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PRESS UP EXERCISES AS AN ALTERNATIVE TO CONVENTIONAL THERAPY OF RADICULAR SYMPTOMS IN PATIENTS WITH LOW BACK PAIN

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Abstract The study examines whether clinical and objective improvement can be achieved in patients with LBP (low back pain) with radicular symptoms using a 6-week exercise program based on press up exercises created from ADL (activities of daily living) movement patterns. This original study involved 10 men with acute L5 / S1 disc hernia. Before starting the exercise program, patients determined the intensity of pain VAS (Visual Analogue Scale), the intensity of paraesthesias (NSIP: numerical

scale of paraesthesia intensity) and the location of paraesthesias. Magnetic resonance imaging (MRI) was used to objectify the extent of the disc hernia, spinal cord compression, and pressure acting on the dural sac. Patients completed -week exercise program consisting only of press up ADL movement patterns in a closed kinematic chain. At the end of the exercise program, patients determined the outcome values of clinical symptoms and underwent control MRI within 2 weeks at the latest. At the end of the study all patients showed a statistically significant reduction in pain intensity ($p = 0.005$), paraesthesia ($p = 0.006$). The pressure on the dural sac was reduced in all patients. One of the patients had a partial reduction of intervertebral disc hernia by 35.7%. None of the patients had a change in spinal root compression. Conventional therapy should focus on influencing clinical symptoms that appear to correlate with dural sac compression. We dare to argue that reduction of hernia disc is not a sign of primary recovery in LBP patients with acute phase radicular symptoms.

Key words: ADL (activities of daily living), spinal disc herniation, dural bag, motor learning, paresthesia

Introduction

Inadequate primary prevention of postural health in childhood, continuing in adulthood, results in the formation of structural disorders of the musculoskeletal system, the manifestation of which is pain. The lack of physical activity in the movement regime is one of the factors that supports the mentioned upward trend of musculoskeletal diseases.

Currently, low back pain (LBP) is one of the most frequently diagnosed diseases of the musculoskeletal system. Surveys show that about 80% of the population have personal experience with LBP with radicular symptoms, while 40% of them suffer from backache once a year (Adams, 2000 Hayden et al., 2010; Stefanakis et.al., 2012; Huijnen et al., 2020; Maniadakis & Gray, 2000). Approximately 2–5 % of the population suffer from radicular symptomatology, which is caused by intervertebral disc herniation according to most authors (Adams et al., 2010; Turk et al., 2019; Cavalcanti et al., 2020; Ozcamdalli et al., 2020). Another theory of etiopathogenesis of radicular symptomatology works on the principle of pathological changes in the blood supply caused not only by a herniated disc but also changes in the posterior longitudinal ligament (Komori et al., 1996; Adams, 2005; Adams et al., 2010; Stefanakis et al., 2012). Therefore, radicular symptoms should result from uneven loading of intervertebral discs. Summation of asymmetric loading, i.e., creep phenomenon, accelerates degeneration of a disc, which succumbs to exerted forces and thus herniates at some point. The resulting hernia impacts surrounding tissues, in particular the tissues placed in the intraforaminal space. The pressure on intraforaminal structures and the dural bag, which protects them, increases. There is not only mechanical oppression of neural structures by the herniated disc, which can lead to an inflammatory response and chemical pain, but also pressure accumulation of interacting tissues in the dural bag. The result is dural bag compression and increased tension of the posterior longitudinal ligament. One of the most frequent causes of LBP with radicular symptoms is disc herniation diagnosed in the L4/L5 or L5/S1 segments (Adams, 2005; Adams & Roughley 2006; Adams et al., 2010; Stefanakis et al., 2012).

Although this is a quite common diagnosis, no optimal therapeutic procedure guaranteeing effective treatment has been found. Since disc herniation occurs the most frequently on the basis of repeated pathological loading of the spine, it is necessary to focus not only on structural changes, which can be monitored during magnetic resonance imaging, but also on clinical symptomatology associated with relevant daily living activities of a patient (Choi et al., 2010; Nemček, 2016; Cavalcanti et al., 2020; Ozcamdalli et al., 2020).

Today, occupations which are potentially risky for occurrence of radicular symptomatology prevail. These are activities with predominantly flectional loading of the spine, e.g., desk jobs (IT branch, drivers, office jobs), but

also manual work, such as a locksmith or a bricklayer, where intradiscal pressure increases. All "risky" occupations have a linking factor in the form of a flexed position of the spine, which causes simple local ligament pain at the beginning. If these people prefer activities or spine positions increasing intradiscal pressure in their leisure time, probability of occurrence of pathological changes in the intervertebral disc significantly rises (Kerr et al., 2001; Ganesan et al., 2017; Samiei et al., 2019; Adams et al., 2000). Summation of asymmetric loading of a disc results in its pathological degeneration and pressure exerted on the surrounding neural structures starts to increase. Clinical response changes and local pain is replaced by radicular symptoms, which are not present only in the form local backache. This is a vicious circle when people tend to search for antalgic positions in an effort to relieve pain. These positions can temporarily reduce local backache, but they often do not impact or they even worsen peripheral symptomatology caused by recurrent pressure increase in the dural bag (Adams, 2005; Adams & Roughley, 2006; Stefanakis et al., 2012).

Therefore, we consider it useful to apply motor patterns based on ADL of the general population to conventional therapy of patients with LBP. The managed therapy will not only reduce clinical symptoms during a workout with a physiotherapist but after primary fixation of motor learning new more effective motor patterns for ADL will be automated. The therapy consisting of modified motor patterns for ADL can be used also as a self-therapy. Practising and mastering motor skills in the closed kinematic chain (CKC) is an essential factor of correct performance of activities in the open kinematic chain (OKC) according to (Dvořák 2005a, 2005b; Latash, 1993; Palaščáková Špringrová, 2011; Vagner et al., 2017; Palaščáková Špringrová et al., 2020). Movements in the CKC allow easier co-activation of muscle chains. Thanks to physiological involvement of muscle chains, which allows even loading of spine structures, the spine straightens. Thanks to physiological co-activation of muscle chains not only joints get into an ideal position but their use in the relevant position or movement is more economical (Poková et al., 2018; Vagner et al., 2018). On the basis of the facts above we consider it appropriate to design a therapeutic programme consisting of ADL motor patterns practised in the CKC and focused on LBP with radicular symptoms.

The aim of the study

Lower back pain (LBP) associated with radicular symptoms is one of the most common diagnoses. There are a number of conventional therapies that are used to treat LBP, but the most effective form of rehabilitation is unknown.

The aim of the study was to find out whether clinical and objective improvement in patients with LBP with radicular symptoms can be reached by means of a 6-week exercise programme consisting of press up ADL motor patterns.

Material and methods

Ten men of 43 ±2.3 years of age on average with a neurological diagnosis of intervebral disc herniation in the L5/S1 segment took part in the study. They were patients of the neurological department of Středomoravská nemocniční a.s. hospital in Přerov. All monitored participants had completed their secondary education. From the perspective of professional anamnesis seven participants labelled their work as a desk job and three of them were manual workers. The probands of the group were physically inactive in terms of the implementation of physical activity in their movement regime (in childhood, adulthood).

In order to maintain homogeneity of the study we determined criteria that all the participants had to meet: the patients underwent neither rehabilitation treatment focused on S1 radicular syndrome, nor rehabilitation treatment focused on problems in the lumbar spine during the last year. The patients never underwent spinal surgery. They did not feel any clinical symptoms of S1 radicular syndrome for more than three months. In order to avoid distortion of the results by chemical symptoms of pain, which patients suffer from in the acute stage, our participants had to undergo infusion therapy before commencing the rehabilitation programme. The infusion included the following analgesics: Novalgin, Myorelaxant Guajacuran and Solumedrol for antiedematous effects with added MgSO4. Infusion therapy was complemented with vitamin B and Milgamma administered orally by a neurologist. The participants underwent infusion therapy before initial examination with a physiotherapist.

Before commencing the exercise programme the patients were screened with MRI (magnetic resonance imaging) for objectivization of structural changes in the disc and the surroundings tissues. It was a standard static projection when the patients were in the supine position with a pillow placed under their knees. Three monitored parameters were selected from the resulting sagittal and transverse T1 and T2 projections: extent of the intervebral disc herniation, oppression of the S1 nerve root and pressure exerted on the dural bag. While two values are typically stated in the description of nerve root compression in the Czech Republic (i.e., with or without nerve root oppression), three variables are mentioned in the description of pressure applied to the dural bag (i.e., without oppression, minimal pressure on the dural bag and oppression of the dural bag). The same radiologist described both initial (Table 1) and final data from MRI examination. In order to avoid distortion of the results, the radiologist was not informed about the course of the study. The patients started the 6-week exercise programme within a period of no more than two weeks from the initial MRI examination.

Table 1. Initial MRI examination

Patient/factors	HE (mm)	NR	DB
Patient 1	3	O	O
Patient 2	7	O	O
Patient 3	13	O	O
Patient 4	7	O	O
Patient 5	4	O	O
Patient 6	5	O	O
Patient 7	17	O	O
Patient 8	10	O	O
Patient 9	13	O	O
Patient 10	9	O	O
Arithmetic mean	8.8	10/10 O	10/10 O

Explanatory notes: HE: hernition extent, NR: S1 nerve root, DB: dural bag, O: oppression.

Before commencing the exercise programme, a physiotherapist carried out an initial clinical examination (Table 2). The following was assessed during the initial clinical examination: pain intensity according to the Visual Analogue Scale (VAS) and paresthesia intensity in the S1 dermatome. We created a special scale for assessment of paresthesia intensity: a numeric paresthesia intensity scale (NPIS). The NPSI works on the same principle as the VAS, thus the patient determines paresthesia intensity on a numeric scale where 0 means no paresthesia and 10 is maximum level of paresthesia intensity. The last evaluated clinical criterion was paresthesia location in the S1 dermatome. Most sources evaluate success of the therapy in patients with radiculopathy caused by intervebral disc herniation according to the VAS, functional limitation (disability) or according to sleep disorders (Ozturk et al., 2006;

Luire et al., 2008; Tosteson, 2008; Steven et al., 2009; Hahne et al., 2010; Kamanli et al., 2010). For that reason, we decided to apply the VAS to the monitored clinical parameters. The second clinical factor that patients in the acute stage complain about the most is parestehia, which significantly increases functional limitation in ADL. So, we decided to include paresthesia intensity and location in our monitored clinical parameters. The patients evaluated clinical symptoms when sitting in the prolonged (1 minute lasting) uncorrected position on the chair without back support.

Table 2. Initial clinical examination: evaluation in the uncorrected position on the chair for 1

Patient/factors	VAS	NPIS	PL
Patient 1	9	7	ED
Patient 2	5	4	CK
Patient 3	0	5	CK
Patient 4	2	7	CK
Patient 5	9	6	ED
Patient 6	7	4	CK
Patient 7	3	3	ED
Patient 8	5	5	ED
Patient 9	1	7	CK
Patient 10	6	4	LSK
Arithmetic average	4.7	5.2	4/10 ED 5/10 CK 1/10 LSK

Explanatory notes: VAS: subjective pain assessment, NPIS: numeric scale of paresthesia intensity in S1 dermatome, PL: paresthesia location in S1 dermatome, ED: entire S1 dermatome, LSK: from lumbar spine to knee joint, CK: caudal from knee to S1 dermatome.

The patients underwent a 6-week rehabilitation programme consisting only of press up exercises in the closed kinematic chain. These press up exercises were based on positions of children´s motor development. The individual motor patterns, which we included in the therapy, were selected according to the activities of daily living of the general population. The patients attended a 45-minute managed rehabilitation once a week. The remaining six days they followed up the exercise programme themselves at home without physiotherapist´s intervention. According to the participants the average time of home workout was 15 minutes. Since they worked out twice a day the total time was 30 minutes per day. During self-therapy they practised only such motor patterns that they trained with a physiotherapist in the managed therapy beforehand. In the course of the rehabilitation programme the physiotherapist accelerated the therapy by adding new motor patterns (Table 3). During the 6-week rehabilitation programme the patients practised almost 6000 repetitions of the press up exercises.

Table 3. Movement programme of press up motor patterns (Palaščáková Špringrová, Vagner)

Exercises	Number of repetitions	Inclusion of motor patterns in the therapy
Press up in the supine position	10	1st therapy
Rotation (L/R hip)	10/10	1st therapy
Press up in the prone position	10	1st therapy
Press up while sitting on the chair	10	1st therapy
Press up from the prone to the all-four position	10	2nd therapy
Press up while putting a foot forwards and standing up (L/R LE)	10/10	2nd therapy
Self-motorisation in the sitting position with both legs bent to a side (L/R)	20/20	4th therapy
Dynamic stretching in the supine position (L/R LE)	20/20	4th therapy

Explanatory notes: L: left, R: right, LE: lower extremity.

At the same time the participants were educated about regime measures, which should have minimized increase in intradiscal pressure, thus also compression of neural structures during ADL. The education included straightening in static positions (sitting, lying, standing up) and avoiding irritation positions (in particular prolonged flexion). The patients were instructed to avoid positions and activities worsening their symptomatology, specifically radiation to the lower extremity. They did not have a set comprehensive rest regime, vice versa they were invited to maintain maximum possible extent of their physical activities, which they were able to practise without any irritation phenomena.

After the end of the exercise programme the patients underwent control MRI examination and final clinical values were determined. The final MRI examination was always planned by two weeks after termination of the exercise programme.

We processed the collected data by means of theoretical methods of inductive reasoning, deductive reasoning and analysis. Next, we applied the methods of mathematical statistics, i.e. arithmetic means (μ), standard deviation (s), median (Me), interquartile range (IQR), with the results recorded in the tables. Despite a limited amount of data statistical normality was not rejected, so we could use the pair t-test (t-test, $p < 0.01$) for comparison of initial and final values of disc herniation extent. Due to non-compliance with data normality we used the Wilcoxon matched-pair test for determination of statistical significance of differences between initial and final measurements of the VAS and the NPIS (Wtest, $p < 0.01$).

The results of the study

The whole monitored group of patients completed the study. During and after completion of the study no medical complications occurred in the participants.

All patients reported statistically significant decrease in pain ($p < 0.01$) and paresthesia (see Table 4). According to the patients pain intensity was on average 4.7 points of the VAS at the beginning of the study. During the final examination the reported pain intensity was 0.9 points of the VAS. It was a statistically significant difference ($p = 0.005$; in round figures). At the beginning of the study reported paresthesia intensity was 5.2 points of the NPIS. At the end of the study paresthesia intensity was on average 0.4 points of the NPIS. It was also a statistically significant difference ($p = 0.006$; in round figures). All monitored patients reported also improvement of paresthesia location (Table 4).

Only 1 from 10 patients reported partial reduction of intervebral disc herniation and it was 35.7%. No reduction of intervebral disc herniation occurred in the remaining nine patients. There was no change in S1 nerve root oppression in any patient. Pressure on the dural bag was reduced in all patients. At the beginning of the study a radiologist identified dural bag compression according to the MRI results in the whole monitored group. At the end of the study the radiologist reported minimal dural bag compression in the whole group of patients (Table 5).

Table 4. Comparison of initial and final clinical examination: evaluation in the uncorrected position on the chair for 1 minute

Patient/factors	VAS 1	VAS 2	NPIS 1	NPIS 2	LP 1	LP 2
Patient 1	9	2	7	1	ED	CK
Patient 2	5	0	4	0	CK	WP
Patient 3	0	0	5	0	CK	WP
Patient 4	2	0	7	1	CK	LPl
Patient 5	9	3	6	0	ED	WP
Patient 6	7	1	4	1	CK	LPl
Patient 7	3	0	3	0	ED	WP
Patient 8	5	1	5	0	ED	WP
Patient 9	1	0	7	1	CK	LPl
Patient 10	6	2	4	0	LSK	WP
Arithmetic mean	4.7	0.9	5.2	0.4	4/10 ED, 5/10 CK, 1/10 LSK	6/10 WP, 1/10 CK, 3/10 LP1
Standard deviation (s)	3.15	1.10	1.48	0.516	×	
Median (Me)	5	0.5	5	0	×	
Interquartile range (IQR)	4.5	1.75	2.75	1	×	
Statistical significance (p)	0.005174 (p < 0.01)		0.00551 (p < 0.01)		×	

Explanatory notes: VAS 1: initial subjective pain assessment, VAS 2: final subjective pain assessment, NPIS 1: initial numeric scale of paresthesia intensity in S1 dermatome, NPIS 2: final numeric scale of paresthesia intensity in S1 dermatome LP 1: initial examination of paresthesia location in S1 dermatome, LP 2: final examination of paresthesia location in S1 dermatome, ED: entire S1 dermatome, LSK: from lumbar spine to knee joint, CK: caudal from knee to S1 dermatome, LPl: lateral preference inventory, 5th metatarsal and 5th finger, WP: without paresthesia.

Table 5. Comparison of initial and final MRI examination

Patient/factors	HE 1 (mm)	HE 2 (mm)	NR 1	NR 2	DS 1	DS 2
Patient 1	3	3	O	O	O	MIN
Patient 2	7	4,5	O	O	O	MIN
Patient 3	13	13	O	O	O	MIN
Patient 4	7	7	O	O	O	MIN
Patient 5	4	4	O	O	O	MIN
Patient 6	5	5	O	O	O	MIN
Patient 7	17	17	O	O	O	MIN
Patient 8	10	10	O	O	O	MIN
Patient 9	13	13	O	O	O	MIN
Patient 10	9	9	O	O	O	MIN
Arithmetic mean	8.8	8.55	10/10 O	10/10 O	10/10 O	10/10 MIN
Standard deviation (s)	4.49	4.67	×	×	×	×
Median (Me)	8	8	×	×	×	×
Interquartil range (IQR)	6.75	7.62	×	×	×	×
Statistical significance (p)	0.3434 (p > 0.01)		×	×	×	×

Explanatory notes: HE 1: initial value of herniation extent, HE 2: final value of herniation extent, NR 1: initial evaluation of S1 nerve root, NR 2: final evaluation of S1 nerve root, DS 1: initial evaluation of dural bag, DS 2: final evaluation of dural bag, O: oppression MIN: minimal compression, **μ**: arithmetic mean.

Discussion

Many studies about conventional treatment of LBP with radicular symptomatology concerning various physiotherapeutic methods were developed. We cannot say for sure which of the physiotherapeutic methods (e.g., low up to high intensity aerobic exercises, stabilization and fitness training, a workout aimed at improvement of spinal flexibility, traction, …) is the most effective. Deviations in classification of disc herniation caused by various imaging techniques, or different ways of classification of disc herniation can result from quite inconsistent

evaluation of effectiveness of conventional therapy (Kamanli et al., 2010; Ozturk et al., 2006; Choi et al., 2010; Mayer et al., 2010; Chou, 2011; Poková et al., 2018). Kamanli et al. (2010) and Ozturk et al. (2006) used traction therapy as a conventional treatment of patients with disc hernation in their studies. In both cases they noted significant improvement in clinical symptomatology in monitored participants. In our study we decided to use press up exercises in the CKC based on ADL of the general population as conventional therapy. The basic principles of workout include pressing up on the acral parts, during which muscle activity is transmitted from peripheral body parts to the centre. When pressing up antagonistic muscle chains are co-activated. Co-activation results in spine straightening and centration of root joints (Palaščáková Špringrová, 2011; Palaščáková Špringrová et al., 2020). We consider press up exercises as a certain type of active traction exercises, the aim of which is automation of acquired motor patterns with the straightened spine based on motor learning in individual ADL.

The group of patients we monitored perceived sensitive symptoms of radicular syndrome, which limited them in performance of ADL, as the primary problem. Our patients considered irritation pain in back and lower extremities with paresthesia as more serious limitation of ADL in comparison with motor deficit associated with S1 radicular syndrome. Pathological loading of the spine in ADL causes immediate pain only in minimum cases. The pain occurs over time following summation of pathological stereotypes, which individuals stop being aware of, and they fix wrong physical activity habits (Doubková et al., 2018). On the basis of the above-mentioned facts, we created a precondition: if individuals´ ADL are set up well, they do not suffer from backache, they can perform their job in an adequate manner and spend leisure time without any limitations. Due to long-lasting asymmetrical loading of the spine pain limiting motor skills of an individual both in job and leisure time develops. According to the Institute of Health Information and Statistics of the Czech Republic in 2017 people suffering from chronic LBP were on average 70 working days unable to work for health reasons. At the average wage of CZK 25,000 per month these people lost approximately CZK 16,000. Unfortunately, we have neither comprehensive data about losses that companies suffered, nor the amount of financial means invested in LBP treatment in the Czech Republic in 2017. We can learn some information on the basis of data from 1998 when Great Britain provided GBP 1.632 million for LBP treatment (recalculation considering inflation rate in 2020: GBP 28.894 million). LBP is not only a medical diagnosis. It is a socio-economic problem of the modern society. It is necessary to focus particularly on LBP prevention and prevent time consuming and many times more expensive treatment (Maniadakis & Gray, 2000; Hayden et al., 2010; Huijnen et al., 2020; Bendíková, 2020; Bendíková & Balkó, 2022).

Summation of unevenly distributed disc loading results in its faster degeneration. Degenerative changes in the disc and the surrounding neural structures are indeed very common and we can take note of them from the second decade of life. However, structural changes in the disc do not have to signify occurrence of radical clinical symptoms (Matveeva et al., 2012; Bendíková, 2020). Recurrent increase in intradiscal pressure caused by pathological loading of the spine during ADL results in increase in pressure exerted on neural structures contained in the dural bag. Excessive flexion motor patterns and static loading of the lumbar spine in semiflectional positions, such as flabby sitting on the chair or working when bending over, increase compression in the dural bag and accelerate occurrence of local inflammation of neural structures in overburdened intraforaminal space. Irritation pain occurs. Increasing pressure on the dural bag increases pain and paresthesia in lower extremities and an individual starts to be significantly limited in ADL. Many people do not solve their LBP problem until the clinical symptoms tie them down in their common life. Limitation of ADL mainly in patients with chronic manifestation of LBP impacts significantly also their psyche, in particular motor control psycho-physiology. As time passes these people create various alternative

motor strategies with the aim not to incite or not to increase pain and paresthesia. As a result, the patients avoid certain movements or positions, including positions decreasing pressure on the dural bag. The individuals identify these "therapeutic movements and positions" on the basis of their fixed motor patterns of ADL and they consider them pathological.

On the basis of the above-mentioned information, we dare to claim that correction of spinal structure loading in ADL should be part of therapy of LBP with radicular symptoms. Therefore, we interconnected physiotherapeutic exercises with ADL that the patients regularly performed. Our exercise programme included motor patterns such as standing up from a chair, rotation from the supine to the lateral and prone position, or dynamic transitions from the prone to the standing position.

Pressing up on the acral parts in the CKC results in spine straightening, which should decrease both intradiscal pressure and pressure exerted on the dural bag. Since it is a progressively arising problem, one-time correction of the spine is insufficient. Therefore, it is important for the patients to fix these new straightened motor patterns in ADL (Palaščáková Špringrová, 2011; Vagner et al., 2018). The right dosing of the therapy is as important as the selection of motor patterns and their implementation in therapy. During the 6-week exercise programme our patients performed approximately six thousand repetitions of press up exercises. The time of primary fixation of motor patterns in everyday workout is 6–8 weeks; in terms of the number of repetitions it deals of ca 4–10 thousand repetitions in case of basal motor patterns, such as ADL of the general population (Palaščáková Špringrová, 2011). In the acute stage it is appropriate to practice the workout several times a day (in our case it was twice a day), thanks to which the patients get used to new movement stereotypes faster and they are earlier able to apply them to ADL. More frequent repetition of press up exercises is beneficial also in terms of clinical symptomatology reduction (Poková et al., 2018; Palaščáková Špringrová et al., 2020). Frequent relief of pain and paresthesia accelerates return to more challenging physical activities and the patients perform their ADL without almost no limitations (Palaščáková Špringrová et al., 2020). Clinical symptomatology reduction has a positive effect also on mental stability of the patients. In our point of view conventional therapy should be aimed at reduction of sensitive symptoms of radical syndrome in the acute stage. As soon as subjective difficulties are reduced or eliminated, patients start to perceive their motor deficit more intensively and they consider it the top of their limitations. So, the sub-acute and chronic stage of the treatment should be focused on restoration of motor functions and physical condition, which helps prepare the patients for return to their usual physical activities in both professional and common life.

In our view press up exercises are very beneficial in LBP therapy for both static and particularly dynamic co-activation (Palaščáková Špringrová, 2011; Poková et al., 2018; Vagner et al., 2018). Static co-activation, which is the basis, is important for patients to correctly perform dynamic motor patterns with a straightened spine. Correct performance of press up exercises on the acral parts leads to muscle co-activation and spine straightening in the static position, e.g., in the supine position; an individual performs a phase movement or dynamic transition to another position, such as to the lateral, while constantly pressing up on the acral parts. In order to boost therapy effectiveness and to accelerate return of the patients to ADL we interconnected press up activities with ADL in our monitored patients. The press up exercises, which they learned to perform under supervision of a physiotherapist, reduced clinical symptomatology and they could be immediately applied to ADL of our participants. We consider dynamic transitions the key factor of LPB therapy. One of the reasons is already mentioned interconnection of the therapy with ADL, when the patients constantly practice dynamics and change in positions. Another reason is maximum possible dynamics of patients who are limited in ordinary activities and forced to avoid dynamic transitions

from individual positions to other ones. Last but not least, static correction is insufficient for application to ADL. Individuals learn how to adjust their body posture in static positions, but they are not able to maintain this adjustment when changing positions.

Research limitations

We monitored changes in the intervebral disc and the surrounding tissues by means of MRI examination, which is considered the best imaging method of the intervebral disc and the surrounding tissues. We chose the standard supine position with a pillow placed under the lower extremities to display neural structures. It was static imaging aimed at the L5/S1 segment, which is primarily used for classification of morphological changes in intervebral discs in the Lp area. From the perspective of biomechanics this position was not ideal in terms of distribution of pressure on intervebral discs. Light kyphotisation of the lumbar spine occurs in this position and intradiscal pressure rises, which can result in dorsal shift of the nucleus pulposus. This position can be one of the reasons why we took note of structural changes in the area of the intervebral disc only in one out of ten patients (Adams et al., 2000; Kerr et al., 2001; Ganesan et al., 2017; Samiei, 2019).

We believe that static imaging by means of MRI examination cannot comprehensively assess morphological findings, which change depending on change of the spine position. McGregor et al. (2002), who proved in his study that under various postural conditions morphological findings in the spine differ, confirms the benefits of MRI examination (McGregor, 2002).

Ozturk et al. (2006), Burgetová et al. (2010), Çitişli & İbrahimoğlu (2015), they all proved in their studies that disc herniation can be reduced by means of conventional therapy (Luire et al., 2008). We agree with the statement that disc herniation can be reduced by means of conventional therapy. However, all the studies mentioned above perform control measurement of disc herniation no sooner than 16 weeks after completion of the treatment. According to the results of our study we do not assume that reduction of disc herniation should be considered a significant factor of recovery in the acute stage of treatment. On the basis of the results of our study we can consider reduction of pressure on the dural bag and its structures as an objective indicator of recovery. In the acute stage of treatment, we should focus specifically on clinical symptoms, because the most appropriate treatment of LBP with radicular symptomatology can be selected only on the basis of them.

Conclusion

Pharmacological treatment, which was indicated to our group of patients, in combination with press up exercises in the closed kinematic chain seems to be effective therapy of LBP with radicular symptomatology. The patients managed to reduce pressure on the dural bag during a 6-week exercise programme, which resulted in reduction or elimination of clinical symptomatology. In the acute stage the patients with LBP with radicular symptoms feel the most limited by clinical symptomatology. We are convinced that conventional therapy should focus primarily on the impact of clinical symptomatology, not on structural changes in the disc and the surrounding tissues. Comparison of initial and final MRI examination in our monitored group of patients did not reveal any statistically significant changes in the herniated disc. We dare to claim that reduction of disc herniation neither signifies primary recovery, nor reduces clinical symptomatology in patients with LBP with radicular symptoms in the acute stage. Reduction of pressure on the dural bag correlated with reduction of clinical symptomatology,

therefore according to our measured results it is a significant indicator of recovery in patients with LBP with radicular symptoms in the acute stage.

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