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Comparison of the impact of two physical therapy methods on pain and disability in patients with non-specific lower back pain: a controlled clinical pilot study

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Lower back pain (LBP) is a serious public health problem which is widespread, particularly in developed countries.
Objectives. The aim of this study was to compare the impact of two physical therapy approaches, i.e., Acral Coactivation Therapy (ACT) and conventional therapy, in terms of intensity of pain and disability in patients with non-specific LBP.
Material and methods. Thirty patients in subacute or chronic stages of LBP were involved in this single-blind pilot study. The experimental group consisted of 15 patients (age: 39.3 ± 6.3; BMI: 27.1 ± 5.2) who worked out according to ACT. The control group included 15 patients (age: 45.3 ± 7.1; BMI: 27.8 ± 5.8) who followed conventional therapy. The patients in both groups completed 10 therapy sessions. The Short-Form McGill Pain Questionnaire (SF-MPQ) was used to assess any change in pain between the first and last therapy sessions, and the Visual Analogue Scale (VAS) was applied to assess current pain before and after each therapy session. The Oswestry Disability Index (ODI) was used to assess the effect on disability.
Results. The patients who followed ACT showed a larger decrease in the scores of almost all criteria of pain assessment on the SF-MPQ ($p < 0.05$), a larger decrease in current pain evaluation according to the VAS within individual therapy sessions ($p < 0.05$), and a larger decrease in disability score in the ODI ($p < 0.05$) in comparison with the control group.
Conclusions. ACT is an efficient therapy for pain reduction, both immediately after a workout and long-term.
Key words: lower back pain, physical therapy modalities, pain measurement.

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Background

Lower back pain (LBP) is a serious public health problem which is widespread, particularly in developed countries. The prevalence of lower back pain during one's lifetime has been reported to be over 84% and the prevalence of chronic back pain is about 23%, in which case 11–12% of those affected suffer from disability [1]. In LBP therapy, it is necessary to prevent transitioning to the chronic stage because it can significantly impact illness behavior and the more expensive, more difficult treatment it entails [2]. Therefore, back pain is a societal problem.

Even though the occurrence of this disease is so high, an optimal treatment has not yet been developed. Systematic reviews focused on LBP show that working out seems to be slightly more efficient, or at least comparable to other methods used in the treatment or prevention of these difficulties, such as physical or manual therapy [3–7]. However, the benefit of working out compared to other therapies is that patients can practice it themselves. Although many types of workout used in the treatment of non-specific LBP have been examined, there is no evidence that one form of workout is better than another, which reflects the complexity of this issue.

The ideal method of LBP treatment should be easily understandable so that patients can practice it independently at home or collectively within group workouts in rehabilitation or fitness centers, at work, at school, etc. in order to prevent LBP, or to be able to help themselves as quickly as possible in case of pain. The method should also have an immediate effect on pain in order to increase patient compliance, without which a therapy cannot produce any effect. Finally, the effect of the therapy should be permanent. Acral Coactivation Therapy (ACT) could meet such criteria.

Ingrid Palaščáková Špringrová, who developed Acral Coactivation Therapy, has been exploiting the press-up exercises by Roswitha Brunkow in her physical therapy practice since 2006. Some basic ideas of this method inspired her to develop ACT. She has been verifying and extending the method in recent years.

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The basic publication relating to the method was published in 2011 [8]. Acral Coactivation Therapy is a method which exploits motor learning. It is based on managed fixation of press-up motor patterns derived from children's motor development and its variants. Motor pattern fixation leads to a straightening of the spine. This method mainly uses similar motor patterns that an individual is able to use in common everyday life (e.g., rotation from a supine position to lying on one's side, or standing up from a sitting position by means of press-up exercises). Another very important principle is pressing up by means of the acral parts, i.e., the heels of the hands and feet. Pressing up stimulates the *punctum fixum* at the acral parts, which coactivates the ventral and dorsal muscle chain, resulting in spine straightening. Also, the method is based mainly on the principle of closed kinetic chains (CKC) that are more favorable in terms of neurophysiological management. However, after mastering CKC, or if there is a reason for that, open kinetic chains can be involved as well. Another ACT principle exploits reciprocal inhibition and muscle coactivation [9].

The impact of ACT on pain and disability in patients suffering from lower back pain was examined in this pilot study.

Material and methods

Study design

The study is a randomized, controlled pilot study. It was single-blinded, i.e., the examining physicians did not know which therapy the patients had undergone.

Participants

Thirty-eight patients at 30–55 years of age in the subacute and chronic stages of non-specific LBP took part in the study. The patients of the Rehabilitation Department in Šternberk Hospital who were examined by rehabilitation physicians and diagnosed with non-specific LBP from July 2016 until March 2017 were involved in the study. The exclusion criteria were specific back pain, root pain, surgery of the lower limbs or spine, and congenital or acquired orthopedic defects of the lower extremities that can be clearly associated with back pain. During the initial examination, the physicians informed the participants about the course of the study and received their informed consent.

The patients who met the initial criteria were randomly divided into two groups: an experimental group, Group A, and a control group, Group B. Thirty patients completed the study. Eight patients did not complete it – two of them for health reasons and six due to absence from the therapy sessions. The characteristics of the patients are described in Table 1.

The Group A consisted of 15 patients (12 women and 3 men; age: 39.3 ± 6.3; BMI: 27.1 ± 5.2; 6 patients in subacute stage and 9 in chronic stage). Group B included 15 patients (13 women and 2 men; age: 45.3 ± 7.1; BMI 27.8 ± 5.8; 8 patients in subacute stage and 7 in chronic stage).

Measurement

The initial and final examination (eight weeks later) – which were both executed by a rehabilitation physician – included a medical history and a basic neurological and kinesiological examination. In order to evaluate the intensity and nature of the pain, a Czech version of the Short-Form McGill Pain Questionnaire (SF-MPQ) was used [10]. Disability was assessed by means of a Czech translation of the Oswestry Disability Index (ODI) version 2.1a [11]. The patients filled out the questionnaires themselves during the initial and final medical checks. For the evaluation of current pain intensity, the Visual Analogue Scale (VAS) was used immediately before and after each workout under the guidance of a physical therapist (a scale of 0–10; 0 = no pain, 10 = the worst pain one can imagine).

Intervention

In both groups, the therapy lasted eight weeks. During the first two weeks the patients attended therapy sessions twice a week under the guidance of a physical therapist and they were asked to work out independently at home following the physical therapist's instructions. In the later six weeks the patients attended therapy sessions managed by a physical therapist only once a week and were asked to work out at home independently three times per week. Thus, the patients underwent ten therapy sessions under the guidance of a physical therapist and were assigned to work out independently in their home environment 22 times. The physical therapist recorded the number of home workouts for the purposes of the subsequent therapy session and the patients were required to provide accurate information, even if they did not comply with the number of workout sessions. Every therapy session with a physical therapist took 25 minutes. Current pain intensity immediately before and after each therapy session was recorded in the VAS.

The patients in Group A worked out according to the principles of ACT. Every patient in this group obtained a copy of "The Acral Press-Up Exercises for Straightened Spine" [12] and the motor patterns the patients were meant to practice at home were recorded in the patients' diaries. The motor patterns were the same for all patients, though they were potentially slightly modified to suit individual needs. The therapy included manual techniques and non-specific mobilization in compliance with ACT based on patients' individual needs. In addition, there was training on the correct motor stereotypies according to ACT. A detailed description of the involvement of particular motor patterns is included in the Appendix. The patients repeated each motor pattern ten times, possibly ten times on each side. Within their home workout they were meant to perform five motor patterns ten times, or to perform enough motor patterns that the total number of repetitions within one workout was at least 100.

The patients in Group B followed a therapy which is commonly used in the given institution and which consisted of exercises, mobilization, and soft techniques based on the patients' individual needs. Within their home workout, the patients were asked to practice all of the exercises they had mastered by repeating them ten times.

Data analysis

The measured values were processed in the software program Statistica 12. The non-parametric Mann–Whitney *U*-test was used to compare two samples and the Wilcoxon test for pair samples was applied to compare two dependent variables. In all cases, the value of $p \leq 0.05$ was considered statistically significant.

Ethical consideration

The study was approved by the Ethical Committee of Palacky University in Olomouc, Czechia.

Results

The patients from Group A and Group B did not statistically differ in their basic characteristics before therapy in terms of BMI, PRI-S, PRI-A, PRI-T, PPI, ODI score, or level of pain (VAS). Thirty patients completed the study; two patients did not complete it for health reasons and six more did not complete it because they missed the therapy sessions (Table 1).

The average difference in pain intensity parameters between the beginning and the end of the therapy was 4.7 in PRI-S, 2.0 in PRI-A, 6.6 in PRI-T, 1.4 in PPI, and 4.1 on the VAS. The control group reported an average difference of 2.6 in PRI-S, 0.4 in PRI-A, 3.0 in PRI-T, 0.6 in PPI, and 1.0 on the VAS. The reduction of pain intensity in the experimental group was very statistically significant in all measured parameters: by 72.3% in PRI-S, 95.2% in PRI-A, 77.6% in PRI-T, 66.6% in PPI, and 77.3% on the VAS. The statistical analysis determined that the differences between the experimental group and the control group in all parameters of pain evaluation according to the Short-Form McGill Pain Questionnaire – except for PRI-S – were statistically significant at the level of $p = 0.05$ (Table 2).

Table 1. Participant's characteristics at the beginning of the study

	Group A (experimental)	Group B (control)	
	(*n* = 15)	(*n* = 15)	
	Men: 3	Men: 2	
	Women: 12	Women: 13	
Characteristic	**Mean**	**Mean**	***p*-value for difference between groups**
Age	39.3 ± 6.3	45.3 ±7.1	S (0.02)
BMI	27.1 ± 5.2	27.8 ± 5.8	NS (0.87)
PRI-S	6.5	5.7	NS (0.72)
PRI-A	2.1	1.6	NS (0.88)
PRI-T	8.5	7.3	NS (0.69)
PPI	2.1	2.3	NS (0.63)
VAS	5.3	4.7	NS (0.34)
ODI (%)	26	23.8	NS (0.90)

* $p \leq 0.05$; ** $p \leq 0.01$ (Mann–Whitney U-test).
PRI-S – Pain Rating Index, sensory descriptors; PRI-A – Pain Rating Index, affective descriptors; PRI-T – Pain Rating Index, total descriptors; PPI – Present Pain Intensity; VAS – Visual Analogue Scale; ODI – Oswestry Disability Index; NS – non-significant; S – significant.

Table 2. Effect of the therapy – comparison before and after therapy and within and between groups

	Group A (experimental) (*n* = 15)			Group B (control) (*n* = 15)			
Outcome measures	**Before a study on the self esteem and academic performance among the students. *Int J Health Sci* 2018; 2(1): 1–7. Mean (SD)**	**After mean (SD)**	***p*-value for difference within the group**	**Before mean (SD)**	**After mean (SD)**	***p*-value for difference within the group**	***p*-value for difference between the groups**
PRI-S	6.5 (3.4)	1.8 (2.2)	0.000987**	5.7 (2.8)	3.1 (3)	0.018604*	0.089019
PRI-A	2.1 (2.6)	0.1 (0.4)	0.007686**	1.6 (1.8)	1.2 (1.4)	0.465209	0.046488*
PRI- T	8.5 (5.3)	1.9 (2.3)	0.000805**	7.3 (3.4)	4.3 (3.6)	0.025371*	0.027926*
PPI	2.1 (0.7)	0.7 (0.7)	0.001474**	2.3 (0.7)	1.7 (1.1)	0.032970*	0.012822*
VAS	5.3 (1.6)	1.2 (1.5)	0.000655**	4.7 (1.5)	3.7 (2.5)	0.099482	0.000906*
ODI	26 (9.8)	12.5 (9.1)	0.001206**	23.8 (10.7)	18.9 (11.7)	0.015654*	0.013590*

* $p \leq 0.05$; ** $p \leq 0.01$ (Mann–Whitney U-test).
SD – standard deviation; PRI-S – Pain Rating Index, sensory descriptors; PRI-A – Pain Rating Index, affective descriptors; PRI-T- Pain Rating Index, total descriptors; PPI – Present Pain Intensity; VAS – Visual Analogue Scale; ODI – Oswestry Disability Index.

Table 3. Average improvement in VAS during the study

	Group A		Group B	
	VAS	*Δ (%)*	VAS	*Δ (%)*
Beginning of the study	5.3		4.7	
4^{th} therapy session	2.6	51	4.5	4
6^{th} therapy session	2.7	49	3.3	30
8^{th} therapy session	1.9	64	3.5	25

VAS – Visual Analogue Scale; *Δ* (%) – difference in VAS between the beginning of the study and the 4^{th}, 6^{th}, and 8^{th} therapy sessions in %.

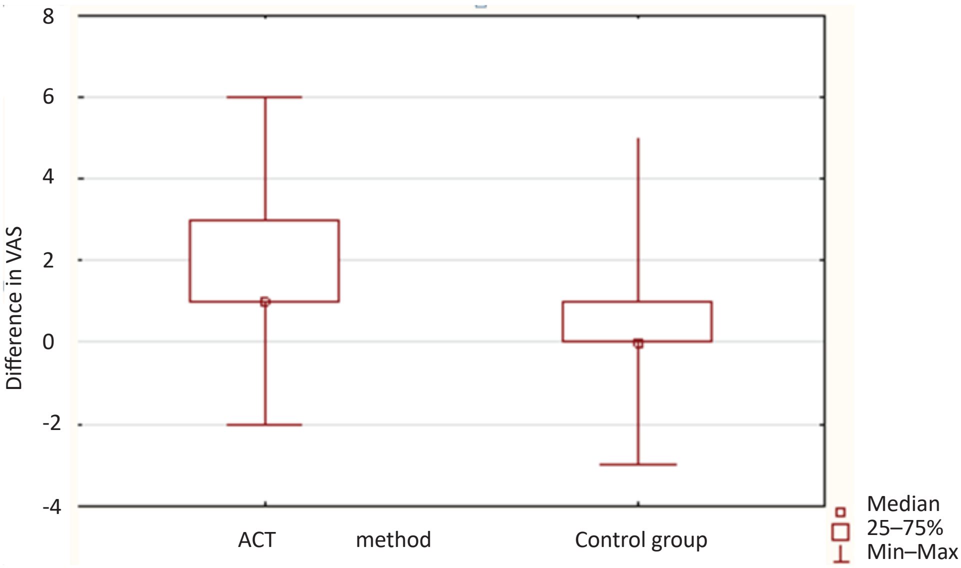

Figure 1. Difference between Group A and Group B in pain intensity immediately before and after a workout

According to the interpretation of the ODI scores, both groups fell within the category of "medium disability" (26% in Group A, 23.8% in Group B) at the beginning of the therapy.

The average difference in the decrease in ODI scores between the beginning and the end of the therapy was 13.5% in Group A and 4.9% in Group B. Statistical processing of the results revealed that the difference between the Group A and Group B was statistically significant (Table 2).

The results also indicated that the patients in Group A were recovering much faster. For example, during the second week of treatment the average improvement in the patients in the experimental group was more than 50% higher than that in the control group, where the value corresponded to 4% (Table 3).

Another parameter monitored in the study was the change in pain intensity according to the VAS immediately before and after the therapy sessions under the guidance of a physical therapist (Figure 1). The average change in pain intensity immediately before and after a workout was 1.7 in the experimental group and 0.7 in the control group. Statistical processing of the results shows that the difference between Group A and Group B was statistically significant. The values where current pain intensity immediately before and after the therapy session scored zero in the VAS were excluded from the results. Forty-four zero values were excluded in the significant group and ten in the control one.

Discussion

It is worth remembering that non-specific LBP consists in pain itself and that damage to anatomical structures is less essential in the pathophysiology. At the same time, the illness should be perceived as a functional impairment that gradually disappears when correct human body functions recover, rather than as a structural defect which is definitively resolved after removal. Treatment should mainly focus on eliminating pain and functional limitations by means of regular and lifetime movement. If there is no pain, there is no illness.

The study demonstrated that ACT statistically significantly influences pain. This difference is clinically very significant because the patients themselves consider a change of 30–35% to be a significant improvement and a change of 45–50% to be a very significant improvement [13, 14]. At the end of the therapy, more than half of the patients were completely without pain. The experimental group reached obviously better results in comparison with the control group (Table 2).

Another very important aspect of the therapy is the change in current pain immediately after a workout. If patients leave therapy sessions with less or no pain, they should be able to move normally in everyday life (i.e., the illness behavior is prevented) and their disability rate is simultaneously lower [15]. The difference in pain intensity (VAS) immediately before and after the therapy sessions was 1.7 in Group A and 0.7 in Group B. Thus, the difference between the groups was on average 1.0 in favor of Group A, and it was assessed as statistically significant ($p < 0.05$) with zero chance probability. The effect of ACT is more than twice as powerful immediately after a workout than the conventional therapy, so it has a more positive effect on patients' everyday life.

In the study the effect of the treatment on disability was also assessed. After completing the therapy, the ODI value was 12.5% in the experimental group and 18.9% in the control group. Both groups can be classified in the category of "mild disability" (0–20%) (Fairbank and Pynset, 2006). Individual authors differ in their opinions regarding the minimum clinically significant improvement, but the values range between 5.2% and 16.3% [16, 17]. The statistically significant difference between the groups amounting to 8.6% indicates that ACT can be considered more efficient than the conventional therapy in terms of reducing disability in patients with LBP.

The mechanism of action of ACT can be established on several factors. It is partly foot dorsiflexion, which is one of the most essential elements of ACT. This element can be found in many other methods (PNF, the Brunkow method, etc.). It has been observed that foot dorsiflexion activates the deep stabilization system through muscle chains. A study which focused on spine stabilization examined the effect of the combination of abdominal wall activation and foot dorsiflexion in comparison with the activation of abdominal muscles alone [18]. Another study suggests that dorsiflexion is used in PNF, where it activates the somatic core on the basis of leg muscle irradiation [19], thus helping to resist placing pressure on the spine and to eradicate pain [20]. It was found out that after eight weeks of working out, the group which practiced exercises with foot dorsiflexion claimed a significant reduction in pain and disability in comparison with the control group. The benefit of dorsiflexion is evident in this study. Another study [21] found that the combination of dorsiflexion and abdominal muscle activation resulted in a significant thickening of the transversus abdominis muscle, as measured by ultrasonography, in comparison with mere activation of the abdominal muscles. Unfortunately, there is still no evidence that ACT activates the deep stabilization muscles or thickens the transversus abdominis muscle. However, since dorsiflexion is the essential element of this therapy, the same results as in the above-mentioned studies can be expected.

Next, the spinal traction that takes place during an ACT workout can play an essential role as well. However, a systematic review [22] concluded that traction had little or no influence on pain intensity, functional conditions, or people with back pain returning to work. These studies dealt with passive traction, whether manual or instrumental. Traction within ACT, though, occurs as a result of involving whole-body muscle chains; thus, it can be more efficient and more permanent than passive traction, which is not likely to last long after standing up. As a consequence, patients can be free of pain for at least some time after a workout and they will be able to perform the movements they previously avoided. Crossover in disability is evident.

The greater effect of ACT on disability reduction can be partly explained by pain relief, partly by including motor patterns which are similar to common daily movements into the therapy. Disability can also be reduced by means of education on the correct motor stereotypies, such as lifting loads or standing up from a chair, in compliance with the ACT. An individual corrects spine straightening and pressing up on the acral parts and transfers them to their daily life according to ACT motor patterns, which results in better perception and understanding of their own body's functions.

Besides the improved functioning of the musculoskeletal system itself, the therapy also provides general whole-body muscle strengthening and exercise-induced hypoalgesia. It has been known for a long time that physical activity increases the activity of the opioid system, numbing pain at the peripheral and central levels, and that it influences patients' mental state [23]. Lubkowska and Krzepota [24] observed positive correlations in the quality of life and health behaviors of the respondents between the Psychological domain and all categories of health behaviors (HBI).

Despite the significant results found in this study, it is obvious that ACT is not a universal method in LBP treatment. What is the position of ACT in LBP therapy in comparison with other methods? The McKenzie method is efficient in LBP treatment according to the EBM (evidence-based medicine). The studies comparing this method with stabilization and strengthening exercises concluded that the method was comparable or mildly better [25–27]. The McKenzie method is successful in improving pain and disability [28], though there is a lack of evidence assessing treatment efficiency in the long run. With that in mind, it would be very interesting to compare the efficiency of the McKenzie method alone with a combination of the McKenzie method and a workout designed to develop general strength, such as the Pilates method, one which focuses on the deep stabilization system, or ACT. In connection with the results of this study, the question arises of whether ACT is an ideal method for current improvement and long-term maintenance of a pain-free state thanks to its effect on current pain and the method's strengthening nature, without the combination of other methods. In case of relapse, a workout can be more intense. In order to prevent the possible reversion of difficulties, an occasional workout (i.e., 1–2 times per week) can be sufficient after treatment. However, the long-term effect of ACT on LBP has not yet been proven.

The methods which focus on activating the deep stabilization system (isolated activation of the transversus abdominis muscle and the multifidi muscles) are significant in LBP treatment, since the abdominal wall is thought to influence spine stabilization [29]. A systematic review [7] claims that this procedure is more efficient than the minimum intervention for pain relief, but it is not liable to have a significant influence on disability in patients with chronic LBP. In comparison with other types of workout or manual therapy, this method is not more efficient. In this review, the impact on current pain intensity was not assessed and information on long-term prognosis is missing.

Acral Coactivation Therapy is useful within individual therapy sessions. Furthermore, thanks to its simplicity and clearly defined exercises which focus mainly on patients' own activities, ACT is a suitable therapy for group workout as well as self-therapy.

Limitations of the study

There are several limitations that should be taken into account. First of all, it is a small sample of patients, though it should be noted that this is a pilot study. Another limitation is the statistically significant higher average age in the control group. Next, the impact on pain and disability has not been assessed long-term. Last but not least, it would be useful to conduct a multicenter study, i.e., to have several therapists independent of each other performing the therapy in order to significantly increase the number of patients involved in the study.

Conclusions

Based on the results of this pilot study, it may be concluded that ACT is an efficient therapy for pain reduction, both immediately after a workout and in the long term. Next, ACT is suitable for reducing disability in patients with non-specific lower back pain. However, in order to prove that this method is more efficient in comparison with other commonly used procedures in LBP treatment, it is necessary to conduct other studies, preferably multicenter ones, based on a larger sample of patients, in order to compare the effect of this therapy with other procedures commonly used in clinical practice.

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