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Impact of personality-oriented programs of physical rehabilitation on the heart rate variability in women with post-mastectomy syndrome

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Abstract

Introduction. The aim of the study was to determine the effect of personality-oriented physical rehabilitation programs on the heart rate variability in women with post-mastectomy syndrome.

Methods. The following methods were applied: theoretical analysis of scientific and methodologic literature data, heart rate variability analysis, and mathematical statistical methods. The subjects of the study were 50 women with late symptoms of post-mastectomy syndrome. The study was conducted during the ambulatory rehabilitation stage after Madden radical mastectomy. All the indicators of the heart rate variability were equivalent in the main and comparison groups at the beginning of rehabilitation. The impact of training was examined every 6 months over the course of a year.

Results. Measurements were taken three times: at the beginning of rehabilitation and after 6 and 12 months. It was found that most of the investigated parameters of heart rate variability in both groups steadily improved during the year of rehabilitation. The average values of stress index and amplitude of mode after 12 months of rehabilitation were lower in the main group than in the comparison group but the values of the standard deviation of normal-to-normal intervals and the very low-frequency component of the spectrum were better by 6.48 ms ($p < 0.05$) and 203.29 ms² ($p < 0.05$), respectively.

Conclusions. The personality-oriented programs of physical rehabilitation were effective in augmenting heart rate variability and restoring autonomic balance in patients with post-mastectomy syndrome.

Key words: heart rate variability, breast cancer, physical rehabilitation

Introduction

Modern methods of treating breast cancer are based on the use of therapies with complex impacts on cancer, including radiation therapy, chemical therapy, hormone therapy and immunotherapy, but the priority method is still surgery [1–3]. The most common complications after breast cancer treatment are: restriction of the movement amplitude in the shoulder joint, decreases in the muscle strength and functional capacity of the upper extremity, breast oedema, pain, disorder of the cardiorespiratory and autonomic nervous system [4–8]. Together, these complications are referred to as post-mastectomy syndrome (PMS).

Heart rate variability (HRV) is an important indicator of deviations in the autonomic nervous system and its assessment remains the most informative non-invasive method of the quantitative evaluation of heart rhythm autonomic regulation. The close interaction between the sympathetic and parasympathetic parts of the autonomic nervous system and the humoral influence provides the optimal level of adaptation to the conditions of the internal and external environment [9–11].

Studies were performed to investigate the concept of using HRV data to assess the processes of adaptation and stress for predicting the individual health level [12]. In addition, Baevsky and Ivanov [13], as well as Baevsky et al. [14] proposed

to employ HRV for the assessment of metabolic disorders in cancer patients. It is known that the reaction to malignancy and specific anticancer treatment is significantly bound with the state of homeostatic mechanisms. Autonomic nervous system is one of the major adaptive systems of the human body, which plays the key role in the regulation of homeostatic mechanisms. Results of scientific investigation indicate that physical exercises help to improve the functional state of the autonomic nervous system in cancer survivors [15–20].

Some papers have presented reduced functionality of the autonomic nervous system, reflected in relatively high values of stress index, amplitude of mode, and vegetative index in the decrease of neurohumoral regulation in women with PMS [21, 22]. Previous research [23, 24] has clearly shown that all patients who have undergone radical treatment for breast cancer have an extreme need for physical and psychological rehabilitation. However, the theoretical analysis of the available papers in the scientific literature suggests that the issues related to physical rehabilitation for patients with PMS have not been completely resolved.

Taken together, the above illustrates the importance of developing and introducing personality-oriented rehabilitation programs and determining their usefulness for an improvement of the functional state of the autonomic nervous system in patients with PMS.

The aim of the study was to determine the effect of personality-oriented physical rehabilitation programs on HRV in women with PMS.

Subjects and methods

The research was performed in the Regional Cancer Centre in Zaporizhia, Ukraine. It was conducted in accordance with the principles of the Declaration of Helsinki. All the patients were informed about the aim of the investigation. The total of 50 women with late symptoms of PMS participated in the research. Using a random sampling method, we formed the main group and the comparison group, with 25 individuals in each. The average age of the patients in the two groups was 55.44 ± 1.06 and 55.60 ± 1.14 years, respectively. All the participants had undergone radical mastectomy by Madden and adjuvant radiotherapy. The type of surgical and adjuvant treatment was similar among the patients in the studied groups. The time after surgery was 6 months.

The inclusion criteria were as follows: 50–60 years of age, recent history of modified radical mastectomy, consent to participate in the study, treatment-related pain, lymphedema, limitation of shoulder joint motion, and decreased muscle strength in the hand on the side of the operation. The exclusion criteria were: bilateral lymphedema, metastasis, primary lymphedema, pulmonary oedema, chronic nonspecific lung disease, congestive heart failure, or any contraindications limiting rehabilitation. All the women who were selected for the research met the eligibility criteria.

At the beginning of physical rehabilitation, the patients were offered the opportunity to choose, in accordance with their own desires and goals, a personality-oriented program of physical rehabilitation which they would participate in for the following year. Before taking part in the experiment, the patients were interviewed and given clear explanations concerning the features of each program.

Two complex personality-oriented programs were created, one for the main group and one for the comparison group. The main group program included aqua aerobics (aqua motion, aqua building, aqua stretching), conditional swimming, and recreational aerobics; the program for the comparison group included conditional swimming and Pilates exercise. The individualization of exercises was carried out in each program by varying the environmental conditions, such as water and air conditions, and employing a complex combination of different means (see below). When forming the study groups, we adhered to the principle of strict randomization, which enabled us to compare the effectiveness of the proposed rehabilitation programs.

The personality-oriented programs included a reasonable choice of means, methods, and forms of physical rehabilitation. The collected data about the subjects referred to the process followed in the post-surgery period; age; characteristics of physical, functional, and psycho-emotional status; presence of collateral pathology; type of attitude toward the disease; and the volume of surgical intervention. The means, forms, and methods of physical rehabilitation thought to be most effective for reaching the assumed targets were selected individually for each patient in both groups.

General and special physical exercises were the main means of physical rehabilitation, but we also employed static and dynamic breathing exercises; breathing through pre-loaded lips, controlled coughing, autogenic drainage, manual pressing, and manual vibration; post-isometric relaxation; elements of labour therapy; lymphatic drainage massage

and self massage; topical talks; consultations; and auto-training.

Special exercises for patients with different types of vegetative regulation disorders were applied in certain phases of the respiratory cycle. With parasympathicotonia, the focus was directed on increasing the duration of inhalation and breath holding after the inspiration phase. In the case of sympathicotonia, exercises aimed at extended exhalation and breath holding after the exhalation phase. Regulated breathing exercises were performed in a static (without limb or body movement) and dynamic (in combination with certain movements) modes. The training lasted 50–60 minutes per session and took place three times a week. Independent training performed by the patients included the fulfilment of therapeutic positions, self-massage, relaxation exercises, and auto-training.

The patients were involved in their relevant programs for a year, and the effectiveness was controlled every 6 months. The following methods were applied in the study: theoretical analysis of scientific and methodologic literature data, HRV analysis, and mathematical statistical methods. HRV indicators were assessed with the electrocardiographic complex KARDIOLAB (Scientific and Technological Centre of Radio-Electronic Medical Equipment and Technologies XAI-Medica of the National Aerospace University, Kharkiv, Ukraine, registration certificate number 6037/2007, conformity certificate number UA-MI/2p-2765-2009). The following indicators were assessed: standard deviation of the normal-to-normal intervals (SDNN), square root of the mean squared differences of successive normal-to-normal intervals (RMSSD), very low frequency (VLF), low frequency (LF), high frequency (HF), total power (TP), LF/HF ratio, stress index (SI), amplitude of mode (Amo). Electrocardiographic signal was recorded in the second standard chest leads. HRV parameters were calculated from short-term 5-minute recordings. All indicators of HRV were equivalent in the main and comparison groups at the beginning of the rehabilitation. Thus, the groups were homogeneous at the start of the study.

All these parameters were divided into three categories: time domain (changes over time), frequency domain (spectrum of oscillatory components), and geometric domain.

Time domain:

- 1) SDNN (ms), reflecting all the cyclic components responsible for variability in the period of recording;
- 2) RMSSD (ms), estimating high frequency variations in the heart rate.

Frequency domain:

- 1) VLF (ms^2), frequency of < 0.04 Hz, reflecting mainly the sympathetic system activity, but also the vascular tone loop of the baroreflex system, thermal regulation and the activity of the renin-angiotensin system;
- 2) LF (ms^2), frequency of 0.04 – 0.15 Hz, showing the activity of the baroreflex function (blood pressure maintenance) and both sympathetic and parasympathetic (vagal) activities;
- 3) HF (ms^2), frequency of > 0.15 – 0.40 Hz, indicating the parasympathetic (vagal) activity;
- 4) TP (ms^2), being the subsumption of the measurements between 0.003 and 0.4 Hz and serving as a benchmark of total variability;
- 5) LF/HF, the relative amounts of LF and HF power, a measure of balance between the sympathetic and parasympathetic nervous system activity [10].

Geometric domain (by Baevsky):

- 1) Amo (%), the number of cardiointervals, corresponding to the value of Moda, expressed as the percentage to the volume of the sample; it increases significantly in stress conditions;

2) Si, stress index of regulatory systems, characterizing the activity of sympathetic regulation mechanisms and the state of the central regulation contour [13].

The analyses of HRV indicators were performed with the Statistica for Windows software (version 8.00). The significance of differences between the main and comparison groups was determined by Mann-Whitney U test. Within-group comparisons were performed with the use of the Wilcoxon signed-rank test. Values of $p < 0.05$ were considered statistically significant.

Results

The conducted experiment revealed a positive influence of the developed personality-oriented physical rehabilitation program on the improvement of HRV in both groups.

Changes in the HRV parameters in the main group are presented in Table 1. These results suggest that most indicators of the vegetative function improved significantly after 6 months of rehabilitation, particularly the stress index, which improved by 104.16 conventional units (c.u.) ($p < 0.01$), indicating a reduction in the sympathoadrenal system activity and stress level. The results concerning spectral characteristics of HRV presented significant changes in the total activity of regulatory systems, particularly TP, which increased by 190.92 ms² ($p < 0.001$) by the preferential growth of VLF by 94.40 ms² ($p < 0.05$). All the studied HRV parameters increased statistically significantly during the second half of the year, except for the RMSSD and LF/HF ratio.

Table 2 presents changes in the HRV parameters in the comparison group. The main indicators characterizing the process of stress regulation systems decreased significantly after 6 months of physical rehabilitation: Amo decreased by 7.40% ($p < 0.01$), Si by 98.76 c.u. ($p < 0.001$); during the second half of the year, they were reduced by 3.76% ($p > 0.05$) and 87.12 c.u. ($p < 0.01$), respectively.

During the second half of the year, most of HRV indicators improved significantly: SDNN by 6.6 ms ($p < 0.001$), TP by 433.48 ms² ($p < 0.001$), LF by 264.16 ms² ($p < 0.01$), and HF by 75.48 ms² ($p < 0.05$).

The comparison of HRV indicators between the patients of the main group and the comparison group during rehabilitation is presented in Table 3. The value of Si was lower by 85.84 c.u. ($p < 0.05$) in the main group as compared with the comparison group after six months of training with personality-oriented programs of physical rehabilitation. The average values of Si and Amo after 12 months of rehabilitation were lower in the main group as compared with the comparison group by 114.60 c.u. ($p < 0.01$) and 9.32% ($p < 0.01$), respectively. The values of the SDNN and VLF component of the spectrum were better by 6.48 ms ($p < 0.05$) and 203.29 ms² ($p < 0.05$), respectively.

Discussion

In most cases, the structure of the HRV is characterized by lack of balance divisions of the autonomic nervous system, stabilization of regulation and its transition from the reflex level to the low – humoral and metabolic level, not able to quickly provide homeostasis.

Physical rehabilitation programs for patients with PMS are designed with the expectation of complex effects on physical, functional, and psycho-emotional states. The personality-oriented programs developed and verified here were based on the synthesis of existing physical rehabilitation methods for patients with cancer, and the patients were allowed to select the means according to their own attitudes toward the disease.

On the basis of the obtained indicators, we conclude that the patients improved with their TP, SDNN, LF, and HF, which suggests expansion of the adaptive capabilities of the autonomic nervous system.

The key to the effectiveness of physical rehabilitation of women with PMS is consistent and full implementation of tasks that will maximize their physical and functional state and improve the quality of life after leaving the hospital.

The achieved results confirm the effectiveness of the proposed physical rehabilitation programs and could be regarded as a reason to put them into practical use. The programs helped to increase the functionality of the autonomic nervous system in patients of both groups.

Table 1. The evolution of heart rate variability indicators ($M \pm SD$) in the main group patients during the rehabilitation

Indicator	Main group ($n = 25$)		
	Beginning	Six months	One year
SDNN (ms)	21.40 \pm 7.46	26.04 \pm 8.51***	36.64 \pm 10.15***
RMSSD (ms)	12.64 \pm 4.30	17.20 \pm 6.86***	21.40 \pm 9.14
TP (ms ²)	506.76 \pm 287.35	697.68 \pm 384.22***	1261.96 \pm 513.78***
VLF (ms ²)	173.88 \pm 136.00	268.28 \pm 152.55*	450.92 \pm 221.90**
LF (ms ²)	181.20 \pm 124.04	226.24 \pm 104.19	500.84 \pm 255.22**
HF (ms ²)	145.72 \pm 115.08	184.64 \pm 125.64	278.36 \pm 177.19*
LF/HF (c.u.)	2.05 \pm 1.16	1.58 \pm 1.04	2.05 \pm 1.55
Amo (%)	65.24 \pm 14.48	64.48 \pm 13.70	50.96 \pm 8.33***
Si (c.u.)	483.60 \pm 114.79	379.44 \pm 119.33**	263.56 \pm 105.63***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, compared with the initial data

* $p < 0.05$, ** $p < 0.01$; *** $p < 0.001$, compared with the data of six months

SDNN – standard deviation of the normal-to-normal intervals, RMSSD – square root of the mean squared differences of successive normal-to-normal intervals, TP – total power, VLF – very low frequency, LF – low frequency, HF – high frequency, Amo – amplitude of mode, Si – stress index

Table 2. The evolution of heart rate variability indicators (*M ± SD*) in the comparison group patients during the rehabilitation

Indicator	Comparison group (<i>n</i> = 25)		
	Beginning	Six months	One year
SDNN (ms)	21.64 ± 6.52	23.56 ± 6.24***	30.16 ± 11.27***
RMSSD (ms)	13.73 ± 4.58	16.64 ± 6.88	20.64 ± 12.31
TP (ms ²)	487.43 ± 304.61	559.24 ± 193.32***	992.72 ± 455.40***
VLF (ms ²)	141.38 ± 122.46	154.88 ± 133.73	247.63 ± 115.03
LF (ms ²)	179.83 ± 101.28	195.84 ± 109.19	460.00 ± 292.87**
HF (ms ²)	154.13 ± 98.92	202.88 ± 136.70*	278.36 ± 119.89*
LF/HF (c.u.)	1.45 ± 0.90	3.34 ± 1.24	1.64 ± 0.98
Amo (%)	71.44 ± 13.97	64.04 ± 10.55**	60.28 ± 13.40
Si (c.u.)	564.04 ± 219.54	465.28 ± 160.76***	378.16 ± 164.80**

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001, compared with the initial data
* *p* < 0.05, ** *p* < 0.01; *** *p* < 0.001, compared with the data of six months
SDNN – standard deviation of the normal-to-normal intervals, RMSSD – square root of the mean squared differences of successive normal-to-normal intervals, TP – total power, VLF – very low frequency, LF – low frequency, HF – high frequency, Amo – amplitude of mode, Si – stress index

Table 3. Comparison of heart rate variability indicators (*M ± SD*) between the main group (MG) and comparison group (CG) patients during the rehabilitation

Indicator	Six months		Twelve months	
	MG (<i>n</i> = 25)	CG (<i>n</i> = 25)	MG (<i>n</i> = 25)	CG (<i>n</i> = 25)
SDNN (ms)	26.04 ± 8.51	23.56 ± 6.24	36.64 ± 10.15	30.16 ± 11.27*
RMSSD (ms)	17.20 ± 6.86	16.64 ± 6.88	21.40 ± 9.14	20.64 ± 12.31
TP (ms ²)	697.68 ± 384.22	559.24 ± 193.32	1261.96 ± 513.78	992.72 ± 455.40
VLF (ms ²)	268.28 ± 152.55	154.88 ± 133.73	450.92 ± 221.90	247.63 ± 115.03*
LF (ms ²)	226.24 ± 104.19	195.84 ± 109.19	500.84 ± 255.22	460.00 ± 292.87
HF (ms ²)	184.64 ± 125.64	202.88 ± 136.70	278.36 ± 177.19	278.36 ± 119.89
LF/HF (c.u.)	1.58 ± 1.04	3.34 ± 1.24	2.05 ± 1.55	1.64 ± 0.98
Amo (%)	64.48 ± 13.70	64.04 ± 10.55	50.96 ± 8.33	60.28 ± 13.40**
Si (c.u.)	379.44 ± 119.33	465.28 ± 160.76*	263.56 ± 105.63	378.16 ± 164.80**

* *p* < 0.05, compared with the data of the main group and the comparison group in 6 months;
* *p* < 0.05, ** *p* < 0.01, compared with the data of the main group and the comparison group in 12 months
SDNN – standard deviation of the normal-to-normal intervals, RMSSD – square root of the mean squared differences of successive normal-to-normal intervals, TP – total power, VLF – very low frequency, LF – low frequency, HF – high frequency, Amo – amplitude of mode, Si – stress index

Prospects for further research include determining the effectiveness of the personality-oriented programs in improving the functional state of the upper limb in patients with PMS.

Limitation

Although the results are very optimistic, our study has several limitations. Firstly, the population involved constituted of female Ukrainian subjects, which limits the possibility to generalize the research onto other populations. Secondly, the study was conducted in one institution only; therefore, institutional bias might occur. Thirdly, the sample was small. In addition, minor differences among the examined women concerning lifestyle and genetic factors might affect the scientific results.

Conclusions

The developed personality-oriented programs of physical rehabilitation were individually designed exercise programs incorporating aqua aerobics, conditional swimming, recreational aerobics, and Pilates training, according to the patients' preferences. The study proved the programs to be effective for women with PMS.

Conflict of interest statement:
Authors state no conflict of interest.

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Functional outcomes in relation with the progression level in young degenerative disc disease patients

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Abstract

Introduction. The aim of the study was to evaluate the functional outcomes in degenerative disc disease patients by the type of herniation.

Methods. The study covered 48 individuals (28 females and 20 males) aged 18–35 years who were found with a degenerative disc disease in lumbar spine (protrusion or extrusion according to the American Society of Neuroradiology). The participants were divided into two groups by the type of herniation: the protrusion and the extrusion group. The functional outcome was assessed with the Oswestry Disability Index (ODI) questionnaire and the Numeric Rating Scale (NRS).

Results. Statistically significant differences were shown in ODI scores in both groups. The extrusion group demonstrated a 7.6% higher level of functional disability related to lumbar spine pain when compared with the protrusion group. The NRS results were not statistically significant between the groups. A statistically significant difference was observed between the groups during standing position, during sleep and in sex life. Respectively a 27%, 32%, and 28% greater number of individuals in the extrusion group reported problems related to these three daily activities when compared with the protrusion group.

Conclusions. Our study results revealed statistically significant differences in general ODI scores between the groups. Moreover, patients with protruded lumbar disc showed better outcomes in routine activities when compared with the extrusion group.

Key words: low back pain, lumbar disc herniation, protrusion, extrusion, Oswestry Disability Index

Introduction

The prevalence of low back pain indicates a far-reaching and essential problem of the contemporary medicine. Moreover, current scientific research shows that in highly-developed countries the problem is present among nearly 84% of the population [1]. The reasons for the high incidence are bound with extensive risk factors of the pathology: type of work, lack or proper physical activity, or inter-individual intervertebral disc features may have impact on the patient's condition [2]. Nevertheless, the diagnosis is not always clear because of the aetiology of degenerative disc disease (DDD). Research has shown that low back pain can be caused by disorders not directly related to the spine structures and may be primarily associated with the sacroiliac or hip joints, although the same studies indicate that spine structural damage is responsible for almost 65% of lower back pain [3].

It is estimated by some authors that the prevalence of lumbar disc herniation in patients who suffer from low back pain reaches about 90% [4]. According to the American Society of Neuroradiology, there are two stages of lumbar disc herniation: protrusion and extrusion [5]. These vary in nucleus pulposus and annular tear severity stages. Protrusion may be focal or broad-based and refers to the situation when the largest plane of the disc edges is less than the distance between the edges of the base. A disc is extruded when the

annulus fibrosus is ruptured and inferior material can migrate from the inside to outside of the disc, causing damage to the nerve structures. Both pathologies can produce pain as a result of contact with the longitudinal posterior ligament, nerve roots, or dura mater.

However, despite highly-developed imaging methods, the correlation between radiology imaging and functional or clinical outcomes in DDD patients still remains unclear [6, 7]. Many surgeons have to consider a non-surgical way of treatment; on the one hand, the patient's imaging leaves no doubt about the need of the operation, but on the other, the clinical and functional outcome seems to be at least acceptable, suggesting the possibility to undertake non-surgical treatment, such as physical therapy [8]. Frequently, patients with protruded lumbar disc suffer from pain and feel uncomfortable about their daily activities.

The aim of the study was to evaluate the functional outcome in DDD patients by the type of the herniation. The following research questions were asked:

1. Does functional outcome demonstrate diversity in DDD patients according to the type of herniation?
2. Are there any differences in general pain suffering between the protrusion and extrusion group?
3. Are there any differences in pain suffering during specific activities between patients with protrusion and extrusion?

Subjects and methods

Subjects

This study involved 48 individuals (28 females and 20 males) aged 18–35 years who were found with DDD in lumbar spine. The diagnosis was made by an experienced radiologist on the basis of magnetic resonance imaging (MRI) or computer tomography (CT). The research was carried out in the Department of Orthopaedics and Traumatology in Wrocław Medical University, Poland. The study was approved by the Scientific Research Ethics Committee at the University School of Physical Education in Wrocław, Poland. All the participants received detailed information on the research, and were informed that they could opt out at any time without incurring any consequences. The inclusion criteria were: age 18–35 years, DDD in lumbar spine confirmed by MRI or CT (protrusion/extrusion according to the American Society of Neuroradiology), subacute state of the disease. The exclusion criteria were: advanced degenerative changes in lumbar facet joints, spondylolisthesis, history of lumbar spine fractures, rheumatic disease, lumbosacral transitional vertebra, neurological deficit in lower extremities. The individuals were divided into two groups by the type of herniation. The first group (PRO) covered 23 subjects with a protruded lumbar disc; their mean age was 26.7 ± 2.9 years. The second group (EXT) included 25 participants with an extruded lumbar disc; their mean age was 29.2 ± 3.3 years. Table 1 shows the differences in the somatic features in both groups.

Functional outcome

To evaluate the functional outcome, the standard Oswestry Disability Index (ODI) questionnaire was used. It contained 10 sections which referred to general pain intensity and pain felt exactly in different aspects of daily activities (personal care, lifting, walking, sitting, sleeping, sex life, social life, travelling). Each section included 6 possible answers (0 points stood for no pain at all, while 5 points equalled maximum pain and being unable to carry out the activity). The maximum number of points was 50 for each participant, and the overall score was presented as percentage. Later, the number of individuals who felt pain in each of the sections separately was determined. It was assumed that the 0-point answer stood for absence of pain, and any other answer referred to the experience of pain during daily activities. The ODI scale is sufficiently wide to reliably detect improvement or worsening in

most subjects, and its reliability was defined to excess 80% [9]. To depict the participants' subjective pain perception, the Numeric Rating Scale (NRS) was applied. The NRS is an 11-point visual scale (0–10) by which each individual defined their actual pain intensity; the lower the value, the less intensive pain was reported by the patient. NRS shows adequate responsiveness to be used in both clinical and research settings [10].

Statistical analysis

All computations were performed with the Statistica 12 PL software by StatSoft. The differences in the somatic features between the two groups were validated by Student's t-test. The comparison of ODI and NRS group results were performed with Mann-Whitney U test. Differences in the number of individuals who felt pain during specific daily activities were calculated with the use of the χ^2 test. Statistical significance was established at the level of $p < 0.05$.

Results

Statistically significant differences were shown in ODI scores in both groups. The EXT group demonstrated a 7.6% ($p = 0.001$) higher level of functional disability related to lumbar spine pain when compared with the PRO group. The NRS results were not statistically significant between the groups ($p = 0.15$). Table 2 demonstrates the diversity of ODI and NRS scores between the groups.

The analysis of pain during daily activities has shown that in the EXT group, there were more individuals who felt pain over each activity. A statistically significant difference was observed between the groups during standing position, during sleep and in sex life. Respectively a 27%, 32%, and 28% greater number of individuals in the EXT group reported problems related to these three daily activities when compared with the PRO group. Table 3 shows the share of individuals who suffer from pain during specific activities according to the ODI questionnaire.

Discussion

Many authors confirm that disc imaging results do not correlate well with the patients' functional and clinical outcomes [11, 12]. In these studies, a standard 5-point Pfirrmann's clas-

Table 1. Mean values (\pm SD) of somatic features in both study groups

Feature	PRO group	EXT group	<i>p</i> -value
Age [years]	26.7 ± 2.9	29.2 ± 3.3	0.009*
Body height [cm]	171 ± 8.7	163 ± 8.7	NS
Body mass [kg]	70.0 ± 15.1	73.7 ± 14.9	NS
Female/male	12/11	16/9	NS

PRO – protrusion, EXT – extrusion, NS – not significant

* $p < 0.05$

Table 2. Oswestry Disability Index (ODI) and Numeric Rating Scale (NRS) results

	ODI					NRS				
	PRO group	EXT group	U	Z	<i>p</i>	PRO group	EXT group	U	Z	<i>p</i>
$\bar{x} \pm SD$	19.9 ± 7.4	27.5 ± 8.7	135.0	–3.13	0.001	5.2 ± 1.1	5.6 ± 2.2	217.5	–1.43	NS

PRO – protrusion, EXT – extrusion, NS – not significant

Table 3. Number of individuals who suffer from pain during specific activities

Pain context	Total [%]			Pain context:	Total [%]		
	PRO	EXT	p		PRO	EXT	p
General pain	96	100	NS	Standing	57	84	0.03*
Personal care	78	88	NS	Sleeping	48	80	0.02*
Lifting	91	92	NS	Sex life	52	80	0.04*
Walking	74	92	NS	Social life	35	48	NS
Sitting	78	92	NS	Traveling	39	40	NS

PRO – protrusion, EXT – extrusion, NS – not significant
* $p < 0.05$

sification for disc degeneration and Modic changes to describe the vertebra body and end-plate condition were used. The studies were aimed to evaluate the correlation of the MRI and functional (ODI) results. The analysis referred to both the degenerative changes of facet joints and DDD according to Pfirrmann’s grade classification. The classification includes 5 radiologically different stages which take into account the condition of the disc, nucleus pulposus, signal intensity, and disc height. This grade scale can be conventionally divided into two main groups according to the last criteria: 1–3 grades include normal disc height, while grades 4 and 5 stand for reduced disc height. Therefore, in order to simplify the relations, a 2-grade (protrusion and extrusion) American Society of Neuroradiology classification was used [13]. Pfirrmann’s classification presents higher value with regard to radiological features only. Modic changes refer to the vertebral body end-plate MRI signal (T1: bone marrow oedema and inflammation; T2: presence of yellow fatty marrow as a result of marrow ischaemia; T3: subchondral bony sclerosis). Studies of the aforementioned authors confirm the need to develop contemporary clinical diagnostic tools to properly and efficiently assess and evaluate the functional outcomes of DDD patients.

Our study results showed statistically significant differences in general ODI scores between the groups. Patients from the PRO group showed decreased pain and better outcomes in routine activities when compared with the EXT group. Other studies revealed a tendency to clarify the difference between ODI and Visual Analogue Scale (VAS) scores between the groups (1–3 and 4–5 according to Pfirrmann’s classification) in patients aged 50–65 years. This confirms that the subjective functional condition (ODI and VAS) shows differences in older patients as well as in younger age groups [12, 14].

In none of the analysed studies was the explanation of the disease’s phase found, which might play an important role in the assessment of the patients’ condition. The first analysis of ODI scores concerned the general score, while the further one referred to specific aspects included in the questionnaire. The results show that the larger disc pathologies were observed in patients, the higher values they presented in the ODI questionnaire. This fact indicates that the DDD severity plays an important role in patients’ health condition. Higher ODI values were observed in each section in the EXT group as compared with the PRO group, but only 3 of the differences were statistically significant. There were no significant differences in NRS results between the groups. Consequently, inter-individual spinal canal compromise might be important in the explanation. It might affect the course of illness by provoking pain with slight disc damage or, con-

versely, without causing pain, but with massive disc pathology. This may indicate that there is no one universal scheme for assessing and evaluating functional and clinical outcomes in DDD patients.

Among the analysed ODI aspects, statistically significant differences were observed only with reference to standing (57% vs. 84%), sleeping (48% vs. 80%), and sex life (52% vs. 80%). Sleeping and standing are the only static activities in the entire questionnaire. This finding might be related to poorer nutrition of the disc structure during static positions owing to lack of variable pressure, which is responsible for further degeneration of the disc [15]. Pain and discomfort during sex life reported by patients presented statistically significant differences between the groups. Other authors [14–17] also observed that the more patients suffered in their sex life, the higher ODI and VAS scores they obtained, but according to these studies this dysfunction is caused by psychological disorders rather than physical impairment [18, 19].

Limitation

The article is burdened with limitations which include a small number of individuals, very few clinical tools used for patients’ evaluation and their subjectivity, and, what is more, lack of information about the percentage of spinal canal compromise. Low back pain may vary depending on the single day. The validity and reliability of NRS and ODI may be reached by applying 3 pain measurements per day for 4 following days [20]. It is necessary to continue and develop studies in this field with greater numbers of individuals and among other age groups. Additionally, more functional outcome tools and more specific radiological imaging analysis, such as measuring disc material and inter-individual spinal canal dimensions, are needed.

Conclusions

- 1. Individuals with extruded lumbar disc show worse functional outcomes than those with protruded lumbar disc.
- 2. There is no difference in general pain suffering between the protrusion and extrusion groups.
- 3. Patients with extruded lumbar disc suffer significantly more pain during standing, sleeping, and sex activities than those with protruded lumbar disc.

Conflict of interest statement:
Authors state no conflict of interest.

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Assessment of fundamental movement patterns and risk of injury in male soccer players

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Abstract

Introduction. The aim of the study was to assess the functional status of male soccer players in different age groups who played on different surfaces.

Methods. The study included 45 soccer players aged 13–35 years. Among them, 15 were junior players, 15 were players of the senior Silesia-Opole 3rd league (SL), and 15 were senior players in the futsal Extra Class league (SF). The functional status and basic motor skills were assessed according to the results obtained in seven motor tasks included in the Functional Movement Screen™ (FMS) test.

Results. The mean total scores in the FMS test were statistically significantly higher among both senior futsal and senior 3rd league players than among junior players. However, there were no significant differences between the results obtained by the two senior groups (SL and SF). Seniors achieved higher scores in most of the assessed tasks, but they performed significantly better than juniors only in the trunk rotary stability test. Juniors obtained correct results in the active straight leg raise trial significantly less frequently, but only in comparison with the SF group. Differences were also observed between the teams of seniors playing on different training surfaces (grass vs. hard floor).

Conclusions. Senior players (those who played on grass as well as on hard floor) demonstrated a better functional status than juniors. Fewer deficits in fundamental movement patterns were identified in the SL group than in the SF group.

Key words: soccer, futsal, Functional Movement Screen, movement fundamentals, training surface

Introduction

Soccer is one of the most popular sports disciplines in the world. In order to meet its requirements, contemporary soccer players undergo extremely rigorous training. Excessive training load leads to load-related changes and injuries that often hamper a player's career or even terminate it prematurely. Consequently, many people engaged in sports face the key issue of how to effectively improve the players' motor, tactical, and technical skills while minimizing the risk of injury and preventing overload. To address this concern, increasingly greater attention is paid to such matters as prevention, individualization of training, or regular and thorough monitoring of the players' health. Many sports clubs and organizations introduce prophylactic programs that involve standardized procedures aimed at reducing the risk of injury [1]. An individual approach is also crucial, as each player constitutes a separate part of the team and often displays considerably different tolerance for load and different shortcomings in a given motor skill [2]. This fact must be taken into account when planning the training cycle, especially in team sports. This, however, requires an individual assessment of a player's functional capabilities and potential risks to the motor system [3].

An extremely important aspect of safe training is proper periodicity. The aim of periodicity is to combine different training methods into particular programs, to achieve an optimal

progression of load during a given stage of the macrocycle, and, equally importantly, to prevent injury [4].

Many studies confirm the high reproducibility and comparativeness of functional assessments that use the Functional Movement Screen™ (FMS) test among different samples [2, 5–7]. The proposal to apply FMS for functional assessment came from American physical therapists Cook and Burton [8, 9]. The main goal of the FMS test is to identify persons with an increased risk of injury to the motor system, determine asymmetries, and, subsequently, establish the procedure (i.e. introduce appropriate corrections or load progression) [2, 8, 9]. A given deficit (i.e. the weak link) affects all other links in the biokinetic chain, leading to overload. The qualitative assessment of motion helps to determine particular motor limitations and improve performance at a given motor task, which in turn adds to the development of the quantitative parameters of motion (higher levels of the motor preparation pyramid) [3, 8].

Factors that may definitely affect basic motor skills in soccer players are age and the related experience. Among the risk factors for sports injury in children and youth, the subject literature lists a different structure of the nervous, hormonal, and musculoskeletal systems (higher porosity and plasticity of the bones, looser ligaments, and incomplete bone growth) than in adults, mental characteristics (including a low attention span, undeveloped hand-eye coordination, low awareness, and low motivation for motor training), changes in body

proportions, and considerable differences in physical fitness and growth rate between children of the same age [10]. In turn, risk factors for sports injury in adults include lowered elasticity of soft tissues, lowered neuromuscular control, and lowered bone density.

The functional status of soccer players may also depend on the training surface (grass or hard floor at a sports hall) [11].

This study analysed the functional status of male soccer players who represented different levels of skill and trained on different surfaces, in the context of detecting a potential risk of injury of the motor system. The aim of the study was to determine whether there were differences in the functional status and, consequently, in the risk of injury among soccer players depending on skill and surface, and to indicate any deficits among the players.

Subjects and methods

Subjects

The study included 45 soccer players of the Beskids Sports Association club, Rekord Bielsko-Biała, at different levels of skill, aged 13–35 years (mean age, 21.2 years). The inclusion criteria for the study were regular participation in training within the preceding 12 months and no injury (defined as a state that prevents active participation in training for at least 7 days) within the preceding 4 weeks. From among the group of 50 study participants 5 persons sustained injuries within the preceding 4 weeks and were thus excluded from the study. Among the study participants, 15 were junior players (born in 2002), 15 were seniors from the futsal Extra Class league (SF), and 15 were seniors from the Silesia-Opole 3rd league (SL). Only the SL group trained on natural grass. The other two groups trained on an artificial surface. Table 1 provides the detailed characteristics of the study participants.

All study participants were informed about the procedure and aim of the study. They provided their written consent for participation, and filled a questionnaire concerning their basic personal and anthropometric data. The participants were also informed that they could opt out of the study at any point.

Table 1. Basic anthropometric data of the study participants

		Mean	Min	Max	SD
Juniors	Age	13.00	13	13	0.00
	Body height	164.27	147	176	8.15
	Body weight	53.87	38	70	8.73
	BMI	19.86	16.33	22.72	1.99
Seniors (3 rd league)	Age	24.34	18	33	4.17
	Body height	179.94	167	191	6.49
	Body weight	76.20	65	89	8.20
	BMI	23.75	20.83	25.40	1.19
Seniors (futsal)	Age	26.34	17	35	4.83
	Body height	176.60	166	186	6.12
	Body weight	76.00	65	87	6.67
	BMI	24.36	22.28	27.99	1.54

Methods

The study was conducted in Bielsko-Biała, Poland, at the ‘Record’ training facility during the winter break between seasons (from February 1 to March 28, 2015). Fundamental movement patterns were assessed in accordance with the guidelines developed by Cook, the author of the FMS method. The assessment employed the FMS set as outlined in the protocol proposed by its developers [8, 9]. The FMS set includes a 150 × 15 × 10 cm base, a pole of ca. 150 cm in length, and a hurdle (two poles of ca. 50 cm in length each and a rubber band).

Each participant underwent 7 scored trials that are part of the FMS test: (1) deep squat (DS) (Figure 1), (2) hurdle step (HS) (Figure 2), (3) in-line lunge (IL) (Figure 3), (4) shoulder mobility (SM) (Figure 4), (5) active straight leg raise (ASLR) (Figure 5), (6) trunk stability push up (TS) (Figure 6), and (7) rotary stability (RS) (Figure 7). In accordance with the criteria proposed in literature, a participant was given 3 points for a correct performance of a given trial; 2 points were granted for a trial performed with compensation, 1 point – if the participant was unable to correctly execute a given movement pattern, and 0 – when the participant experienced pain during the trial. Each of the 7 trials was performed 3 times. The best score out of the 3 attempts was used for analysis. In addition, each participant performed 3 provocation trials: SM, TS, and RS, which were analysed in combination with particular fundamental movement patterns. The additional trials were performed after the test proper. The participants were not given points for successfully executing the provocation trials. Rather, the provocation trials were conducted to observe the pain response; if pain did occur, the participant was given 0 points. All provocation trials were conducted according to the methodology proposed by Cook et al. [8, 9]. In the case of asymmetric trials (i.e. those in which points are given separately for the left and right sides of the body), the lower of the two scores was used for analysis. This applied to most of the patterns, with the exception of the 2 symmetrical trials, i.e. DS and TS [8, 9].

Statistical analysis

1. The following variables were used for statistical analysis:
 - a. for ranked variables: mean rank, standard deviation for the mean rank, minimums, maximums, and medians;
 - b. for qualitative variables: sample sizes and percentages.
 2. The statistical significance of the differences between the three groups for ranked variables was assessed with the Kruskal-Wallis H test with a precise estimation of probability. If a statistically significant general effect was observed, differences between pairs of groups were assessed with the use of the Mann-Whitney U test with a precise estimation of probability.
 3. The statistical significance of the proportion (percentages) between correct and incorrect results was assessed with z-tests for proportions.
- Statistical significance was assumed at $p < 0.05$ for all assessments.

Results

Each participant obtained from 12 to 20 points in total in the FMS test. The mean numbers of points amounted to 16.53 ± 1.77 . Juniors achieved the lowest result, with the mean score of 15.27 ± 1.33 points. Both SF and SL groups received better mean scores than juniors in the test (by 17.53 and 16.80 po-



Figure 1. Deep squat trial



Figure 2. Hurdle step trial



Figure 3. In-line lunge trial



Figure 4. Shoulder mobility trial

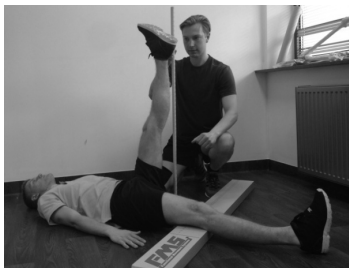


Figure 5. Active straight leg raise trial



Figure 6. Trunk stability push up trial

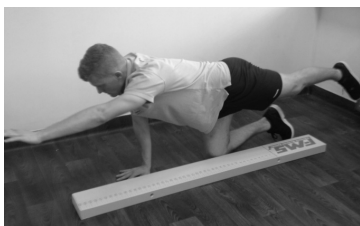


Figure 7. Rotary stability trial

Table 2. Results of the FMS test

	Group	Mean	SD	Min	Max	Median
DS	J	2.27	0.46	2	3	2
	SL	2.47	0.52	2	3	2
	SF	2.13	0.35	2	3	2
HS	J	2.00	0.53	1	3	2
	SL	2.33	0.49	2	3	2
	SF	2.20	0.41	2	3	2
IL	J	2.80	0.41	2	3	3
	SL	2.93	0.26	2	3	2
	SF	2.73	0.46	2	3	3
SM	J	2.13	0.74	1	3	2
	SL	2.53	0.64	1	3	3
	SF	2.47	0.52	2	3	2
ASLR	J	2.00	0.53	1	3	2
	SL	2.33	0.49	2	3	2
	SF	2.6	0.51	2	3	3
TS	J	2.13	0.52	1	3	2
	SL	2.87	0.35	2	3	3
	SF	2.67	0.49	2	3	3
RS	J	1.93	0.26	1	2	2
	SL	2.07	0.26	2	3	2
	SF	2.00	0.00	2	2	2
Total score	J	15.27	1.33	12	17	15
	SL	17.53	1.81	14	20	18
	SF	16.80	1.37	15	20	17

DS – deep squat, HS – hurdle step, IL – in-line lunge, SM – shoulder mobility, ASLR – active straight leg raise, TS – trunk stability push up, RS – rotary stability, J – juniors, SL – seniors from the Silesia-Opole 3rd league, SF – seniors from the futsal Extra Class league

ints, respectively). In 5 of the 7 trials (HS, SM, ASLR, RS, and TS), juniors obtained the lowest mean scores. In the 2 other trials (DS and IL), SF players achieved the lowest mean scores (Table 2).

The statistical analysis indicated the significance of the differences in the total FMS score between the groups ($p = 0.001$). Detailed analysis showed that the mean FMS score in both the SL and SF groups was statistically significantly higher than among juniors (statistical significance amounted to $p = 0.019$ and $p = 0.006$, respectively). The differences in the obtained scores between the SL and SF groups were found to be statistically insignificant. Furthermore, in the TS test, the SL and SF groups achieved statistically significantly higher scores than juniors ($p = 0.001$ in both cases), with no statistically significant differences between SL and SF (Table 3).

The distribution of correct results (3 points obtained during a trial) and incorrect results (2, 1, or 0 points) in each trial and in each group of soccer players was also analysed (Table 4).

In the DS trial, SL players obtained a correct result statistically significantly more often than SF players. In the ASLR trial, juniors achieved a correct result less often than SF players. In the TS trial, juniors got a correct result less often than both SF and SL groups (Table 5).

Table 3. Statistical analysis of the differences in FMS scores between the groups

	χ^2 (2)	Precise p	Differences between groups (Mann-Whitney U p)		
			J-SL	J-SF	SL-SF
DS	4.02	0.162			
HS	3.24	0.208			
IL	2.08	0.488			
SM	2.86	0.242			
ASLR	8.43	0.013			
TS	14.51	< 0.001	0.001*	0.001*	0.390
RS	2.93	0.682			
Total score	13.01	0.001	0.019*	0.006*	0.165

DS – deep squat, HS – hurdle step, IL – in-line lunge, SM – shoulder mobility, ASLR – active straight leg raise, TS – trunk stability push up, RS – rotary stability, J – juniors, SL – seniors from the Silesia-Opole 3rd league, SF – seniors from the futsal Extra Class league
* Statistical significance of $p < 0.05$

Table 4. Percentage distribution of correct (3 points) and incorrect (0, 1, or 2 points) results obtained in the FMS test

Variable	Group	Correct result (%)	Incorrect result (%)
DS	J	26.67	73.33
	SL	46.67	53.33
	SF	13.33	86.67
HS	J	13.33	86.67
	SL	33.33	66.67
	SF	20.00	80.00
IL	J	80.00	20.00
	SL	93.33	6.67
	SF	73.33	26.67
SM	J	33.33	66.67
	SL	60.00	40.00
	SF	46.67	53.33
ASLR	J	13.33	86.67
	SL	33.33	66.67
	SF	60.00	40.00
TS	J	20.00	80.00
	SL	86.67	13.33
	SF	66.67	33.33
RS	J	0.00	100.00
	SL	6.67	93.33
	SF	0.00	100.00

DS – deep squat, HS – hurdle step, IL – in-line lunge, SM – shoulder mobility, ASLR – active straight leg raise, TS – trunk stability push up, RS – rotary stability, J – juniors, SL – seniors from the Silesia-Opole 3rd league, SF – seniors from the futsal Extra Class league

Table 5. Statistical analysis of differences in the percentage distribution of correct and incorrect results in the FMS test among juniors, seniors playing on grass, and seniors playing indoors

Dependent variable	Differences between groups					
	J-SL		J-SF		SL-SF	
	z	p	z	p	z	p
DS	1.1	0.256	0.9	0.361	2.0	0.046*
HS	1.3	0.195	0.5	0.624	0.8	0.409
IL	1.1	0.283	0.4	0.466	1.5	0.142
SM	1.5	0.143	0.7	0.456	0.7	0.464
ASLR	1.3	0.195	2.7	0.008*	1.5	0.143
TS	3.7	< 0.001*	2.6	0.010*	1.3	0.195
RS	1.0	0.309	–	–	1.0	0.309

DS – deep squat, HS – hurdle step, IL – in-line lunge, SM – shoulder mobility, ASLR – active straight leg raise, TS – trunk stability push up, RS – rotary stability, J – juniors, SL – seniors from the Silesia-Opole 3rd league, SF – seniors from the futsal Extra Class league
* Statistical significance of $p < 0.05$

Discussion

The study participants displayed differences in their functional status depending on age and the training surface. Seniors obtained better results in the FMS test than juniors. Furthermore, participants who played on grass performed better than those who played indoors.

Individual functional assessment is part of motor preparation and a starting point for the training of athletes in both individual and team disciplines on all levels of skill, including professional soccer teams [2, 5]. Even the sum of points obtained in the FMS test alone provides information about a given player's basic motor skills [8, 9]. Schneiders et al. conducted the FMS test among active young men, who obtained a mean score of 15.8 points [12]. The juniors from the Beskids Sports Association club, Rekord Bielsko-Biała, who participated in the presented study achieved a similar mean score in the FMS test, i.e. 15.27 points. In turn, seniors got better mean scores: 17.53 points among SL players and 16.80 points among SF players. The lower scores obtained by juniors may stem from the incomplete development in such key areas as bone growth, coordination skills, or muscle strength, which results in a decreased stability of the joints [10, 12]. These factors not only make it difficult to perform the assessed movement patterns without compensation, but also greatly increase the risk of overload and injury [1, 5].

The study showed that, as expected, seniors displayed better basic motor skills than juniors. This may be due to the appropriately directed long-term training that shaped not only the senior's motor and technical skills, but also prevention, including stability training or symmetrical strengthening of the motor system. Kiesel et al. obtained similar results. In their study, professional soccer players achieved above-average scores in the FMS test ($\bar{x} = 16.9$ points) [2]. As with this study, Adamczyk et al. also observed differences in the functional status of players with different levels of skill. They noted a proportional correlation between the FMS score and sports class [13].

The FMS test allows to assess the risk of injury [2, 5, 6]. Research shows that the FMS score of 14 points or less considerably increases the risk of injury in the future (even by 50%). Among the participants of the study, 4 were unable

to exceed 14 points. Out of these 4, as many as 3 were juniors (one obtained 12 points and two achieved 14 points); the fourth player belonged to the SL group (14 points). The results indicate that in the case of junior players, an additional, detailed analysis of all trials should be performed. Juniors should also take part in specialized functional training that would aim to reduce the risk of injury by improving the players' mobility, stability, and neuromuscular control, and by correcting their fundamental movement patterns.

One of the aims of the present study was to determine the most common movement deficits in soccer players. Among the study participants, the lowest FMS scores and the most common deficits in basic motor skills were observed in the TS ($\bar{x} = 2.0$), HS ($\bar{x} = 2.18$), and ASLR ($\bar{x} = 2.31$) trials.

Juniors obtained the lowest mean scores in these three trials (1.93, 2.13, and 2.00 points, respectively), which indicates that the youngest group have insufficient strength and coordination of the core muscles of the trunk and the muscles of the pelvic girdle. However, Grabara et al. note that soccer training is more effective at shaping certain motor skills in children, especially the flexibility and mobility of spine joints, as compared with traditional physical education curricula [14]. These authors' study suggests that FMS scores could be lower among peers (i.e. children born in 2012) who do not train.

Juniors obtained the lowest score in the RS trial; this result was statistically significantly lower than in both senior groups. Donatelli states that the better the stability muscles of the trunk are synchronized with the muscles of joints responsible for movement, the greater the chances are for good performance at sports and the lower the risk of injury [15]. Research has confirmed the effectiveness of stability training not only among athletes, but among particular professional groups as well. For instance, Peate et al. assessed the functional status of fire fighters with the FMS test, after which the fire fighters underwent regular stability training. After two months, the group performed better in the follow-up test and, more importantly, the number of injury-related absences from work decreased by 62% and the number of accidents was reduced by 42% [16].

Actions performed while standing on one foot are of particular importance for soccer players, and this asymmetric position dominates during matches. Every pass, shot, block, and jump requires the activation of muscles under asymmetric conditions [17]. This ability is verified in the HS trial of the FMS test. The HS trial proved to be very difficult for the studied players. Each group displayed deficits in neuromuscular coordination of the pelvic girdle, decreased mobility, and decreased stability of the entire kinematic chain of the lower limb. As compared with the mean FMS scores among the general population (2.23) [12] and professional soccer players (2.60) [18], the score obtained by the study participants was below average (2.18). The observations made by the authors of this study indicate that the most common dysfunction that appears during the FMS test is the non-axial alignment of the stepping leg. In a vast majority of cases, the testees showed an excessive external rotation in the hip joint when stepping over the hurdle.

The active lifting of an extended lower leg is another motor task during which the study participants showed a considerable deficit, especially the group who played on grass (juniors: $\bar{x} = 2.00$ points; SL: $\bar{x} = 2.33$ points). The SF group obtained a higher mean score in the ASLR trial ($\bar{x} = 2.6$ points). Deficits in the active raising of an extended lower limb may often be related to excessive tension and functional shortening of the muscles of the hip and shin, which is common among soccer

players. Furthermore, this group of muscles is subject to injury among soccer players especially frequently [15]. There are many reasons why injuries of the biceps femoris, semitendinosus, and semimembranosus muscles are so common. Apart from Donatelli's statement that post-exercise muscle damage most often concerns two-jointed muscles and muscles with a dominance of type II fibres, these reasons include an incorrect activation of the pelvic girdle muscles during motion, inappropriate warm-up, insufficient flexibility, and failure to strengthen the muscles during eccentric contraction [1, 15, 19]. Eccentric contraction is extremely important, as appropriate eccentric strength of the hip and shin muscles allows for the compensation of load when walking or running and for many functional movements during play. As Dvorak notes, it is crucial to introduce plyometric training, primarily in order to shorten the period required for the compensation, i.e. the period between the efficient contraction of the muscle and the initiation of the concentric contraction [19].

Factors that increase the risk of injury in the muscles of the hip and shin also include unbalanced muscle strength, which can be assessed indirectly through the FMS test in the DS and IL trials. Unbalanced muscle strength results from functional changes which in turn are believed to stem from disruptions to the distribution of tension between agonist and antagonist muscles [3, 15]. Many coaches do not take into account the rule of a balanced development of antagonist groups of muscles, which often leads to over-strengthening of the quadriceps femoris muscle, disregarding or underestimating the development of the antagonist muscles, i.e. the hip and shin group and the gluteus maximus muscle.

The result of the DS test indicated considerable deficits in the mobility and stability of the entire kinematic chain of the lower limb and the lumbar section of the spine. The group who played soccer indoors obtained the mean score of only 2.13 points in this trial. Higher results were observed among the two other groups: 2.26 points among juniors and 2.47 points in the SL group. This disproportion may be caused by the specificity of indoor soccer, which requires the use of slightly different movement patterns, which, furthermore, are repeated more frequently indoors than on a larger pitch covered with grass. Indoor soccer forces the players to perform rapid, dynamic movements, frequently change the direction they are moving in, and assume specific, often unnatural positions. This may lead to incorrect movement strategies and, as a consequence, to weaker stability and thus to a structural damage to the motor system both above and below the pelvic girdle. Studies have also shown that playing on a hard floor increases the level of tissue stress markers [11]. Epidemiological research confirms the high rate of injuries in the knee and ankle joints among futsal players, frequently reporting cases of tendinopathy of the Achilles tendon and the ligament of the patella [20].

In sum, seniors displayed a better functional status than juniors. In most trials, the SL group obtained better scores than the other two groups, with the exception of the ASLR trial, in which the SF group achieved a higher mean score than the SL group, who played on grass. The results observed in the study indicate that during the motor preparation of athletes, coaches and physical therapists should pay greater attention to the achievement of appropriate muscle elasticity, to functional exercises that focus on strengthening the pelvic girdle muscles, to the improvement of central stability, and to the usage of varied surfaces for each part of training.

Limitations

It should be emphasized that the assessment of basic motor skills with the use of the FMS test only allows for a subjective interpretation. In order to maximize the reliability of the study, each participant was supervised by the same person during the trials. The research assessed the effect of the surface on the relevant parameters. However, the group of participants who trained indoors only included seniors. A higher comparative reliability could be achieved by including young futsal league players.

Conclusions

1. The mean total FMS score obtained by the participants of the study does not indicate an increased risk of injury. On the other hand, individual scores suggest that 13% of the

participants (four players) are characterized by an increased risk of injury.

2. Seniors (both the group who played on grass and those who played indoors) showed a better functional status than juniors.

3. The most common deficits in basic motor skills among the study participants were a low stability and mobility within the hip-pelvic-lumbar system and a muscular imbalance within the kinematic chain of the lower limb.

4. The soccer players who play on grass display a better functional status than the indoor players. This correlation was observed in all trials except for ASLR.

Conflict of interest statement:

Authors state no conflict of interest.

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The impact of compression garments on the quality of life in patients with chronic venous disease

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Abstract

Introduction. Assessment of quality of life in patients suffering from chronic venous disease of the lower extremity who were treated with compression garments.

Methods. Patients of both sexes aged 30–75 years with chronic venous disease and at least varices, but without active ulceration, were qualified for the study. To assess the quality of life, the CIVIQ-20 questionnaire was used before and after 4 weeks of compression therapy with second class compression.

Results. The combined results of the CIVIQ scale rose from 61.49% before compression to 75.17% after 4 weeks of compression therapy ($p \leq 0.01$). No correlation was found between sex, age, career status or type of work and the averaged CIVIQ score.

Conclusions. Compression therapy with special garments significantly improves the quality of life in patients with chronic venous disease. Larger studies are still needed in this field.

Key words: quality of life, compression therapy, chronic venous insufficiency

Introduction

Epidemiological studies carried out in Poland have indicated that chronic venous disease (CVD) affects 47% of women and 37% of men. The frequency of CVD occurrence increases with age, and in the 60–70-year-old cohort it rises even up to 60% [1, 2].

The disease has been known for 3500 years. As our knowledge about venous diseases has grown throughout ages, so did our understanding of their treatment. One of the CVD conservative treatment methods, compression therapy, was for the first time mentioned in the works of Hippocrates. In 1525, Ambroise Paré described, as an effective method for venous ulcer treatment, wrapping the distal part of the lower limb, from the foot to the knee. In 1676, Wiseman made first compression stockings out of leather. The next major step followed in 1854 in Vienna when Unna's boot was applied to the treatment of venous insufficiency [3]. Currently, compression therapy is considered the gold standard for prophylaxis and treatment of venous and lymphatic system diseases.

CVD, because of its symptoms, not only impacts the patient's everyday functioning, but also constitutes a serious health and socio-economic hazard, as well as therapeutic challenge. The advancing course of the disease and chronic character of the treatment may significantly impact the patients' quality of life (QoL) [4, 5]. Data related to the QoL for patients using compression garments is scarce because the medical community has been concentrated only on the effectiveness of compression therapy (reduction of oedema or size of varices, healing of ulceration) for many years, not taking into

account the patients' perception or acceptance of the proposed therapy. Furthermore, lack of objective tools for QoL assessment put into question the usefulness of such analyses.

Currently, specific questionnaires are applied to assess QoL, which investigate the most pertinent issues relating to everyday life, as well as consider symptoms characteristic of specific illnesses. Everyday functioning of the patient, their physical, social, and psychological conditions are all taken into account. Only this comprehensive assessment does reveal a full picture of the disease and its effects on QoL.

The aim of our study was to evaluate the QoL of patients suffering from CVD of the lower limbs who were treated with compression garments. The hypothesis was put forward that the application of properly selected compression therapy significantly reduced pain, improved local symptoms, and, consequently, raised the QoL, despite the chronic nature of the therapy.

Subjects and methods

Patients of both sexes, without comorbidities which could influence the perception of compression therapy (leg ischaemia, leg deformities, skin inflammation), aged 30–75 years, who during the specialist consultation (vascular medicine) were prescribed 2nd class compression therapy because of the occurrence of at least varices (2C according to the clinical, aetiological, anatomical, and pathological [CEAP] classification) [6, 7] were qualified to the study.

The exclusion criteria were venous disorders of a degree lower than 2C or active venous ulceration (6C according to

CEAP). Patients with comorbidities which could influence the perception of compression therapy, such as leg ischaemia, leg deformities, or skin inflammation, were also excluded.

Patients were recruited in the first quarter of 2014 in the Specialist Surgical Practice in Zgorzelec, Poland. All participants were informed about the aim and regulations of the experiment and provided their written informed consent to participate. To assess the patients' QoL, the Polish version of the Chronic Venous Insufficiency Questionnaire (CIVIQ-20) [8] was used. The evaluation carried out twice: before the compression therapy and four weeks after its implementation.

The patients were instructed about the rules of the compression garments usage: every morning before they started their daily activity, with a break for the sleep period. They received a prescription for appropriate garments on the basis of the recorded results (morning circumference and length) of the limb measurement. All participants were also instructed about the possible benefit from physical activity, avoiding constipation, cool showers, as well as leg elevation.

The CIVIQ-20 form consists of 20 questions relating to the patient's subjective assessment of QoL, self-esteem, and health status during the disease. The questions describe the functioning and QoL of the patient in terms of perceived pain (questions 1–4), physical acuity (questions 5–7, 9), social functioning (questions 8, 10, 11), and psychological condition (questions 12–20). According to the QoL research guidelines from 1996 [8], each of the 20 questions receives points on the Likert scale, ranging from 1 to 5. In the cases of blank answers to a question, the accepted value is 1, and when there are two answers, the higher value is accepted. An analogue scale (from 0 = worst to 100 = best) is used to assess the QoL, as well as self-esteem of the patient [9].

The acquired research data were analysed together with demographic information (age group, sex, career, sitting or standing work), which, in the researchers' opinion, could significantly impact the results.

The linear regression function was applied to assess the correlation between variables. The Pearson correlation coefficient was used to indicate the correlation level. The chi-squared test was employed to analyse the hypothesis. The statistical significance was set at the value of $p \leq 0.01$.

The study was performed in accordance with the ethical standards of the Declaration of Helsinki.

Results

The total of 47 patients were recruited and then included in the study: 25 women and 22 men, aged 30–75 years. The average age was 54.4 years (52.3 years for women and 56.7 years for men). In the studied group, 51–60-year-olds formed the majority (Table 1). None of the recruited patients had contraindications to use compression therapy. During the physical examination, all of the patients presented varices and declared swelling after their daily activity (3C in the Clinical classification according to CEAP). All participants denied previous deep venous thrombosis (DVT) and the observed pathology was considered idiopathic by the surgeon (E_p in Etiology according to CEAP). There was no information in the subjects' medical records about deep vein patency (no ultrasonographic assessment before the decision to apply compression therapy) as none of the patients presented signs or symptoms of DVT (A_0P_0 according to CEAP). Compression therapy is routinely prescribed to patients with CVD despite the deep venous status and the pathophysiology of the observed disturbances.

Table 1. Number of patients according to the age range

Age range (years)	Number of patients		
	Women	Men	Total
30–40	4	1	5 (10.6%)
41–50	6	3	9 (19.1%)
51–60	10	11	21 (44.7%)
61–70	4	6	10 (21.3%)
> 70	1	1	2 (4.3%)
Total	25	22	47 (100%)

As far as their professional work is concerned, 46.8% of the participants were employed, 29.8% were retired, and 23.4% were unemployed. Additionally, the employed patients were further subdivided according to the work type (standing work, 54.5%; sitting work, 45.5%).

The declared compliance (everyday usage of the garments) was 100%. The combined value of points achieved in the CIVIQ scale in the assessed group was 2890 points (61.49%) before the compression therapy and 3533 points (75.17%) after the treatment ($p \leq 0.01$) (Table 2).

No statistically significant correlations between sex, age, career status, or type of work and the averaged CIVIQ score were found (Table 3).

Discussion

Until now, studies about QoL in patients with venous insufficiency have been carried out mostly among patients with advanced disease. The research [5, 10] proves that patients with CVD and chronic ulcerations are characterized by disturbed functioning in everyday life, not only owing to physical pain, but also social problems (e.g. maintaining employment), which significantly decreases their QoL. That is why the European Society for Vascular Surgery recommends QoL assessment as a routine practice for the purposes of evaluating the total disease burden of the patient [11].

Prevention of the most advanced form of CVD, venous ulcer, is the basis for each patient care. Compression therapy reduces CVD symptoms through improving the function of the venous system and increasing the venous return; currently, it forms the foundation of conservative therapy in this group of patients. Unfortunately, each degree of venous insufficiency (not only the most advanced ones) can become a cause of reduced QoL. In the case of small changes, i.e. spider veins, the problem is more cosmetic in nature but oedema or ulceration are more burdensome because of pain or social difficulties. Each of the mentioned changes may have a significant impact on the everyday life, as well as QoL of the patients, depending on their expectations. This also relates to the chronic nature of the treatment and its potentially cumbersome applications, such as the everyday usage of compression garments. Psychological problems are common in patients with CVD, most often taking the form of anxiety, depression, low self-esteem, and social exclusion [12]. These issues are often ignored during traditional therapeutic procedures [13–15], whereas the full knowledge about the patient and their attitude to the disease and to the proposed treatment has a tremendous influence on maintaining the patient's compliance [10].

Table 2. CIVIQ values expressed in percentage of points before (A) and after (B) the compression therapy, according to the socio-demographic characteristics of the subjects

Socio-demographic characteristics		CIVIQ points (%) \bar{x}		Median		Standard deviation	
		A	B	A	B	A	B
Total		61.49	75.17	61	75	7.45	7.24
Sex	Women	61.44	75.80	60	75	8.21	7.52
	Men	61.55	74.45	61	74.5	6.89	7.02
Age	30–40	68.20	84.60	70	86	5.07	8.81
	41–50	61.67	76.22	61	75	7.47	5.58
	51–60	61.40	75.33	61	75	6.80	5.87
	61–75	60.10	71.90	62.5	72.5	8.87	7.14
Professional status	Employed	62.64	76.14	61.5	75	5.53	5.43
	Unemployed	63.09	79.09	61	78	8.98	7.20
	Retired	59.43	70.57	56.5	70.5	8.68	7.78
Type of work	Standing	62.50	76.50	61	76	6.11	6.46
	Sitting	62.80	75.70	62.5	74	5.05	4.21

CIVIQ – Chronic Venous Insufficiency Questionnaire

Table 3. Correlation and linear regression function for CIVIQ according to the socio-demographic variables

Socio-demographic characteristics		Correlation r_{xy}	Linear regression $y = ax + b$
Sex	Women	0.89	$y = 0.82x + 21.41$
	Men	0.94	$y = 0.96x + 15.12$
Age	30–40	0.85	$y = 0.68x + 37.89$
	41–50	0.88	$y = 0.66x + 35.48$
	51–60	0.93	$y = 0.81x + 25.87$
	61–75	0.95	$y = 0.77x + 25.77$
Professional status	Employed	0.86	$y = 0.85x + 22.88$
	Unemployed	0.95	$y = 0.76x + 30.86$
	Retired	0.95	$y = 0.88x + 20.78$
Type of work	Standing	0.93	$y = 0.99x + 14.76$
	Sitting	0.73	$y = 0.88x - 3.59$

CIVIQ – Chronic Venous Insufficiency Questionnaire

In this study, we observed that regular, properly performed short-term compression therapy significantly improved QoL in all its aspects in patients suffering from CVD. The level of QoL in patients with CVD of the lower limbs improved as a result of applying compression garments by 22.25% in all the assessed aspects of life. It was no surprise that the largest improvement was noted in terms of functioning and QoL with regard to pain (44.31%).

Compression therapy with the use of compression garments has an accepted position as an effective form of CVD therapy and forms the basis of conservative treatment for this disease. However, data in the literature are ambiguous. Staszkiwicz et al. [4], who assessed the effects of treatment on the improvement of QoL in patients with CVD of the lower limb, indicated that (besides pharmacological therapy) compression therapy significantly contributed to better QoL.

Studies by Özdemir et al. [13] confirmed that even short-term (4-week) compression therapy might improve QoL, which was linked with the diminishment of ‘venous symptoms’. Charles [14] studied the effect of lower leg ulceration and compression therapy on the QoL of 65 patients by the use of the SF-36 questionnaire. He confirmed that proper treatment of the venous ulcer with compression therapy significantly improved QoL in two groups of patients: with healed and with unhealed ulcerations. However, there are also reports which do not seem as enthusiastic. Renner et al. [15] did not find a statistically significant improvement in QoL even in patients (treated with compression garments) who had healed ulcerations. They attributed the result to the numerous comorbidities in the studied group.

Because of the limited and ambiguous nature of to-date studies, it is necessary to expand the subject research to a wider scale. In the current model of therapy, patients are encouraged to actively participate in their treatment. Without analysing if the effect of therapy, as well as its form are acceptable to the patients and lead to improve their status and/or QoL, we cannot expect good compliance. At present, because of the lack of large scale clinical studies, smaller ones may have a significant contribution to the medical knowledge and may attempt to answer the question if the effective treatment pertains to every aspect of the patients’ lives.

Limitation

Owing to the small size of the treated group, the study should be considered a pilot one, possibly requiring corrections of several methodological aspects in the future. This refers to both the number of participants and the follow-up time. It cannot be ruled out that the necessity of everyday therapy application will have a negative effect on the results in a longer follow-up despite the objective decrease of CVD signs. As mentioned above, an improvement in the local or general status (in our study, the perception of pain), as well as potential side effects of the therapy may play a significant role in the patients’ perception. Therefore, despite the objective improvement in the patients’ status, certainly being significant, the subjective QoL experience should not be disregarded.

Conclusions

Compression therapy with special garments significantly improves QoL in patients with CVD. Larger studies are needed to support the results.

Conflict of interest statement:

Authors state no conflict of interest.

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Usefulness of intermittent pneumatic compression in medicine

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Abstract

Many studies exist that document the use of intermittent pneumatic compression in lymphedema, venous ulcers, prophylaxis of deep vein thrombosis and limb ischaemia. This article discusses the basics and usefulness of this therapy on the basis of available studies and recommendations. As the method is characterized by lack of serious side effects, good patient compliance, and high effectiveness, intermittent pneumatic compression should be taken into consideration as an alternative or additional treatment in many conditions.

Key words: intermittent pneumatic compression, chronic venous insufficiency, lymphedema, critical limb ischaemia

Introduction

In the 21st century, physiotherapy is a very complex academic discipline owing to the dynamic development of different branches of medicine which have displaced physiotherapy from its traditional role in the treatment of patients. Undoubtedly, this is a discipline which requires patience from both therapists and patients, which, in today's fast paced life, may be difficult to accept, especially by patients. Finally, the efficacy of some forms of physiotherapy is undermined because of lack of evidence-based medicine support, which in accordance with the current knowledge forms the grounds for acknowledgment as proper therapy, inclusion into the guidelines, as well as reimbursement of services by the national health service. Meanwhile, the increasingly ageing society presents a new challenge to physiotherapists owing to numerous chronic illnesses which require multiple drug therapy; this, in turn, is bound with many side effects. Physiotherapeutic procedures lack serious side effects and may be performed multiple times because there are no special contraindications to their application.

One of the established therapies is intermittent pneumatic compression (IPC), which originated in the 19th century [1]. There exist many studies documenting the use of this technique in different illnesses. The overwhelming majority of the applications refer to elderly patients.

Mechanism of action

Currently, in the majority of countries IPC is most often performed in the therapy of lymphedema or venous ulceration, possibly in the treatment of significant oedema of veno-lymphatic aetiology. These indications result from the mechanical, as well as systemic effects of IPC. A special pump successively inflates and deflates the cuff to promote the return of blood from the tissues. The pressure applied externally is transferred to deeply situated tissues and in this way moves the retained fluids from the subcutaneous tissues, venules and small lymphatic vessels to larger vessels and finally into the main vascular trunks, from which the fluids are directed towards the heart. On the other hand, the provoked tempo-

ral ischaemia of the skin during the compression phase results in hyperaemia due to the mechanism of reactive vasodilatation, which increases the blood flow to the peripheral arteries [2–7]. In this way (a reduction of venous pressure with an increase of arterial pressure) [8], the arterial-venous pressure gradient increases, thus improving the perfusion of the tissues, as well as their oxygenation and nourishment [9–11]. Apart from the described mechanism of action, this form of intermittent compression affects coagulation and is responsible for releasing many substances beneficial to the vessel walls [4, 12–16].

Chronic venous insufficiency

Because of the reasons described above, IPC is not considered controversial in the treatment of venous insufficiency, mainly in active venous ulcers and in venous thromboembolism (VTE) prophylaxis, or in lymphatic insufficiency [13, 17–24]. The lack of consensus in regard to the recommendations for venous ulceration treatment results from differences across many studies with reference to such factors as: the pressure applied in the therapies, the inflation and deflation time and their proportions, the number of chambers used, the total duration of the therapy, the disease severity (the total area of the ulcer). An additional issue is small sample sizes. Despite these problems, however, the results of randomized controlled trials suggest that IPC may reinforce the healing process as compared with no compression, especially if applied as an additional procedure [25].

Venous thromboembolism prophylaxis

The positive effects of IPC on the coagulation system result from improving at least two of the Virchow's triad elements (increasing venous blood flow velocity and reversing hypercoagulability by moderating the procoagulant activity through elevation of the D-dimer level). This has led to accepting the method in VTE prophylaxis in a selected group of patients. The American College of Chest Physicians has recommended mechanical methods (foot or low leg pneumatic pump) alone primarily in patients at high risk of bleeding [26] and, because

of their extra benefit, as an additional modality in prophylactic procedures in patients after orthopaedic surgery [27–30]. The same indications are found in the Polish guidelines [31].

Complete decongestive therapy

In the treatment of lymphedema, despite the lack of consensus [32–39] regarding additional benefits of IPC, it is an integral part of complete decongestive therapy. This comprehensive procedure is useful in the treatment and prevention of lymphedema after breast cancer surgery, but it turns out effective in any case of lymphedema not only because of its very action but also owing to good patient compliance. Serious complications are rare, although skin bullae, itching at the compression site, and other minor adverse effects have been reported.

With the consideration of the pathophysiology of lymphedema and venous or lymphatic insufficiency, as well as the risk factors of deep vein thrombosis, the use of IPC is widely accepted. Despite the limited access to the appropriate devices, the awareness of IPC application in the above described conditions is quite large.

Sports injuries

Oedema is a cause of pain and may be responsible for further tissue destruction. Therefore, IPC is a physical method often utilized in sports medicine, and it constitutes an element of the RICE (rest, ice, compression, elevation) method, applied in the treatment of acute injuries [40].

Critical limb ischaemia

Other potential indications are unfortunately less appealing to physicians and physiotherapists. The effect is that in many countries, including Poland, IPC is not indicated or even remains contraindicated in the treatment in diabetic foot or limb ischaemia. This misunderstanding and lack of knowledge regarding the benefits of IPC deprive many patients of the opportunity for optimal treatment.

Reduction of oedema, anticoagulant activity, as well as vasodilatation resulting from nitric oxide (the most powerful vasodilator) [41] release should entice physicians to a wider

use of IPC in cases of critical limb ischaemia and diabetic foot (neuropathic and related to insufficient blood flow) [42]. An undeniable benefit of IPC is the significant reduction in pain in these patients. Much evidence exists conforming the efficacy of IPC in the group of patients who have no surgical (revascularization) option [8, 43–49]. A variation of rubber calf therapy could be a plastic device – circulator boot [50, 51]. It is also used to locally apply active substances, e.g. antibiotics. Considering the benefits reported by some authors, application of this therapy can be regarded an additional procedure in patients with claudication [10, 16, 52]. This refers to patients who cannot be properly treated with the traditional method, i.e. walking exercise (e.g. because of rheumatoid arthritis).

In the literature, individual reports can be found about reduced risk of amputation and improved healing after revascularization procedure in patients in whom IPC was applied [53]. Patients with cholesterol embolism may also benefit from this treatment [54].

Despite unsatisfactory conclusions (low-quality evidence) drawn by two independent authors of systematic reviews [43, 44] concerning IPC implementation in ischaemic legs, one should remember that there is no alternative therapy for patients who do not qualify for revascularization procedures and suffer from rest pain and/or ischaemic ulceration.

Summary

IPC as a primary or supplementary treatment seems to be a relevant alternative in the management of chronic venous and lymphatic insufficiency, as well as, paradoxically, limb ischaemia. Additionally, in acute conditions such as limb injury or cholesterol embolism, the inclusion of IPC in the treatment should also be considered.

Because of its low cost, as well as ease of application, the described method can be implemented both in hospital or ambulatory settings and by properly trained patients at home. The possibility of multiple application and almost complete lack of side effects constitute a strong argument for including this treatment in chronic therapy.

Conflict of interest statement:

Authors state no conflict of interest.

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1. The Fizjoterapia/Physiotherapy is an international, peer-reviewed scientific journal published by the University School of Physical Education in Wrocław, Poland.
2. The Editorial Office of the journal (hereafter referred to as the Editor) accepts scientific, original papers, not published anywhere before, on various aspects of physiotherapy and rehabilitation. A scientific paper, in accordance with the regulations of the Statement of the Minister of Science and Higher Education of June 2, 2015 on the criteria and procedure of scientific journals assessment, is a paper presenting results of original research of empirical, theoretical, technical, or analytical character, and communicating the present state of the art, the research methods, the course of the research process, its results and conclusions, along with the indication of the quoted literature (bibliography). Scientific papers also include studies of monographic, polemical, or review character, as well as glosses or juridical comments. The Editor also accepts letters to the Editor, scientific conferences reports, and book reviews. Manuscripts in basic science and clinical physiotherapy science are published at the highest priority. Letters to the Editor, reports from scientific meetings and book reviews are also considered.
3. Editor publishes papers that show depth, rigor, originality and high-quality presentation. The scope of the journal: evidence-based rehabilitation; the mechanisms of function or dysfunction; modern therapy methods; best clinical practice; clinical reasoning and decision-making processes; assessment and clinical management of disorders; exploration of relevant clinical interventions; multimodal approaches; psychosocial issues; expectations, experiences, and perspectives of physiotherapists.
4. Only papers written in English are accepted.
5. By submitting a paper, the author agrees to accept the Editor's procedures of qualifying papers for publication and the 'Instructions on submitting and preparing articles' (Appendix 1 to these Author Guidelines).
6. The paper is subject to a two-step qualification procedure: (1) formal internal assessment – pre-review – performed by the Editor-in-Chief and the editorial team (verification of the article compliance with the journal's profile and technical requirements); (2) external review – peer review – performed by two independent reviewers, appointed by the Editor-in-Chief. In addition, empirical papers in which statistical methods were applied undergo verification by a statistical editor.
7. The Author can suggest reviewers, but the Editor reserves the right to the final selection.
8. Reviewers are senior academic staff members or academics at least with the scientific degree of a doctor, competent within the merits of the paper. Reviewers are independent: not affiliated in the same research unit as the author of the publication.
9. The review procedures are consistent with the regulations and recommendations of the Ministry of Science and Higher Education.
10. Papers are accepted for publication after being reviewed favourably by two independent reviewers. If the reviews are contradictory, the third reviewer is appointed, whose opinion becomes decisive.
11. Reviews are written by completing a paper review form (available at <http://physiotherapyquarterly.pl/index.php/pages/review/9>) where reviewers have to explicitly express whether the manuscript is accepted for publication or rejected.
12. The author and the reviewer remain anonymous to each other (double blind review process). Otherwise, the reviewer is obliged to declare no conflict of interest; what is referred to as conflict of interest is a direct personal relationship between the reviewer and the author (kinship, legal relationship, conflict); professional dependence relationship; direct research cooperation within the two years prior to the paper reviewing.
13. Names of the reviewers are not revealed. Once a year, the Editor provides a general list of the cooperating reviewers.
14. The author is informed about the review results and the reviewers' comments, so that they can correct the paper in accordance with the provided directions.
15. The Editor reserves the right to introduce corrections in the paper. An article that does not follow the guidelines can be returned to the author for adjustments.
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17. The final decision on accepting a paper for publication or rejecting it is always taken by the Editor-in-Chief.
18. In the case of a justified lack of publication of a submitted paper, the Editor does not return the costs borne by the author (processing fee).
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25. The Editor shall disclose all cases of scientific dishonesty, including notifying appropriate entities (institutions em-

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playing the authors, scientific associations, associations of scientific editors, etc.). The Editor is obliged to document any symptoms of scientific dishonesty, especially of breaking or compromising the ethical principles effective in scientific research.

26. All experiments employing human or animal subjects, include an explicit statement in the Material and methods section, must obtain approval of an appropriate research ethics committee or the National Ethics Committee on Animal Experiments on implementing the methods suggested by the author in the experiment (a copy of the approval document must be attached to the paper). Any doubts concerning the fulfilment of ethical standards will lead to rejection of the manuscript.
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31. The author receives neither royalty for the published paper nor a journal copy; they are provided solely with a PDF file with the published article.
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33. The author accepts the responsibility to introduce the corrections resulting from the review and send the paper back within 3 week.
34. The author is obliged to cooperate with the publishing editor and the linguistic and statistical proof-readers in order to clarify any ambiguities and correct deficiencies. Lack of the author's response to the editorial remarks within a week shall denote their consent for introducing the suggested changes.
35. In the case of a significant delay in the appointed deadline for introducing corrections by the author, the Editor reserves the right to reschedule the paper to the subsequent volume.
36. The author should list all the people or institutions that contributed to the preparation of the paper, served as consultants, or provided financial or technical support.
37. The original version of the journal is its paper issue.
38. The Editor accepts advertisements that can be placed in advertising inserts next to the cover pages. Prices of advertising are negotiated individually.

REVIEW PROCESS

To achieve the aim of publishing top-quality papers, the editorial process at Fizjoterapia / Physiotherapy consists of two stages: pre-review (1) and peer review (2).

First stage: Pre-review

After submission, a paper enters the pre-review stage. Its aim is to identify papers that have the potential to be interesting for Fizjoterapia / Physiotherapy readers.

The pre-review assessment is based on the following criteria:

- Does the paper fall within the broad remit of the quarterly?
- Is the paper appropriately formatted for the quarterly?
- Is the paper novel and interesting?
- Is the subject area covered by the scope of the journal?
- Does the paper have the potential to make a substantial contribution to the development of the field of physiotherapy?

Second stage: Peer review evaluation

If a paper is not rejected at the pre-review stage, it then goes into the peer review. Each paper is typically reviewed by two independent reviewers (more if necessary; in some cases, the review process can rely on the report of only one reviewer) and a member of the editorial team then makes a decision concerning publication, either:

Reject – the paper is not acceptable for publication and re-submission will not be considered;

Major Revision – the paper requires major changes and needs to go through the review process again with no guarantee of acceptance;

Minor Revision – the paper is provisionally accepted, subject to conditions that need to be addressed when producing the final version of the manuscript.

In both cases of revision, the authors are obliged to return their corrected manuscripts within a period of **4 weeks**. Any extension of that period has to be discussed with the editor-in-chief. Authors are obliged to cooperate with the editorial staff: native speaker, editors (language and statistical data) in order to eliminate ambiguities and errors. In a case when no response to the editorial observations is made within a week, the author's consent for an introduction of the suggested changes is taken for granted.

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The editors of the Fizjoterapia / Physiotherapy support the policy of preventing ghostwriting, guest authorship and plagiarism. If detected, such practices will be disclosed. The Editor requires the principal author of joint publications to complete a declaration, which specifies the contribution of each co-author in the research paper.

The editors require that the authors reveal individual co-authors' contributions to the publication. When submitting a manuscript, the authors will be requested to declare their contribution to: study design/planning, data collection/entry, data analysis/statistics, data interpretation, preparation of the manuscript, literature analysis/search, collection of funds.

Plagiarism is when an author attempts to pass off someone else's work as his or her own. Duplicate publication, sometimes called self-plagiarism, occurs when an author reuses substantial parts of his or her own published work without providing the appropriate references. The authors accept that a submitted manuscript may be screened for plagiarism against previously published works. Manuscripts that are found to have been plagiarized will incur plagiarism sanctions: immediate rejection of the submitted manuscript or published article, prohibition of any new submissions.

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ETHICAL APPROVAL

All experimental studies using human or animal subjects should include an explicit statement in the Material and methods section, identifying the ethics committee approval for each study. Any doubts concerning the fulfillment of ethical standards will lead to rejection of the manuscript.

PREPARATION OF MANUSCRIPT

The manuscript should only be written in English. The articles are published in English. Manuscripts sent in other languages will not be accepted. English text verification before submission is strongly suggested for non-native English authors. The Editor accepts solely papers submitted via the electronic Editorial System. The paper registration proceeds according to the System guidelines. The management of the editorial stages and contacting the author take place via the Editorial System exclusively. The author's e-mail address is used to confirm the reception of the paper by the Editor and to provide information about the editorial process stages. The papers have to be anonymous for the reviewers; therefore, all information identifying the authors of the article within the text, references, footnotes, and bibliography should be removed.

Empirical, original research articles, together with their summary and any tables, figures or graphs, should not exceed 20 pages in length; review articles are limited to 30 pages, case studies are limited to 10 pages, others to 1-2 pages. The page format is A4 (about 1800 characters with spaces per page). Pages should be numbered.

Articles should be written using Microsoft Word with the following formats:

- Font: Times New Roman, 12 point
- Line spacing: 1.5
- Text alignment: Justified
- Title: Bold typeface, centered.

Submitted manuscripts should include at least two files. The first file is the title page with the authors' names. The second file includes the title, abstract, keywords, body text, references. Tables and illustrations should be prepared on separate sheets. The system will automatically compose a file that will serve as a blind copy for reviewers and should not contain elements allowing identification of authors.

The title page should contain the following:

- The article's title
- A shortened title of the article (up to 40 characters in length, including spaces), which will be placed in the running head
- The name and surname of the author(s) with their affiliations written in the following way: the name of the university, city name, country name. For example:
The University of Physical Education, Wrocław, Poland
- Author's correspondence address (author's name, address, e-mail address and phone number).

The blinded manuscript should contain:

- The title of the article without names and surnames of the authors.
- An abstract of approximately 250 words divided into the following sections: Aims, Methods, Results, Conclusions.
- Three to five keywords (preferably, according to the Index Medicus – Medical Subjects Headings (MeSH) terms (<http://www.nlm.nih.gov/mesh>)).
- The main text

The main body of text in empirical research articles should be divided into the following sections: Introduction, Subjects and Methods, Results, Discussion, Limitation, Bibliography.

Introduction:

The introduction prefaces the reader on the article's subject, describes its purpose, states a hypothesis, and mentions any existing research (literature review).

Subjects and methods:

This section is intended to clearly describe the research material (if human subjects took part in the experiment, include their number, age, gender and other necessary information), discuss the conditions, time and methods of the research as well identifying any equipment used (providing the manufacturer's name and address). Measurements and procedures need to be provided in sufficient detail in order to allow for their reproducibility. If a method is being used for the first time, it needs to be described in detail to show its validity and reliability (reproducibility). If modifying existing methods, describe what was changed as well as justify the need for the modifications. The International System of Units (SI) and standard abbreviations should be used.

All experiments using human subjects must obtain the approval of an appropriate ethical committee by the author in any undertaken research (the manuscript must include a copy of the approval document). Authors must declare that the experiments reported in the manuscript were performed in accordance with the ethical standards of the Helsinki Declaration and that the participants signed an informed consent form.

Statistical methods should be described in such a way that it can be easily determined if they are correct. Authors of review research articles should also include their methods for finding materials, selection methods, etc.

Results:

The results should be presented both logically and consistently, as well as be closely tied to the data found in tables and figures.

Discussion:

Here, the author should create a discussion of the obtained results, referring to the results found by others in literature (besides those mentioned in the introduction), as well as emphasize new and important aspects of their work.

Limitation:

List and discuss the limitations of the study, possible sources of bias, and any reasonable alternate explanations for the findings and interpretation of the study.

Conclusions:

When presenting any conclusions, it is important to remember the original purpose of the research and the stated hypotheses as well as avoid any vague statements or those not based on research results. If new hypotheses are put forward, they must be clearly stated.

Conflict of interest statement:

Authors state no conflict of interest.

Acknowledgements:

The author may mention any people or institutions that helped the author in preparing the manuscript, or that provided support through financial or technical means.

Bibliography:

The bibliography should be composed of the article's citations, while being arranged and numbered in the order in which they appear in the text, not alphabetically. Referenced sources from literature should indicate the page number and enclose it in square brackets, e.g., Bouchard et al. [23]. The total number of bibliographic references (those found only in research databases, such as Pubmed, Medline) should not exceed 30 for empirical research papers (citing a maximum

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of two books); there is no limit for comparative research papers. There are no restrictions in referencing unpublished work.

Citing journal articles:

Bibliographic citations of journal articles should include: the author's (or authors') surname, first name initial, article title, abbreviated journal title, year, volume or number, page number, doi. For example:

1. Tchórzewski D, Jaworski J, Bujas P. Influence of long-lasting balancing on an unstable surface on changes in balance. *Hum Mov.* 2010;11(2):144–152; doi: 10.2478/v10038-010-0022-2.

If there are six or fewer authors, all the names should be mentioned; if there are seven or more, give the first six and then use the abbreviation “et al.” If the title of the article is in a language other than English, the author should translate the title into English, and then indicate the original language in square brackets; the journal title should be left in its native name. For example:

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Osiński W, *Anthropomotoric* [in Polish]. Poznań: AWF; 2001. Bibliographic citations of an article within a book should include: the author's (or authors') surname, first name initial, article title, book author (or authors') or editor's (or editors') surname, first name initial, book title, page number, publisher, place and year of publication. For example:

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Citations of conference materials (found only in international research databases, such as SPORTDiscus) should include: the author's (or authors') surname, first name initial, article title, conference author's (or authors') or editor's (or editor's) surname, first name initial, conference title, publisher, place and year of publication, page number. For example:

Rodriguez FA, Moreno D, Keskinen KL. Validity of a two distance simplified testing method for determining critical swimming velocity. In: Chatard JC (ed.). *Biomechanics and Medicine in Swimming IX, Proceedings of the IXth World Symposium on Biomechanics and Medicine in Swimming.* St. Etienne: Université de St. Etienne; 2003; 385–390.

Citing articles in the electronic format:

Citations of articles in the electronic format should include: author's (or authors') surname, first name initial, article title, abbreviated journal title, year of publication, journal volume, and number, website address where it is available, doi number. For example:

Donsmark M, Langfort J, Ploug T, Holm C, Enevoldsen LH, Stallknech B. et al. Hormone-sensitive lipase (HSL) expression and regulation by epinephrine and exercise in skeletal muscle. *Eur J Sport Sci.* 2002;2(6). Available from: <http://www.humankinetics.com/ejss/bissues.cfm/>; doi: 10.1080/17461391.2002.10142575 [27.03.2016].

The main text of any other article submitted for consideration should maintain a logical continuity and the titles assigned to any sections must reflect the issues discussed within. Footnotes/Endnotes (explanatory or supplementary to the text). Footnotes should be numbered consecutively throughout the work and placed at the end of the main text.

Tables, figures, and photographs:

They must be numbered consecutively in the order in which they appear in the text and provide captions – Should be placed within the text – Additionally, figures or photographs must be attached as separate files in the .jpg or .pdf format (minimum resolution of 300 dpi) – May not include the same information/data in tables and also figures – Illustrative materials should be prepared in black and white or in shades of gray (PHYSIOTHERAPY is published in such a fashion and cannot accept color) – Symbols, such as arrows, stars, or abbreviations, used in tables or figures, should be clearly defined using a legend.

Prior to printing, the author will receive their article in the PDF format. It is the author's responsibility to immediately inform the Editorial Office if they accept the article for publication. At such a point in time, only minor corrections can be accepted from the author.

KOMUNIKAT 3

X Międzynarodowe
Dni Fizjoterapii
23-25/11/2017



Jakość i styl życia w świetle nowoczesnej rehabilitacji



Rok założenia 1946



WYDZIAŁ FIZJOTERAPII
AKADEMIA WYCHOWANIA FIZYCZNEGO
WE WROCŁAWIU
2017

Jakość i styl życia w świetle nowoczesnej rehabilitacji

Tematyka sesji

- Zdrowotne aspekty stylu życia w prewencji pierwotnej i wtórnej.
- Nowoczesna fizjoterapia i jakość życia w chorobach wewnętrznych, chorobach nowotworowych. schorzeniach narządu ruchu i chorobach układu nerwowego.
- Aktywność fizyczna, żywienie i jakość życia w wieku rozwojowym, dorosłym i w wieku starszym.
- Kierunki badań nad procesem starzenia się organizmu.
- Nowoczesna kosmetologia w opóźnianiu oznak starzenia się i poprawy jakości życia.
- Terapia zajęciowa w odniesieniu do codziennej aktywności i jakość życia.

Międzynarodowe Dni Fizjoterapii to konferencja naukowa ciesząca się dużym zainteresowaniem, na stałe wpisana w kalendarz naukowych spotkań środowiska fizjoterapeutycznego, medycznego i kultury fizycznej.

Serdecznie zapraszamy do udziału w konferencji X Międzynarodowe Dni Fizjoterapii w pięknym Wrocławiu.

Przewodniczący Komitetu Naukowego
dr hab. Wioleta Dziubek-Rogowska

Przewodniczący Komitetu Organizacyjnego
dr hab. Czesław Giemza

ISTOTNE INFORMACJE

1. **W celu zgłoszenia uczestnictwa proszę o wypełnienie formularza zgłoszeniowego znajdującego się również na stronie: <http://dnifizjoterapii.awf.wroc.pl/>**

2. **Termin nadsyłania streszczeń 15.09.2017 r.**

3. Zakwalifikowane przez Komitet Naukowy i wygłoszone w ramach Konferencji prace, po pozytywnej opinii recenzentów, mogą zostać wydane drukiem w czasopiśmie Fizjoterapia, Human Movement, Gerontologia Współczesna, Acta Balneologia, Wiadomości Lekarskie, Alergologia (regulamin przygotowania pracy do druku wg zasad czasopisma).

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- 250 zł (do 30.06.2017 r.)
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- odpłatność za udział bierny dla pracowników AWF Wrocław zniżka 50% (zgodnie z powyższymi terminami)

4. Opłaty należy dokonywać na konto: 77 1240 3464 1111 0010 6320 9674
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5. W ramach opłaty: materiały konferencyjne, udział w sesjach, jeden obiad, przerwy kawowe w trakcie konferencji.

6. Zgodnie z rozporządzeniem Ministra Zdrowia z dn. 06. 10. 2004 r. za udział w X Międzynarodowych Dniach Fizjoterapii we Wrocławiu przyznane będą punkty edukacyjne.

7. Zakwaterowanie uczestnicy realizują we własnym zakresie.

8. **Miejsce Konferencji:**

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