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# THE IMPORTANCE OF MUSCLE STRENGTHENING IN TREATING DISC-CAUSED LUMBALGIAS

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**Abstract**

*Objective.*The purpose of this research is to prove the effectiveness of the muscle strengthening techniques in regards to diminishing the symptoms of disc disorders in the lumbar spine.

*Methods.*The group of subjects consisted of 6 patients with lumbalgia, with various social background, close age, and professions that demand constantly their dorsal-lumbar muscles. Each subject benefited from 30 physical therapy sessions, conducted three times per week, with one or two days break, in order to prevent muscle and joint overwork. They were chosen according to the following criteria: a common clinical diagnosis - lumbalgia; no contraindications for the physical therapy treatment (heart or respiratory disorders, other types of diseases, etc.); the patients are not in the inflammatory phase; no invalidating diseases; their agreement for the physical therapy treatment.

The methods and techniques that were applied were carefully particularized and individualized according to the patients' symptoms, both at the beginning and over the course of the treatment or sessions.The evaluation tests were the Visual Analog Scale, the joint assessment and the muscle testing.

*Results.*The VAS results, realized through the palpation of the injured areas (ligaments and muscles) show a diminished pain after the strengthening sessions. One can see that following the strengthening exercises, the range of motion was also improved by a few degrees in every direction, which represents both diminished pain reflex contractures in the extensor muscles, and a thinning of the ligament capsules. During the final testing of muscle strength, all subjects recorded a positive score, this aspect being the result of the analytical application of the specific muscle strengthening techniques on each muscle group. The best results recorded by the subjects were in regards to their back muscles, the quadriceps and hamstrings, which means that at the end of the intervention, the patients were able to easily perform eccentric contractions outside the segment, and plyometric contractions.

*Conclusions.*The initial hypothesis was confirmed, thus an adapted and particularized strengthening program had beneficial effects, helping to diminish the pain, reduce the contractures, maintain the strength and correct the muscle imbalances. The correct and complete evaluation of the spine, pain, and the functional status caused by the consecutive disability in patients with lumbalgia is an important component in the rehabilitation program, for this being emphasized the need to use standardized scales through which one can quantify and compare the recorded progress.

*Key Words:*strengthening, spine, muscle imbalance.

## Introduction

Lumbalgia is a pain symptom for which one cannot establish always a direct connection between the importance given by the patient to this illness and the anatomical-pathological modifications of the spine (Kiss, 2002). Pain causes muscle tension, which in turn intensifies stress, the latter increasing the physiological answer through muscle tension, thus forming a vicious circle: stress - spasm (muscle tension) - pain - spasm (Simons and Mense, 2003). The somatic manifestations depend both on the etiopathogenesis of the disease and on the psychological interpretation of the nociceptive message. The lumbar pain associated with a radicular syndrome constitutes over 50% of the cases with this kind of pain. The symptoms appear when the disc compresses a nervous ending in the vicinity, causing a segmental radiculopathy. This consists in paresthesia and weakness in the distribution areas of the injured root (Brooks and Faulker, 1988). Another common symptom in the case of lumbalgia is muscle contracture caused by a nociceptive reflex that goes on the exteroceptor polysynaptic pathways, increasing the answer of the alpha motor neurons. This contracture can be considered the result of a vicinity pathological cause and thus it must be

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cared to until the cause is removed (Mense and Gerwin, 2010). In the case of disc-caused lumbalgias, there is a muscle imbalance, the pathological muscle hypotonia is a pathogenic factor in the static and dynamic disorders of the musculoskeletal system. It generates joint laxity and negatively influences the voluntary control ability and reflex command of skeletal muscles by reducing the excitability and contractility of the hypotonic muscle. Saltin and Gollnick proved that "after a few weeks of training, modifications occur in the properties of muscle fibers, which means changes in their typology. Reversely, under pathological conditions there is muscle deconditioning due to the absence of a certain level of physical activity that translates in the increase of type II (b) fibers" (Sullivan and Green, 1990). The muscles with a high amount of type I fibers have a high oxidative capacity and take a longer time to get tired, but they also produce a lower power. These characteristics makes these fibers to be considered the most efficient. The muscles with a high amount of type II fibers produce higher power, they contract faster"(Brook and Faulkner, 1991).

**Methods**

This study has used the following research methods: the analysis method, through the study of the professional literature; the observation method; the inquiry method; the case study method; the experiment method; the evaluation and exploration method; the recording, analysis, and graphical representation and tabulation method; the statistical-mathematical method.

This study started from the hypothesis that the application of correctly individualized and adapted strengthening techniques can help diminish the pain, by correcting the muscle imbalances, thus preventing the formation of pain reflex positions.

The research was conducted on a group of 6 subjects with disc-caused lumbalgia of various etiologies. They were chosen according to the following criteria: a common clinical diagnosis - lumbalgia; no contraindications for the physical therapy treatment (heart or respiratory disorders, other types of diseases, etc.); the patients are not in the inflammatory phase; no invalidating diseases; their agreement for the physical therapy treatment.

Table 1 shows that the selected subjects had varied social backgrounds, a close age, and professions that demand constantly their dorsal-lumbar muscles. Each subject benefited from 30 physical therapy sessions, conducted three times per week, with one or two days break, in order to prevent muscle and joint overwork. The methods and techniques applied during the treatment were carefully particularized and individualized according to the subjects' symptoms, both during and over the course of the treatment or sessions.

**Table 1.** The group of subjects

| No. | Initials | Age | Gender | Clinical diagnosis | Profession |
|---|---|---|---|---|---|
| 1. | S.P. | 32 | M | Lumbar discopathy, lumbar rectitude dorsal S-curve scoliosis | Economist |
| 2. | F.O. | 40 | M | L5-S1 lumbar polydiscopathy, slight lateral L1-L2 disc tight pain | Truck driver |
| 3. | B.A. | 39 | F | L5-S1 lumbar discopathy. Overwork syndrome. Slight dextroconcave scoliosis of the lumbar spine with a maximum point at L2-L3; slight reduction of the L5-S1 intervertebral space height | Lawyer |
| 4. | M.B. | 32 | M | Moderate median L4-L5 disc protrusion without obvious signs of radicular conflict | Salesman |
| 5. | B.S. | 25 | F | T12-L1 lumbar polydiscopathy | Saleswoman |
| 6. | N.H. | 39 | M | L4-L5 lumbar polydiscopathy, dextroconvex scoliosis of the lumbar spine with tight pain in L2-L3, profile rectitude | Accountant |

The assessment used the static examination of the spine, the Visual Analog Scale (Mungiu, 1999), the joint assessment, spine mobility tests, muscle strength tests. At the end of the evaluation, a functional diagnosis was established for each subject.

The physical therapy objectives were to: diminish pain; reduce the pain reflex contractures; correct the muscle imbalances; improve the joint mobility; prevent the pain reflex positions; reestablish the adequate control of the patients' movements.

The following rules were followed during the strengthening programs: the endurance value was smaller, equal or higher than the strength of the muscles that contract to perform a movement. An endurance smaller than the muscle strength allowed the performance of a short movement. An endurance equal to the muscle strength transforms this dynamic kinetics technique into a static one (isometrics). An endurance higher than the muscle strength allowed the performance of a longer movement, this being gradually diminished from the beginning to the end of it. Also, the exercises were observed so that there are no negative repercussions on movement coordination.

To improve the muscle strength each important muscle group was worked on analytically, but also on a whole, at fitness devices and with various materials such as: gym-balls, elastic ropes, TRX system, extensors, etc. Thus, in the back area, the muscles strengthened were the latissimus dorsi, the rhomboids, the quadratus lumborum; in the hip, the gluteus muscles, the iliopsoas, the pelvitrochanteric muscles, the tensor fascia lata; and in the legs, the adductor muscles, the quadriceps, the hamstrings, the sartorius. To achieve this specific objective, the concentric and eccentric isotonic contraction were chosen, for the inside and outside of the contraction segment, and the plyometric isometric contraction. This way, the muscles work more than the movement of the segment would require. The muscle tension is increased, and as a result, the strength is increased with its hypertrophy, a process in direct correlation with the value of the muscle tension increase. When the muscle tension was increased, the isometric contraction maintained for 6-8 seconds was introduced, at the maximum range of motion. As the opposite resistance of the muscle was increased, an increasingly higher number of motor units were recruited in the effort to defeat this resistance. The following procedures were used to increase the physical effort intensity: getting a larger effort from the subject by using performances against gravity; performing the movements outside the contraction segment; the use of various mobile objects (ropes, medicine balls, dumbbells, etc.); the use of traction (elastic ropes, extensors) and pressure (dynamometers, springs, etc.) devices; performing the exercises at specific devices (cycle ergometer, treadmill, Swedish ladder, gymnastics bench, etc.). Also, the progress was dictated by the increase in the number of repetitions, of the weights used according to the aim: based on the rule "high resistance - low rhythm; low resistance - increased rhythm". Of course, the rhythm was fixed according to the objectives, taking into account also other parameters (age, training level, when pain was felt, etc.).

The therapeutic programs were particularized and adapted according to the symptoms, contraction force, results obtained after the first sessions, heart rate and blood pressure recorded at the beginning and throughout the effort, when pain was felt, etc.

**Results**

This subchapter analyzes the results recorded by the subjects, and calculates the averages of the results recorded after the initial and final assessment. The values recorded in the tables emphasize several aspects regarding the effectiveness of muscle strengthening in treating disc-caused lumbalgias.

Visual Analog Scale results

The VAS assessment is subjective because it allows the subjects to communicate their pain intensity from their perspective; the more intense the pain is (8 - 10/10), the more one must take into consideration the individualization of the treatment, and the patient must be questioned over the entire course of a treatment session, the main reason being the way in which each subject perceives pain, this being influenced by the patient's disorder symptoms and in some cases, his particularities. Thus, one can see in figures 1 and 2 that pain was diminished in all patients, from values close to exacerbated pain (8, 9) to low intensity (1, 2), or even zero.

**Table 2.** Visual Analog Scale results

| Initials | Muscle pain | | | | | | Ligament pain | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Piriformis | | Quadratus lumborum | | Paravertebral muscles | | Sacroiliac ligament | | Iliolumbar ligament | |
| | *I.T.* | *F.T.* | *I.T.* | *F.T.* | *I.T.* | *F.T.* | *I.T.* | *F.T.* | *I.T.* | *F.T.* |
| S.P. | 9 | 2 | 7 | 2 | 8 | 1 | 6 | 2 | 5 | 2 |
| F.O. | 8 | 1 | 6 | 1 | 7 | 1 | 4 | 1 | 6 | 2 |
| B.A. | 7 | 1 | 7 | 2 | 8 | 2 | 4 | 1 | 4 | 1 |
| M.B. | 8 | 2 | 9 | 1 | 8 | 3 | 5 | 2 | 5 | 1 |
| B.S. | 9 | 1 | 9 | 1 | 8 | 2 | 3 | 2 | 5 | 2 |
| N.H. | 7 | 1 | 8 | 2 | 8 | 2 | 4 | 1 | 6 | 1 |

The VAS results, realized through the palpation of the injured areas (ligaments and muscles) show a diminished pain after the strengthening sessions. Thus, subjects S.P., B.A., M.B. and B.S. have felt during the initial palpation a more intense pain, marked with 8 and 9, in the piriformis muscle, while patients B.A. and N.H. have marked it with 7. Also, during the palpation of the quadratus lumborum and paravertebral muscles, subjects M.B. and B.S. have marked their pain with 8-9. One can see in table 2 that at the end of the intervention the subjects' state has improved, marking their pain between 1 and 2, describing it as a slightly uncomfortable sensation that does not encumber their daily life activities. During the palpation of the ligaments, the pain was of a lower intensity than in the muscles, all patients marking it between 4 and 6, then after the treatment, with values between 1 and 2.

- The joint assessment results for the experimental group

**Table 3.** Results of the joint assessment

| Initials | Joint assessment | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flexion | | Extension | | Lat.-R inclin. | | Lat.-L inclin. | | R rotation | | L rotation | |
| | I.T. | F.T. | I.T. | F.T. | I.T. | F.T. | I.T. | F.T. | I.T. | F.T. | I.T. | F.T. |
| S.P. | 63° | 75° | 15° | 20° | 18° | 27° | 15° | 24° | 17° | 25° | 20° | 27° |
| F.O. | 45° | 65° | 10° | 18° | 13° | 20° | 16° | 23° | 18° | 25° | 22° | 28° |
| B.A. | 60° | 70° | 13° | 23° | 15° | 22° | 18° | 26° | 25° | 32° | 27° | 37° |
| M.B. | 60° | 68° | 16° | 19° | 20° | 23° | 15° | 20° | 18° | 22° | 20° | 23° |
| B.S. | 50° | 55° | 10° | 15° | 15° | 18° | 13° | 19° | 15° | 20° | 17° | 22° |
| N.H. | 48° | 54° | 15° | 17° | 13° | 18° | 18° | 22° | 22° | 27° | 24° | 28° |

Subject S.P.had initially a limitation in all motiondirections, more accentuated in flexion ($63^0$), in left lateral inclination ($15^0$) and in right rotation ($17^0$). During the final testing all values have improved, as follows: the flexion, by $12^0$, the extension by $5^0$, the right and left inclinations by $9^0$, the right rotation by $8^0$, and the left rotation by $7^0$.

Subject F.O.,because of vertebral posterior tight pain, recorded initially during extension very low values ($10^0$). Following the treatment, there was an improvement in the range of motion by $20^0$ in flexion, by $8^0$ in extension, $7^0$ in right and left lateral inclination and in right rotation, and $6^0$ in left rotation.

Subject B.A. also had a positive progress, in the sense of increasing the dorsal-lumbar spine mobility, due to the symptoms diminishing, as follows: $10^0$ in flexion, extension and left rotation, $7^0$ in lateral inclination and right rotation, $6^0$ in left lateral inclination.

Subject M.B.had initially a limitation in all motiondirections, more accentuated in flexion ($60^0$), in left lateral inclination ($15^0$) and in right rotation ($18^0$). During the final testing all values have improved, as follows: the flexion, by $8^0$, the extension by $3^0$, the right lateral inclination by $3^0$, the left one by $5^0$, the right rotation by $4^0$, and the left rotation by $3^0$.

Subject B.S.,recorded initially in flexion $50^0$, extension $10^0$, right lateral inclination $15^0$, left $13^0$, right rotation $15^0$ and left rotation $17^0$. Following the program, there was an improvement in the range of motion by $5^0$ in flexion and in extension, $3^0$ in right lateral inclination, $6^0$ in left lateral inclination, and $5^0$ in right and in left rotation.

Subject N.H. also had a positive progress, in the sense of increasing the dorsal-lumbar spine mobility, as follows: $6^0$ in flexion, $2^0$ in extension, $6^0$ in right lateral inclination, $4^0$ in left lateral inclination, $5^0$ in right rotation, and $4^0$ in left rotation.

One can see that following the strengthening exercises, the range of motion was also improved by a few degrees in every direction, which represents both diminished pain reflex contractures in the extensor muscles, and a thinning of the ligament capsules.

The following results were recorded during the manual examination of the muscle strength:

**Table 4.** Initial-final muscle strength test results

| Tested muscles | Results | S.P. | F.O. | B.A. | M.B. | B.S. | N.H. | Arithmetical mean | |
|---|---|---|---|---|---|---|---|---|---|
| Latissimus dorsi | **I.T.** | 4 | 3 | 3 | 3 | 4 | 3 | **I.T.** | 3.33 |
| | **F.T.** | 5 | 4 | 4 | 4 | 5 | 3.66 | **F.T.** | 4.28 |
| Rhomboids | **I.T.** | 4 | 3 | 3 | 3 | 4 | 3 | **I.T.** | 3.33 |
| | **F.T.** | 5 | 4 | 4 | 4 | 5 | 4.5 | **F.T.** | 4.42 |
| Quadratus lumborum | **I.T.** | 4 | 3 | 4 | 4 | 4 | 3 | **I.T.** | 3.66 |
| | **F.T.** | 5 | 3.66 | 5 | 4.5 | 5 | 4.5 | **F.T.** | 4.61 |
| Gluteus muscles | **I.T.** | 4 | 3 | 4 | 3.66 | 4 | 3.33 | **I.T.** | 3.67 |
| | **F.T.** | 5 | 3.33 | 4.5 | 4 | 5 | 4.5 | **F.T.** | 4.39 |
| Iliopsoas | **I.T.** | 4 | 3 | 3 | 3 | 4 | 4 | **I.T.** | 3.5 |
| | **F.T.** | 4.5 | 4 | 4.5 | 4 | 4.5 | 4.5 | **F.T.** | 4.33 |
| Pelvitrochanteric muscles | **I.T.** | 3.66 | 3.66 | 3.66 | 3 | 4 | 3 | **I.T.** | 3.50 |
| | **F.T.** | 4 | 4.5 | 4.5 | 4.5 | 4.5 | 4 | **F.T.** | 4.33 |
| Tensor fascia lata | **I.T.** | 3.66 | 3.66 | 3.33 | 3 | 3 | 3.33 | **I.T.** | 3.33 |
| | **F.T.** | 4.5 | 4.5 | 4.5 | 3.66 | 4 | 4.5 | **F.T.** | 4.28 |
| Adductor muscles | **I.T.** | 3.66 | 3 | 3.66 | 3 | 4 | 3 | **I.T.** | 3.39 |
| | **F.T.** | 4.5 | 4.5 | 4.5 | 4 | 4.5 | 4 | **F.T.** | 4.33 |
| Quadriceps | **I.T.** | 4 | 3 | 4 | 3 | 4 | 3 | **I.T.** | 3.5 |
| | **F.T.** | 4.5 | 4.5 | 4.5 | 4 | 4.5 | 4 | **F.T.** | 4.33 |
| Hamstrings | **I.T.** | 3 | 3 | 3 | 3 | 3 | 3 | **I.T.** | 3 |
| | **F.T.** | 3.66 | 4 | 4 | 3.66 | 4 | 3.66 | **F.T.** | 3.8 |
| Sartorius | **I.T.** | 4 | 3 | 3 | 3 | 3 | 3 | **I.T.** | 3.20 |
| | **F.T.** | 5 | 4 | 4 | 4 | 4 | 3.66 | **F.T.** | 4.11 |

Table 3 shows that during the final testing of muscle strength, all subjects recorded a positive score, this aspect being the result of the analytical application of the specific muscle strengthening techniques on each muscle group. The best results recorded by the subjects were in regards to their back muscles, the quadriceps and hamstrings, which means that at the end of the intervention, the patients were able to easily perform eccentric contractions outside the segment, and plyometric contractions.

**Discussion**

The initial hypothesis was confirmed, thus an adapted and particularized strengthening program had beneficial effects, helping to diminish the pain, reduce the contractures, maintain the strength and correct the muscle imbalances. The correct and complete evaluation of the spine, pain, and the functional status caused by the consecutive disability in patients with lumbalgia is an important component in the rehabilitation program, for this being emphasized the need to use standardized scales through which one can quantify and compare the recorded progress. During the research, some results were recorded objectively, by evaluating the range of the dorsal-lumbar spine in degrees, this offering exact numbers regarding the muscle and joint functionality at the moment of the test. After the lumbar pains diminished, the range of motion in all movement directions was also improved. The beneficial effects recorded by these treatment methods have appeared in a short period of time, with visible results from one session to another, and which have lasted over the time.

**References**

Brooks, S.V., Faulker, J.A., 1988, Contractile properties of skeletal muscle from young, adult and aged mice, Journal Psysiology, 404: 71-82.

Kiss, I., 2002, Fizio-kinetoterapia şi recuperarea medical în afecţiunile aparatului locomotor, Bucharest: Medicală.

Lisbeth H., Kongsted A., Hestbaek L., 2015, Clinical examination findings as prognostic factors in low back pain: a systematic review of the literature, Chiropr Man Therap., 23: 13.

Mense S., Gerwin R.D., 2010, Muscle pain Diagnosis and Treatment, Berlin: Springer-Verglas, 86-100.

Mungiu O.C., 1999, Algeziologie generală, Iaşi: Polirom.

Richard A. Deyo, M.P.H., Sohail K. M., Judith A., Turner M., Brook I. M., 2009, Overtreating Chronic Back Pain: Time to Back Off?, J Am Board Fam Med., 22(1): 62-68.

Simons D.G., Mense S., 2003, Diagnosis and therapy of myofascial trigger points, Schmerz, 17(6):419-24.

Sullivan, M.J., Green, H.J., Cobb, F., 1990, Skeletal muscle biochemistry and histology in ambulatory patients with long-term heart failure, Journal Circulation, 81:518-527.