. This system consisted of two belts fixed on the sacrum and a lower part of the thoracic spine of patient. For each belt, 3 markers are attached which operate by emission and reception of ultrasonic waves.

This study was completely safe for patients. It did not cause any side effects and posed no threat to health of elderly patients. Moreover, it enabled precise movements of the spine e.g. forward flexion, backwards flexion, right lateral flexion and left lateral flexion; rotation in both direction. The frequency of each movement was 20 Hz. The spine movements were determined in three dimensions: front (*planum frontalis*), sagittal (*planum sagittalis*) and transverse (*planum tranversum*).

Patients, at the beginning and at the end of each sequence of movement, were in the neutral position. This position was based on standing in a relaxed position with loosely lowered upper limbs back to the measuring device. Movements were made according to the following

sequences: forward flexion, neutral position, backward flexion, neutral position. The second sequence consisted of: right lateral flexion, neutral position, left lateral flexion, neutral position. The last sequence of movement was based on right rotation followed by neutral position, left rotation and return to the neutral position.

For each movement sequence, three repetitions were performed. Before each sequence of spinal movement, the system was calibrated. This allowed to reduce the influence of measurement error. During the last sequence of movement, a patient had a stabilized pelvis in order to avoid movement of the pelvis and so that movement could concern only the spine. It was crucial for the movements of lateral flexion and rotation to be always performed on the same side. It allowed to avoid mistakes during the study. The movement could not exceed the pain threshold or discomfort.

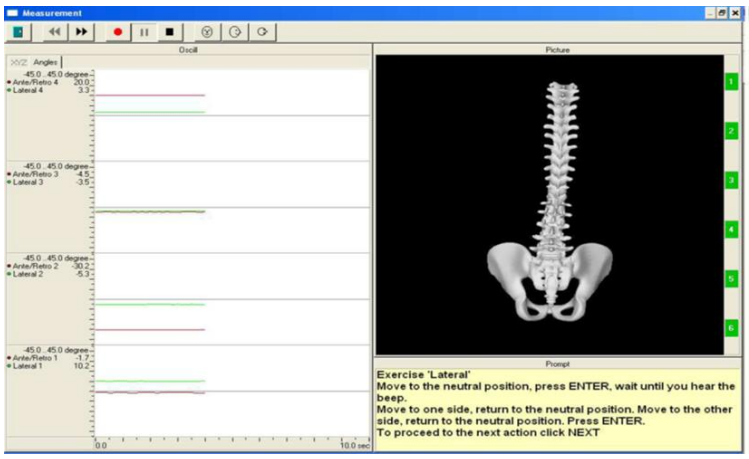
The measured values for each movement range were reported with the values appropriate for age or sex. In order to avoid incorrect representation of movement, program supporting Zebris MLS known as WinSpine 2.2 for Windows (Technomex Company) (Figure 2) was used to perform additional analysis of current movement sequences including the so-called latent movements.

Presentation of the movement curve was carried out by combining the particular movement phases. Moreover, each of the resulting movements formed its own movement phase diagram. Movement flow was presented as boxplots and scatterplots. Scatterplots presented the following angles: forward flexion/ backwards flexion, lateral flexion, rotation and movement of pelvis. Boxplots illustrate the values of forward flexion/ backwards, right lateral flexion and left lateral flexion, rotation in both directions, forward and backward flexion of pelvis and proportions of each of the above-mentioned movements.

The following relationships were evaluated: between the angles of the forward flexion and the entire torso; between angles of forward/backward flexion and the flexion of the whole body; between forward/backward flexion and the angle of the pelvis flexion. Moreover, average proportions of forward / backward flexion, lateral flexion and rotation, were presented. The readout of the movement of the lumbar spine is presented in Figure 3.

To maintain the accuracy of measurements, they were always carried out under the same conditions, i.e. using the same distance between the patient and measurement device. The study was performed by one person. This is a modern system and constitutes an alternative to the linear measurement of the lumbar spine used so far.

Figure 1. A system for 3D analysis of the lumbar spine movement "Zebris MLS" [own archive].



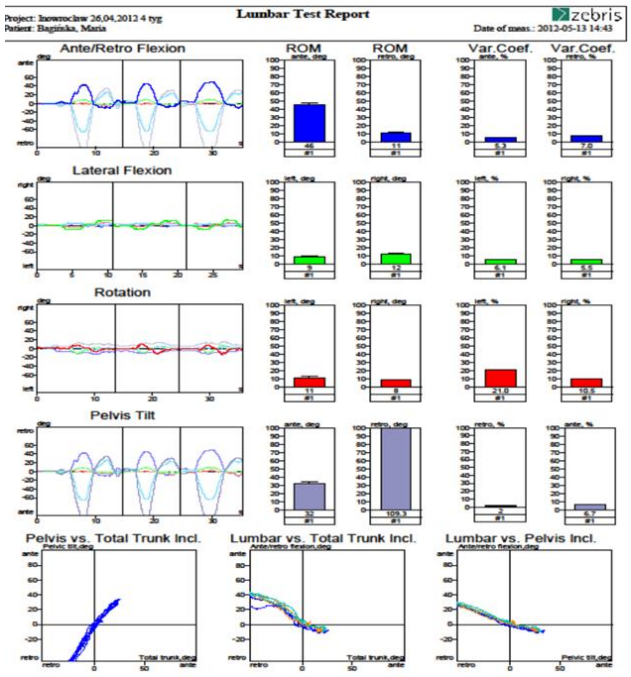


Figure 2. Readout of the assessment of the lumbar spine [own archive].

Assessment of pain intensity was evaluated using the VAS (Visual Analog Scale). This is a 10-point scale, where 0 denotes no pain and 10 describes the pain which prevents from daily functioning. Each patient indicated the extent to pain feeling [11, 12]. Examination of spinal mobility and pain intensity was supplemented by the assessment of physiotherapeutic questionnaire of a patients. It concerned the following information: how to spend free time, subjective assessment of health status, assessment of physical activity and the amount of medication administered before and after therapy. The following statistical methods were used: U Mann-Whitney test, Chi Square test and Pearson correlation.

Results

The study included 46 patients: 31 women (67%) aged 60 – 84 (mean age equal to 69.84 ± 5.86) and 15 males (33%) aged 64 – 75 (mean age equal to 70.5 ± 5.54) (Table 1).

Table 1. Characteristics of the group (n=46) according to sex (p=0,998).

	Sex			**Age [years]**	
	Women n (%)	**Men n (%)**	**p**	**$\bar{x}$±SD (min-max) Me (Q_{25}-Q_{75})**	**P**
Patients (n=46)	31 (67%)	15 (33%)	NS	69,84±5,86 (60-84) 70,5 (64-75)	NS

Characteristics of patients from both groups in terms of leisure time showed that 35% of patients spent their free time passively: reading books, solving crosswords, listening to the radio, watching TV or lying down. Active time spending: walking, riding a bike, working in the garden or picking mushrooms, was attributed to 57% of patients. Only 8% spent their free time involving mixed activity such as going for a walk or reading (Table 2).

Table 2. Characteristics of the group (n=46) according to the type of leisure (p=0,005).

	Leisure activities		
	Passive n (%)	**Active n (%)**	**Mixed n (%)**
Patients (n=46)	16 (35%)	26 (57%)	4 (8%)

In the group of patients involved in 3-week therapy, 50% of patients assessed their physical activity as good, 39% as very good and 11% as bad (Table 3).

Table 3. Characteristics of the group (n=46) according to subjective evaluation of physical activity (p=0,341).

	Subjective evaluation of physical activity			
	Bad n (%)	**Good n (%)**	**Good enough n (%)**	**Very good n (%)**
Patients (n=46)	5 (11%)	23 (50%)	18 (39%)	0 (0%)

In the group of patients undergoing 3-week therapy, more than half (67%) declared a positive attitude towards exercises (Table 4).

Table 4. Characteristics of the group (n=46) in terms of doing exercises (p=0,348).

	Doing exercise	
	Yes n (%)	**No n (%)**
Patients (n=46)	31 (67%)	15 (33%)

Analyzing pain intensity for flexion in the group of patients involved in 3-week therapy before treatment, its level was established at 2.73 ± 3.3 (median = 0.0), while after therapy, it decreased to a value of 2.10 ± 3 0 (median = 0.0). Differences between the 1 and 21 day of therapy were not statistically significant (p = 0.252) (Table 5, Figure 4).

Table 5. Characteristics of the group (n=46) according to the VAS (flexion).

		Pain according to the VAS scale (flexion)		
	Day of therapy	**Mean±SD**	**Median (Q_{25}-Q_{75})**	**p value**
Patients (n=46)	**1**	2,73±3,3	1,5 (0-10)	p=0,252
	21	2,10±3,0	0,0 (0-10)	

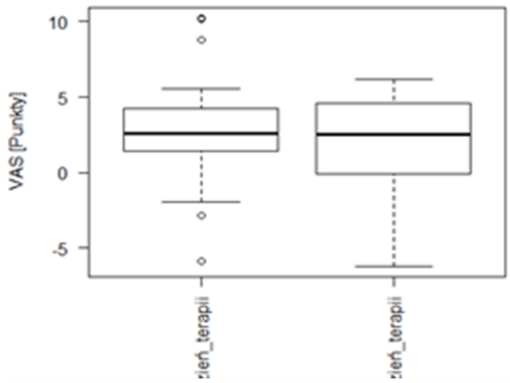


Figure 4. Level of pain according to the VAS (flexion) 1 and 21 day of therapy (21-day therapy).

In addition, the analysis of measurement of pain according to the VAS during evaluation of extension in patients, was performed. Pain occurring during extension at the onset of therapy was established at 2.75 ± 3.40 (median = 2.0) and at the end of therapy is decreased to 2.10 ± 3.00 (median = 0.0). The observed differences were statistically significant (p = 0.0005) (Table 6, Figure 5).

Table 6. Characteristics of the group (n=46) according to the VAS (extension).

		Pain according to the VAS (extension)		
	Day of therapy	**Mean±SD**	**Median (Q_{25}-Q_{75})**	**p value**
Patients (n=46)	**1**	2,75±3,40	2,0 (0-5)	p=0,0005
	21	2,10±3,00	0,0 (0-1)	

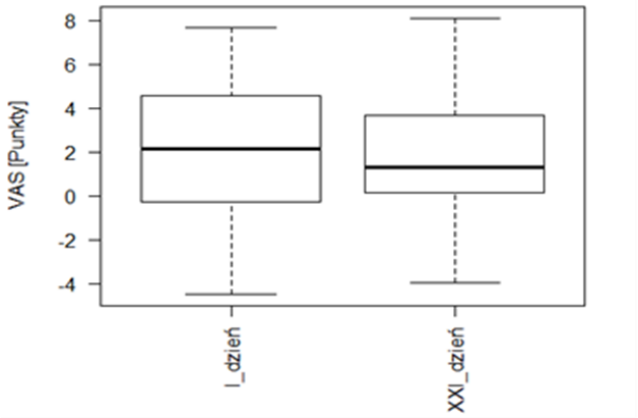


Figure 5. Level of pain according to the VAS (extension) on the 1 and 21 day of therapy (21-day therapy).

Analysis of pain intensity measurement during rotation in both directions, was conducted. The pain during rotation in both directions was 2.00 ± 3.05 (median = 0.0) at the onset of therapy. On the last day of therapy, it decreased to 1.72 ± 2.72 (median = 0.0). The observed differences were statistically significant (p = 0.001) (Table 7, Figure 6).

Table 7. Characteristics of the group (n=46) according to the VAS (rotation).

		Pain according to the VAS (rotation)		
	Day of therapy	**Mean±SD**	**Median (Q_{25}-Q_{75})**	**p value**
Patients (n=46)	**1**	2,00±3,05	0,0 (0-3,5)	p=0,001
	21	1,72±2,72	0,0 (0-4)	

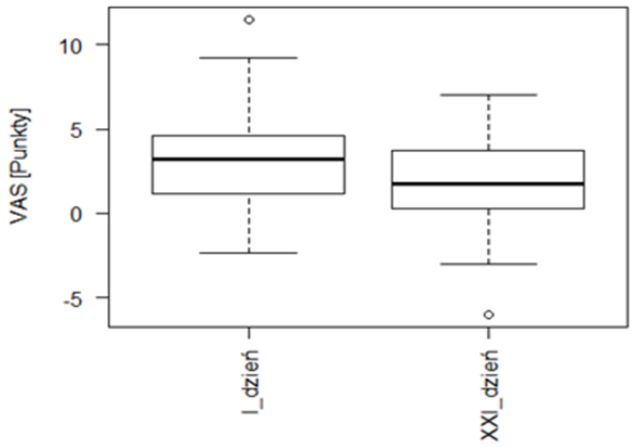


Figure 6. Level of pain according to the VAS (rotation) on the 1 and 21 day of therapy (21-day therapy).

Analysis of pain feeling during lateral flexion showed that it induced pain response on the first day of therapy at the level of 3.00 ± 3.47 (median = 2.00). On the last day of therapy, pain feeling decreased to a value of 2.44 ± 3.03 (median = 1.00). The observed differences were statistically significant (p = 0.0189) (Table 8, Figure 7).

Table 8. Characteristics of the group (n=46) according to the VAS scale (lateral flexion).

		Pain according to the VAS (lateral flexion)		
	Day of therapy	**Mean±SD**	**Median (Q_{25}-Q_{75})**	**p value**
Patients (n=46)	**1**	3,00±3,47	2,00 (0-5)	p=0,018
	21	2,44±3,03	1,00 (0-4,5)	

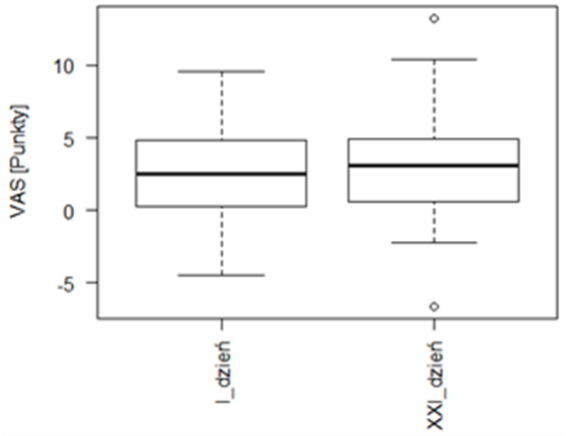


Figure 7. Level of pain according to the VAS (lateral flexion) 1 and 21 day of therapy (21-day therapy).

Analyzing the average value of flexion with the use of a three-dimensional motion analysis system (Zebris MLS) before therapy was 8.14% (43 °) and after therapy it increased to 7.20% (44 °) (Table 9).

Table 9. Range of flexion in the group (n=46) according to the day of therapy (p=0,95).

		Flexion (Zebris MLS)		
	Day of therapy	**(°)**	**(%)**	**p value**
Patients (n=46)	**1**	43	8,14	p=0,95
	21	44	7,20	

Analysis of the extension showed that it was established at the level of 19.21% (11 °) on the 1 day of therapy and at 26.19% (12 °) on the 21 day (Table 10).

Table 10. Range of extension in the group (n=46) according to the day of therapy (p=0,837).

		Extension (Zebris MLS)		
	Day of therapy	**(°)**	**(%)**	**p value**
Patients (n=46)	**1**	11	19,21	p=0,837
	21	12	26,19	

While the range of rotation to the right reduced from 34.70% (9 °) on the 1 day to 20.18% (10 °) on the 21 day (Table 11).

Table 11. Range of rotation to the right in the group (n=46) depending on the day of therapy (p=0,417).

		Rotation to the right (Zebris MLS)		
	Day of therapy	**(°)**	**(%)**	**p value**
Patients (n=46)	**1**	9	34,70	p=0,417
	21	10	20,18	

On the other hand, it was demonstrated that the extent of rotation to the left among study participants on the first day was established at 30.15% (8 °), while on the 21 day – 19,25% (9 °) (Table 12).

Table 12. Range of rotation to the left in the group (n=46) depending on the day of therapy (p=0,261).

		Rotation to the left (Zebris MLS)		
	Day of therapy	**(°)**	**(%)**	**p value**
Patients (n=46)	**1**	8	30,15	p=0,261
	21	9	19,25	

It was found that the range of lateral flexion to the right on the first day was 10.75% (17 °) and on the 21 day – 9.56% (17 °) (Table 13).

Table 13. Range of lateral flexion to the right (n=46) depending on the day of therapy (p=0,685).

		Lateral flexion to the right (Zebris MLS)		
	Day of therapy	**(°)**	**(%)**	**p value**
Patients (n=46)	**1**	17	10,75	p=0,685
	21	17	9,56	

Lateral flexion to the left was 8.59% (16°) on the first day, while on the 21 day – 15,41% (16°) (Table 14).

Table 14. Range of lateral flexion to the left (n=46) depending on the day of therapy (p=0,526).

		Lateral flexion to the left (Zebris MLS)		
	Day of therapy	**(°)**	**(%)**	**p value**
Patients (n=46)	**1**	16	8,59	p=0,526
	21	16	15,41	

Discussion

Saudny et al. report that the idea that elderly are characterized by poor health, is not always true. Sometimes older people are more healthy than younger people. In the group of elderly, women report worse health condition in comparison to men. Subjective assessment of health status also depends, among others, on: positive or negative self-image, temperament and past/present health experiences [13].

Another factor influencing the subjective sense of health status is a regular physical activity at the age-appropriate level [14, 15].

According to Chalé-Rush et al., physical activity includes both intentional, organized forms undertaken to improve own health, including fast walking as well as routine activities such as shopping or walking. The above-mentioned routine activities can be determinants of physical activity in elderly [16].

Kuramoto proposes a form of exercises which is practiced in China for 300 years and is widely known as " tai chi " which "provides" health and improves well-being of elderly. It

contributes to balance improvement, which reduces the fear of falling, increases strength, improves mobility, flexibility of muscles and sleep. By influencing the immune system and reducing bone loss, tai chi has a positive impact on patients with arthritis and immune disorders [17].

In turn, Bruce et al., claim that regular physical activity aimed at reducing pain in patients with osteoarthritis and arthritis prevents from mechanical pain of the back. Lack of activity, however, is associated with greater pain, muscle tension and lower bone density. Aerobic activities reduce stress and pain by 25% (Fifty-Plus Runners Association). In the above group, women report pain more likely ($p = 0.048$). In addition, in patients with chronic diseases, e.g. rheumatoid arthritis, pain was a more important element in the overall assessment of general health status than the physical disability [18].

In the present study we demonstrated that the majority of patients in both groups assessed their physical activity as "good" (39 individuals) and "fairly good" (38 individuals). In addition, more than half of patients in both groups (66 individuals) were doing physical activity willingly. Extending the above-mentioned sentence, we wondered whether positive attitude of the elderly to physical activity is reflected in the form of their free time spending. Taking into account the literature data, the elderly often passively spend their free time reading books or watching television. According to the report of the Canadian Health Survey from 2007, the time spent on watching television gradually increases with age. In individuals aged 65-74 it is estimated at 5.2 hours of free time, while individuals over 75 years of age spend about 15 hours a week watching television [19]. Undertaken physical activity like walking or riding a bike for 4 hours a week can be classified as a low level of activity [20].

Motor activity at a moderate or high level such as participation in competitions, endurance training performed regularly or several times a week, as well as series of activities in the garden, influence the activity of seniors at a high level. Walking and other types of physical activities result in the involvement of different muscle groups, thus contributing positively to the cardiovascular system and the whole organism [20].

In this study, both groups of respondents ($n=46$) spent their time actively almost all the time.

Assessment of pain according to the VAS provided identification of the most painful movements of the spine and determination of the effectiveness of the therapy (relaxation or lack of pain). Boerner et al., after a 10-day therapy with laser light reported pain decrease according to the VAS which decreased from 6 to 3 in patients with osteoarthritis of the spine

[21].

In this study, in a group of patients undergoing 3- and 4-week therapy, the most painful movement was an extension. The highest average reduction of pain gradation was also observed during extension in both groups.

In this study, in the group of patients undergoing 3-week therapy, the most painful movement was attributed to extension. The highest average reduction of pain gradation was also observed during the extension.

Mobility of the spine in patients was also evaluated by means of a system for 3D movement analysis. Imagama et al. carried out the studies on the mobility of the spine movement and spinal flexion angles in the sagittal plane which was exemplified by 100 men with an average age of 70 years. The studies have shown that age is significantly negatively correlated with the angle of lumbar lordosis and the strength of spine muscles. However, it was significantly positively correlated with the mobility of the thoracic spine and strength of the paraspinal muscles. The results were as follows: angle of kyphosis the trunk of 4 ° -68 °, angle of lumbar lordosis of 13 ° -38 °, range of mobility of the thoracic spine of 3 ° -51 °, range of mobility of the lumbar spine of 18 ° -80 °, the total mobility of the spine of 63 ° -158°, paraspinal muscle strength of 32-168,5 kg [22].

Skaf et al., specifythat the reasons for some types of back pain lies in weakening the torso muscles, especially abdomen, leading to changes in the sagittal curvature of the spine. They also depend on the following factors: age, sex, flexion angle of the pelvis and chest. The angles increase with age [23].

Our results allow us to conclude that the greatest pain intensity is attributed to patients from both groups in terms of extension, while changes in the mobility during flexion belong to sagittal plane motion. The ranges of these movements increase with the reduction of pain.

Conclusions

1. Rehabilitation in sanatorium mobilizes physical activity of patients
2. It improves the physical activity by significant increase in the motion range of the spine
3. It exerts a significant analgesic effect

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