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EFFICIENCY OF MCKENZIE EXERCISES AND MANUAL THERAPY IN DISC HERNIATION

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Abstract

A herniated disc is a neurological condition of the lumbar spine, characterised by the displacement of a fragment of the nucleus pulposus into the spinal canal. In this research, we intend to follow the efficiency of physical therapy intervention in lumbar disc herniation's, by means of extension exercises described by Robin Mckenzie and manual therapy techniques applied to the lumbar spine. The research included a number of 15 subjects, diagnosed with a herniated disc, by the radiologist. In the physical therapy office, we measured disk hernia size, intervertebral disk size, Lasegue test, Oswestry Disability Index and pain level. After evaluation, the subjects underwent ten physical therapy sessions. The results obtained were analysed using Wilcoxon and Pearson statistical tests. Based on the results obtained, we identified a series of correlations between the data, that are discussed in the text. We concluded that McKenzie exercises and manual therapy are effective in reducing symptoms in subjects with lumbar disc herniation.

Keywords: Disk hernia, McKenzie, manual terapy, physical therapy

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1. Introduction

A herniated disc is a neurological condition of the lumbar spine, characterised by the displacement of a fragment of the nucleus pulposus into the spinal canal. The disc herniation incidence is increasing, affecting between 60% and 90% of the population aged between 30 and 50 years (Radlo et al., 2014). Approximately 95% of disc herniations are located at the lumbar level, L4-L5, and in 90% of cases, disc herniation is associated with nerve root compression (Wilco et al., 2011).

The first sign of disc pathology is chronic, deep, low back pain. It often disappears in the morning and worsens during the day, especially during physical activities or when adopting (bended) positions which overload the lumbar spine. If the disc herniation is in the acute stage, subjects may experience: pain in the lumbar area, numbness along the sciatic nerve pathway, and limitations in joint mobility, strength deficits, etc.).

Episodes of acute low back pain do not last more than two weeks. Approximately 70% of the herniated discs regress spontaneously and it seems that the greater the intervertebral disc lesion, the better the prognosis.

Degeneration (in the form of dehydration) of the intervertebral disc is one of the main causes of herniated discs. We would like to highlight the fact that disc degeneration precedes the most common diseases of the lumbar spine (articular facet arthrosis, spinal canal stenosis, nerve root compressions, etc.). Other risk factors that may lead to the development of herniated discs are: decreased lumbar lordosis, age, overstraining of the spine through heavy lifting, adoption and permanent maintenance of vicious positions, genetic predisposition, etc. (Adams & Roughley, 2006).

The objective diagnosis of a herniated disc is made by magnetic resonance (MRI), but in its absence, we can use physical examination and functional tests. The numbness localisation, the Lasegue test and the Slump test have been shown to be the most objective tests to evaluate subjects with disc herniation (Vroomen et al., 1999). The Lasegue sign has a sensitivity of 68% (Vucetic & Svensson, 1996) and is positive at approximately 39^0 flexion of the thigh on the pelvis (± 22 degrees), (Lebkowski, 2002).

As far as physical therapy intervention is concerned, the literature presents two main ways of treating patients with herniated discs. The first treatment is the Williams exercises, based on spinal flexion, and the second is the McKenzie exercises, based on spinal extension. The extension exercises described by McKenzie have been shown to be more effective than the flexion exercises, although short-term flexion exercises lead to faster pain relief (Nwuga & Nwuga, 1985).

The lumbar tractions are another effective method to reduce disc herniation's, as they play an important role in maintaining the height of the intervertebral disc and slowing down the degenerative process (Lai & Chow, 2010). The combination of lumbar tractions with extension exercises and muscle relaxation techniques leads to spectacular therapeutic results (Szulc et al., 2015), such as: pain and paresthesia reduction, nucleus pulposus resorption and joint amplitude improvement on the Lasegue test (Choi et al., 2015).

Unfortunately, the recovery rate for herniated discs is about 73% and in 74.6% of patients the pain does not completely disappear (Yorimitsu et al., 2001). Although disc herniation is one of the most common conditions of the lumbar spine, in the literature we identify multiple ways of treatment. The McKenzie exercises and manual therapy used in this research are two of these ways, found in the relevant

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literature. We would like to highlight that, in order to be effective, treatment must be supported by a balanced lifestyle, exercise and a set of rules regarding back posture.

2. Problem Statement

Disc herniation is one of the most common diseases of the lumbar spine. Given the increased incidence of this condition, it is necessary to study new ways of non-invasive treatment. In this paper, we propose an experimental research, in which we used McKenzie exercises and manual therapy, for the treatment of subjects diagnosed with this condition.

3. Research Questions

The research hypothesis was the following: the application of a physical therapy program, with a frequency of 2 sessions per week, for 10 sessions, based on extension exercises and manual therapy, will lead to the reduction of pain and functional impotence, caused by lumbar disc herniation.

4. Purpose of the Study

The *aim* of the research is to follow the efficiency of physical therapy intervention in lumbar disc herniations, through extension exercises described by (Mckenzie, 1997) and by manual therapy techniques applied to the lumbar spine.

5. Research Methods

5.1. Research subjects

We conducted an experimental clinical trial. The research was carried out over a 12- month period in the Physioworld physical therapy office, in Bacău. Throughout this period, we applied the physical therapy intervention and followed the subjects' evolution during the treatment. The research had a number of 15 subjects. All participants in the study were diagnosed with herniated discs by the radiologist, following an MRI (magnetic resonance imaging) examination. Of all diagnosed disc herniations, 8 were at the L5-S1 lumbar level, 6 at the L4-L5 lumbar level and one at the L2 lumbar level. There were also subjects with 2 disc herniations, the most common being at L5-S1 and L4-L5. The age of the subjects included in the research ranged from 21 to 59 years, 12 of whom were male and 3 females.

It should be mentioned that each subject was previously examined by a neurologist or neurosurgeon and the physical therapy treatment was followed according to their indication. Before starting the physical therapy treatment or during it, some of the subjects also received medication.

The research was conducted in accordance with the Declaration of Helsinki on research on human subjects and approved by the ethics committee of "Vasile Alecsandri" University of Bacău.

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5.2. Subject assessment

At the time of presentation to the physical therapist, all subjects had clinical diagnoses established by the neurologist or neurosurgeon, based on MRI images. After reading the physician's recommendations and viewing the MRI images, we personally reviewed and assessed the characteristics of the condition:

i. The size of the herniated disc, the height of the intervertebral disc and the angle of the lumbar spine. In order to obtain these values, we used the Diicom Viewer software, with which we were able to view the MRI images and take the necessary measurements;
ii. Pain intensity, according to the visual analogue scale (VAS). Subjects were asked to quantify pain intensity on a scale from 1 to 10, with 0 representing no pain and 10 representing high pain intensity (Price et al., 1983);
iii. The Lasegue test was used to identify nerve root compression (Kamath & Kamath, 2017). Range of motion was measured by using a goniometer;
iv. Level of disability, according to the Oswestry Disability Index (ODI) questionnaire. The questionnaire uses 10 questions, with 5 possible answers, which indicate the subject's level of disability, with a score ranging from 0 (mo disability) to 50 points (severe disability).

5.3. Intervention

After assessing the characteristics of the conditions for each subject, we established the treatment protocol. Each treatment session lasted 45 minutes, with a frequency of two sessions per week. The duration of treatment was five weeks for each subject. The physical therapy sessions were structured in two parts: the first part, designed to apply manual therapy techniques and the second part, designed to perform the exercises described by McKenzie.

The manual therapy treatment consisted of: combined application of massage, stretching or muscle energy techniques on the main muscle groups responsible for compression of the intervertebral disc and sciatic nerve (erector spinae, gluteus maximus, quadratus lumborum, psoas and piriformis muscles). The techniques were applied individually, with optimal dosing in relation to the patient's symptoms.

McKenzie's exercises described for the treatment of herniated discs were performed under the guidance of physical therapists. We have chosen from these to use the following:

i. supine position, diaphragmatic breathing exercises, performed for 2-3 minutes, paying particular attention to the relaxation of the muscles of the lumbar area, hip and lower limbs. This exercise was performed in order to prepare the successive exercises;
ii. prone position, with support on the forearms, the patient performed trunk extensions. The position was held for 2-3 minutes;
iii. prone position, with support on the palms, the patient performs trunk extensions and returns to the initial position. The exercise is repeated in 3 series of 15 repetitions;
iv. prone position, with support on the palms, the patient performed the trunk extension and return to the starting position. The exercise was repeated in 3 series of 15 repetitions;

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v. standing, palms on the lumbar area, the subject performed extension of the lumbar spine and return to the starting position. The exercise was repeated in 3 series of 15 repetitions.

Patients were instructed to continue performing the exercises at home every day until the end of the physical therapy sessions. The patients were also given a list of recommendations for home treatment, which was intended to optimise the effects of the treatment.

6. Findings

6.1. Results of the research

The results of the subject assessment are presented in Table 1.

Table 1. Results obtained by the subjects at the initial and final evaluation

Nr. crt	Name	Sex	HID (mm)	SHD (mm)	LCA	LTA		PI		ODI	
						I	F	I	F	I	F
1	A.A	M	11.3	11.1	56.8^0	45^0	90^0	6	1	36%	2%
2	B.G	M	13.8	6.6	37.1^0	60^0	90^0	9	2	80%	12%
3	C.C	M	9.1	10.7	42.2^0	45^0	90^0	5	0	14%	0%
4	C.D	M	14.2	7.3	29.2^0	90^0	90^0	4	0	12%	0%
5	C.M	M	8.7	8.5	30.6^0	20^0	70^0	8	0	42%	6%
6	C.R	M	11	5	51.5^0	25^0	65^0	10	2	70%	20%
7	L.F	M	10.3	3.5	45.7^0	70^0	90^0	7	1	54%	8%
8	I.I	F	3.9	9.7	42^0	35^0	80^0	9	3	58%	12%
9	M.P	M	4.4	9.3	32^0	20^0	60^0	10	3	90%	18%
10	R.M	M	10.4	12.5	25.6^0	10^0	70^0	8	1	60%	8%
11	D.G	F	9.7	4.7	41.2^0	90^0	90^0	3	0	14%	0%
12	D.L	M	12.3	4.4	31.2^0	90^0	90^0	2	0	10%	0%
13	R.N	M	9.85	6.7	29^0	25^0	80^0	9	2	64%	14%
14	N.I	F	10.3	5.6	39^0	50^0	90^0	5	1	44%	4%
15	C.V	M	9.1	3.2	32.8^0	90^0	90^0	3	0	8%	0%
Mean Value	-	-	11	5	35.5^0	51^0	82^0	6.5	1.06	43	6

Legend: HID = intervertebral disc height, SHD = the size of the herniated disc, LCA = Lumbar curve angle, LTE_I = Lasegue test initial value, PI_I = pain intensity initial values, ODI_I = Oswestry Disability Index initial value.

6.2. Statistical data analysis

Statistical data analysis was performed by using the IBM SPSS Statistics software. For the analysis of the obtained results, we applied the Wilcoxon test and the Pearson correlation.

The Wilcoxon test (Table 2) was applied for the assessment tests where we performed initial and final testing, in order to highlight the differences obtained at the beginning and at the end of the therapeutic protocol.

The Pearson correlation (Table 3) was applied to all the baseline values we obtained so as to identify a number of functional links between the parameters assessed.

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Table 2. Wilcoxon test results for the Lasegue test, pain level and low back pain disability questionnaire

No.	Statistical indicator	Initial average value	Final average value	Wilcoxon	Sig.	Effect size
1.	LTE	51	82	-2.946	P < 0.05	0,76
2.	PI	6.5	1	-3.481	P < 0.05	0,88
3.	ODI	43.7	6.9	-3.410	P < 0.05	0.88

Legend: LTE = Lasegue Test, PI = pain intensity, ODI = Oswestry Disability Index, Sig. = significance level.

Using the Wilcoxon test, we compared the initial and final values of the Lasegue test, the pain level and the lumbar disability questionnaire.

The initial mean values of the Lasegue test (Mdn = 51^0) were lower compared to the final mean values (Mdn = 82^0). The Wilcoxon signed rank test indicated a statistically significant difference between the two assessments ($Z = -2.946$, $p < 0.05$, $R = 0.76$).

The initial mean pain level values (Mdn = 6.5) were lower compared to the final mean values (Mdn = 1). The Wilcoxon signed rank test indicated a statistically significant difference between the two ratings ($Z = -3.481$, $p < 0.05$, $R = 0.88$).

The initial average values of the disability questionnaire (Mdn = 43.7) were lower compared to the final average values (Mdn = 6.9). The Wilcoxon signed rank test indicated a statistically significant difference between the two assessments ($Z = -3.410$, $p < 0.05$, $R = 0.88$).

Table 3. Person correlation for disc hernia values and functional tests

Pearson Correlations						
	HID	**SHD**	**LCA**	**LTE_I**	**PI_I**	**ODI _I**
HID	1					
SHD	-.278	1				
LCA	-.002	-.037	1			
LTE_I	.449	-.648**	.015	1		
PI_I	-.369	.372	.083	-.825**	1	
ODI _I	-.302	.236	.041	-.709**	.931**	1

Legend: HID = intervertebral disc height, SHD = the size of the herniated disc, LCA = Lasegue test initial value, PI_I = pain intensity initial values, ODI_I = Oswestry Disability Index.

Following the data analysis presented in Table 3, we identified a number of correlations as follows:

i. negative correlation between disc herniation size and the Lasegue test (r = -0.684);
ii. negative correlation between the Lasegue test and pain level (r = -0.825);
iii. negative correlation between the Lasegue test and the Lumbar Disability Questionnaire (r = -0.709);
iv. positive correlation between pain values and the lumbar disability questionnaire (r = 0.931).

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6.3. Discussions

Both in the current research and in the research found in the literature, we have identified a number of risk factors, which may be responsible for the development of disc herniations (body mass index, smoking, physical activity level, work place, etc.). Counteracting these risk factors, together with a physical therapy rehabilitation programme, is one of the best treatments for the prevention and treatment of disc herniations (Huang et al., 2016).

Most of the subjects with chronic low back pain show significant changes in the height of the intervertebral disc (most often at L4-L5 and L5-S1), which are visible radiographically or on MRI. The intensity of the pain and its radiation pattern can be correlated with the size of the herniated disc, but in our research, we did not find a correlation between the two functional parameters mentioned, probably due to the limited number of subjects.

The limited number of subjects prevented us from finding a direct correlation between the size of disc herniation and the height of the intervertebral disc. We could say that this correlation is natural, as long as the nucleus pulposus is mainly composed of water, and water is not compressible (Volkan & Gökhan, 2019). Therefore, explusion of the nucleus pulposus within the vertebral canal also results in a decrease in intervertebral disc height.

We tend to believe that, following a rehabilitation programme, the size of the herniated disc is reduced. In fact, an eight-year study of patients with herniated discs found that: 65% of herniated discs remained unchanged, 17.5% reduced in size, 12.5% increased in size, and 5% fluctuated (Kjaer et al., 2016). This information is particularly important and makes us think that, the effect of physical therapy treatment on disc herniation size is only temporary, because imaging suggests regression of disc herniations after the application of physical therapy and lumbar traction programmes (Ozturk et al., 2006).

The ideas mentioned above have led us to draw the following conclusion: during treatment, the size of the herniated disc can be reduced. In the long-term, if the subject does not change his or her lifestyle with regard to the risk factors that can result in a herniated disc, it will maintain the same size.

Before conducting this research, we considered that the angle of lumbar curvature is directly related to most of the functional parameters assessed. In fact, neither in this research nor in other research we have found, no connections have been identified between lumbar lordosis and pain level (Proskura & Sobera, 2019; Shortz & Haas, 2018), which suggests that lumbar lordosis is just another risk factor that, eventually, may cause disc herniation.

We would also like to point out that the size of the herniated disc is not a predictor of whether patients will undergo surgery (Gupta et al., 2020), which is why most neurosurgeons recommend conservative treatment in the first stage.

The final Lasegue test values had an improvement of 31^0 amplitude from the baseline value. Correlation analysis of the initial values shows a direct correlation between the Lasegue test values and disc herniation size. The larger the disc herniation values, the smaller the Lasegue amplitude test. This shows that the intervertebral disc irritates the nerve root during mobilisation of the lower limb. For the subjects we evaluated, the Lasegue test was objective, but the test sensitivity values varied between 28% (Miranda et al., 2021), 67% (Rabin et al., 2007) and 91% (Devillé et al., 2000) depending on the author. If

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we are unsure of the results obtained by the Lasegue test, the literature also refers to the Slump test, which is said to have a higher sensitivity and specificity than the Lasegue test (Majlesi et al., 2008).

In terms of the efficiency of the applied physical therapy programme, it resulted in an 85% improvement of the Oswestry Disability Index values from baseline. Al-horani et al. (2020) report a 44% improvement in symptoms in patients with disc herniation after following a Mckenzie exercise-based physical therapy programme. In our research, greater symptom improvement (85%) was probably achieved due to the application of manual therapy techniques. Improvements in Oswestry Disability Index values also occurred after the application of McKenzie exercises in cases of recurrent disc herniations (Morris, 1999), as well as in the application of exercises designed to increase lumbar stability (Ye et al., 2015).

The recovery programme applied had a positive effect on pain levels. At the final assessment, only one subject reported a pain level of intensity 3, which is mild pain. Most research that has followed the pain level of the subjects reports decreases in pain. At the same time as pain relief, exercise leads to increased spinal mobility and improved Lasegue test values (Cheng et al., 2020; Hawrylak et al., 2021).

7. Conclusions

Following the research, we can draw a series of conclusions:

i. disc herniation is a neurological condition of the lumbar spine, which in order to be properly treated requires a multidisciplinary therapeutic intervention based on multiple measurements;
ii. given the multiple risk factors we have identified, patient involvement in recovery is fundamental to the success of treatment;
iii. all the assessment tests helped to establish an objective functional diagnosis, which is particularly important for the subsequent development of the recovery programme;
iv. the initial hypothesis that “the application of a physical therapy programme, with a frequency of 2 sessions per week for 10 sessions, based on extension exercises and specific manual therapy means, will decrease the pain and functional impotence caused by the lumbar disc herniation” was confirmed.

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