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**Original Article**

# A complex approach to musculoskeletal dysfunction in the spine

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**Abstract**
Chronic back pain is a common conditionand it is a well-recognised public health burden.A number of studies have reported different methods for treatment of chronic pain syndrome in the spine, because it turns out to be a serious problem.The present researchaims to perform functional study and approve author's kinesitherapeutic methodology in patients with musculoskeletal dysfunction in the spine. **Methodology:**The methodology of the study includes conducting functional studies and tests - anamnesis, somatoskopy, Schober, Ott, Laseg test and Visual Analogue Scale for pain.Contingent of 81 participants were recruited according to the indications of experimental complex therapy and randomly divided in two– experimental group (N=44) and control group (N=37). The complex therapy for the experimental group includes - MLS-laser therapy, manual mobilizations of the soft tissues and specialized exercise.The control group receivedthe same treatment except MLS-laser therapy. Every participant received 10 procedures for 10 consecutive days. **Results:**Mean values of the Ott and Schober test, measured before and aftertherapyfor experimental group was 2.44±0.45cm and 4.18±0.67cm of the Otttest and 1.64±0.44cm and 2.88±0.66cm of Schober test. In control group was respectively 2.42±0.45cm and 2.53±0.44cm of Ott test and 1.57±0.44cm and 1.80±0.53cm of Shober test. Data obtained of Lasegue test in experimental group was67.45±4.05°before and 82.64±3.87°after therapy, while in control group it was 67.16±4.17° before and 69.73±3.90°. Mean values of pain threshold measured before the complex therapy for patients with musculoskeletal dysfunction in the spine was 9.0±0.99mm before and 1.52±0.85mm aftertreatment for experimental group and 8.56±0.98mm and 7.08±1.09mm for control group. Data demonstrates statistically significant differences after treatment ($p<0.05$).**Conclusions:**The significant reduction of pain and muscle spasm during treatment in experimental group improves range of movement and functionality of lumbar spine for patients with this pathology.Data shows the effectiveness and positive impact of the enclosed comprehensive approach including MLS-laser therapy to patients with musculoskeletal dysfunction in the spine.
**Key words:** laser, physiotherapy,backpain, treatment

## Introduction

In recent years, there has been a steady increase in morbidity among the working population, which is reflected in the increasing need for development and improvement of the rehabilitation treatment system.Every person at least once in his or her life experiences discomfort during movement or pain in the spine.The load on the spine is not only when sitting, but also when running and lifting weights.Disease characterized by musculoskeletal pain (MSP) are among the major medical and social problems. MSP associated with nonspecific changes in the spinal structures and paravertebral muscles is the most common type of back pain.There are a number of risk factors for developing back pain.This pathology is a source of suffering and one of the most common causes of short-term or permanent disability.

Painis a major pathogenic factor limiting joint functionin acute conditions and leads to the appearance of"muscle guard" (protective muscle reaction). Although many studies have identified factors associated with improved back pain (Kentetal. 2008), but few have looked at those who predict improvement of specific treatment. Three of the most common causes of musculoskeletal dysfunction associated with spinal cord (cervical, thoracic or lumbar portion) are: chronic cervical pain, without further complications, back pain, and pain of the lumbar region, with a corresponding frequency of 18%, 17.7% and 36% (Gerhardtetal. 2014; Hoyetal.2012). These three pathologies have a negative impact on quality of life of the patient, creating a significant economic and social burdens. Musculoskeletal dysfunctions are the second cause of early retirement due to loss of earning capacity just after mental disorders in recent years (Buchbinderet. al.2013). In approximately 90% of cases of back pain cannot identify specific structural generator of pain and thus structural diagnosis cannot guide treatment decisions. Furthermore, back pain often repeat or continue, so clinicians and patients often expect the pain to be cured, but expectations are not met and the diagnosis and treatment are put


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into question The nature of the patient, the constant mental stress and negative social aspects of their life, can be a primary cause of pain in the spine (Bunzli et. al. 2015).

Various studies have been conducted in an attempt to determine effective methods for conservative treatment of musculoskeletal pain associated with non-specific changes in the spinal structures and paravertebral muscles (Hartvigsen et. al. 2018; Croft et. al. 2015; Foster et. al. 2018).

Zdrodowskaet.al.(2014)investigated the effect of laser therapy and magnetic therapy on the level of pain and the volume of movement of the spine in patients with osteoarthritis in the lumbar region. As a result of their research, the authors report positive results from the application of both types of therapy. However, a more in-depth analysis proves that laser therapy is more effective in relieving pain symptoms(Zdrodowskaet.al. 2014).

Song et.al.(2018)in their comparative study of the effect of high-frequency laser therapy in patients with musculoskeletal dysfunction of the spine, considered 11 studies involving 736 patients. As a result of this study, the authors prove that patients with thoracic and cervical pain respond extremely well to the applied treatment and it is significantly effective (Song et.al. 2018).

In his pilot study Kupeev demonstrated a positive effect on the reduction of pain symptoms in patients with chronic thoracic pain by applying bioactive substances lazarphoresis for the combined treatment of such patients (Kupeev, 2018).

However, there is limited evidence to support the use of manual therapy, including massage, osteopathic manipulative therapy, and MLS laser therapy as an option for managing musculoskeletal dysfunction in the spine. Many systematic studies summarize the results obtained so far after the application of various manual methods for non-specific lumbar pain. The majority of studies do not report a solution to the problem in the longer term.

The present researchaims to perform functional study and approve author's kinesitherapeutic methodology in patients with musculoskeletal dysfunction in the spine.

**Material and Methods**

*Participants*

A contingent of 81 participants were included in the study. All they met the inclusion criteria,according to the indications for the application of the experimental methodology and were randomly divided in two experimental and a control groups. The experimental group consists 44 participants (21 women and 23 men) mean age ($\overline{X}$±SD) for women 51.90±8.50 years, and 52.87±4.46 years for men. The control group was formed of 37 participants (17 women and 20 men) mean age for women 49.29±4.67 years, and 51.90±3.65 years for men. Functional tests and physiotherapy procedures were performedfor the period of September 2018 to December 2019 in the Research Sports and Recreation Center "Bachinovo" South-West University "Neofit Rilski", Blagoevgrad. All participant involved in the research signed a statement of informed consentthat was approved by the Ethics Committee of the SWU "N. Rilski".

*Test protocol and Instruments*

The methodology of the study included functional assessment and tests –clinical history, somatoskopy (view), Schober test, Ott test, Lasegue test and Visual Analog Scale of the Pain (VAS).

***VAS***is a subjective scale from 0 to 10 for assessment of pain threshold, where 0 is no pain, and 10 is unsupportable pain. Testing were doneafter experimentally induced palpable pain (measurements were doneat the same pressure, the same person) in TT and evaluated of the patient.

***Schober test*** is a functional test used to measure the range of movement in the lumbar spine. From L5, 10 cmare measured in the cranial direction. The patient performs flexion of the body. At full range of movement the distance between the two points increases by about 3.5 - 4 cm, when there is limited mobility the distance increases by 1 - 2 cm or does not change in more serious pathology.

***Ott test***is a functional test used for examine toracic spine mobility. The test is donefrom a standing position. We measured a distance of 30 cm from the processusspinosus of TH1 caudally. The therapist notes the upper and lower vertebrae. The patient performs full flexion, and in this position the therapist measures the same distance again. Normally, at full range of movement, the distance between the marked points increases by about 3.5 - 5 cm. In the case of limited mobility of the chest, flexion is reduced, and in some cases may be completely absent.

***Lasegue test*** –the therapist performs passive flexion in the hip joint. Pain in the lumbar segment positive test. It goes in degrees. In the case of a root lesion, it is provoked by low back pain at a smaller angle of flexion (about 30-40 °). At an angle above 70 °the pain can be provoked by hip joint, lumbar muscles and sacroiliac joint. Testing is always performed first for the healthy leg.

Functional assessment were done before and after complex therapy for both groups.

*Procedure:*

Methods of application of complex therapy - procedures apply schedule within 10 consecutive days in accordance with the protocol. MLS-laser therapywas appliedonly for the experimental group daily for 10 days, with the application of cervical share C3 - C7, for thoracic portion of C7 through T9 and lumbar portion of L2 to S2 for no more than 10 minutes of the procedure for a total of 10 procedures. First 3-4 treatments with a frequency of 500-700Hz (at a dose of 1,3 J / sm²), in the last 7-10 procedures, the frequency increased to 1500

Hz (dose 1,3 J / sm²). Laser MLS therapy is an innovative therapy to treat pain, inflammation and edema, as well as the regeneration of soft tissues. Technique is based on the work of diode lasers and has a strong anti-inflammatory, antiedematous and analgesic effect. Manual-soft tissue mobilization - the therapy includes a set of manual techniques to normalize the function and maximum rapid reduction of pain. Specialized exercise – including analytical exercise, relaxation post isometric techniques, specific exercise (McKenzie), common exercise for mobility of the spine.

The control group received all the same treatment except the MLS-laser therapy.

*Statistical analysis*

The evaluation of research results were realized by statistical and mathematical methods and procedures using Graph Pad Prism 3.0. We used the primary statistics variables like: Median (Mdn), arithmetic mean (±), variation range (VR =max - min) standard deviation (Sd) (Karashtranova, Atanasova, 2010). In term to calculate statistically, significant differences we use Wilcoxon for depend quantitative variables and Mann-Whitney test to compare independent quantitative variables.

**Results**

We made a functional assessment and obtain different variables of the the Ott test, Schober test, Lasegue test and VAS before and after the complex therapy for both groups. The primary characteristics of the research contingentare represented on the Tab1. For the experimental group and on Tab 2. for the control group.

Table 1. The primary characteristics of experimental group

| Measured values | Experimental group N=44 | |
|---|---|---|
| | Men N=23 | Women N=21 |
| Age (years) | 52.87±4.46 | 51.90±8.50 |
| Body weight (kg) | 96.61±9.08 | 74.38± 8.99 |
| Body height (cm) | 173.7±3.88 | 167.6±4.46 |

Kg – kilogram; cm- centimeters;

Table 2. The primary characteristics of control group

| Measured values | Experimental group N=37 | |
|---|---|---|
| | Men N=17 | Women N=20 |
| Age (years) | 51.90±3.65 | 49.29±4.67 |
| Body weight (kg) | 90.75±2.76 | 81.00± 3.39 |
| Body height (cm) | 171.3±3.55 | 168.4±3.76 |

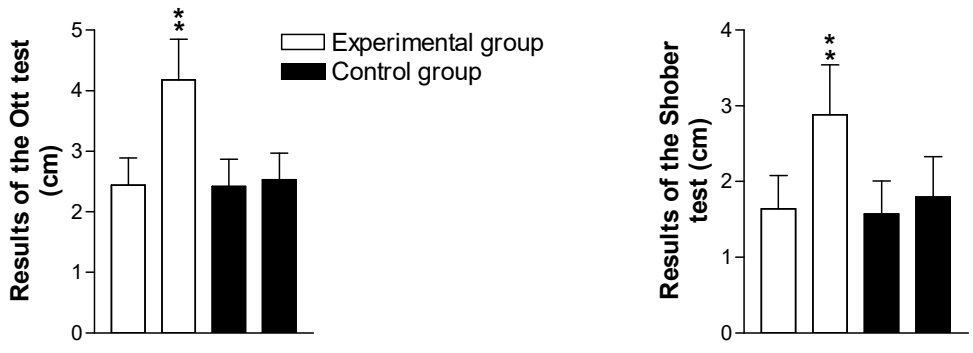
Kg – kilogram; cm- centimeters;

Mean age of the participants of the experimental group (21 women and 23 men) were respectively 51.90±8.50 years for women, and 52.87±4.46 years for men. Mean height and weight were as follows 167.6±4.46cm and 74.38± 8.99kg for women and 173.7±3.88cm and 96.61±9.08kg for men (Tab.1).

Mean age of the participants of the control group (17 women and 20men) were respectively 49.29±4.67 years for women, and 51.90±3.65 years for men. Mean height and weight were as follows 168.4±3.76cm and 81.00± 3.39 kg for women and 171.3±3.55cm and 90.75±2.76kg for men(Tab. 2).

Different variables of the the Ott test, Schober test, Lasegue test and VAS were obtain before and after the complex therapy for both groups and data is represented on Fig. 1.

**A** **B.**

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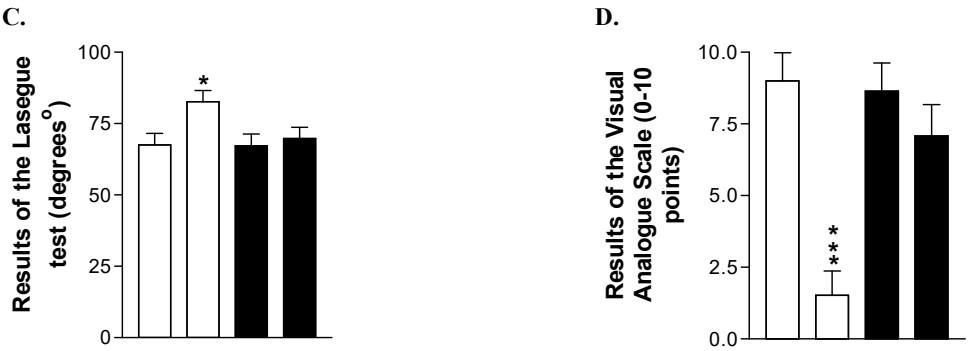


**Figure1.**Dynamic of the results of the Ott test – **A**; Shober test – **B**; Lassegue test – **C** and Visual Analogue Scale (VAS) - **D** for the experimental group before and after treatment - □ ,and for the control group before and after treatment - ■;
*** Statistically significant differences, Mann-Witney test p < 0,001 after complex therapy
**Statistically significant differences, Mann-Witney test p < 0,03 after complex therapy
* Statistically significant differences, Mann-Witney test p < 0,05 after complex therapy

Mean values obtained of the Otttest for the experimental group before and after the administered complex therapy were as follows: 2.44±0.45cm, and 4.18±0.67cm. The differences between the final measurements of the Otttest shows statistically significant differences in this group (Wilcoxon, p<0, 05). For the control group mean values obtained of the Ott test for the experimental group before and after the administered complex therapy were as follows: 2.42±0.45cm, and 2.53±0.44cm without statistically significant differences before and after treatment.

Furthermore, we obtain statistically significant differences comparing data of the measurements of two groups after therapy (Mann Whitney p<0.05). This proves the positive effect of the applied complex therapy (Fig. 1. A.). Mean values of the Schober test for the experimental group, measured before and after the administered complex therapy were 1.64±0.44cm, 2.88±0.66cm. For the control group obtained data before and after the administered complex therapy were respectively: 1.57±0.44cm, 1.80±0.53cm. The differences between the results of two experimental and control group after treatment, indicate statistically significant differences (Mann Whitney, p<0, 05) (Fig. 1 B.).

Lassegue test average values for the experimental group obtain before, were 67.45±4.05**°** and 82.64±3.87**°** after complex therapy. For the control group obtained results were 67.16±4.17**°** before and 69.73±3.90**°** after(Fig. 1.C.).

Mean values of the pain thresholdmeasured before and 10 days after the complex therapy for the participants of the experimental group were 9.0±0.99mm. At the end of the pain threshold was reduced to 1.52±0.85mmfor the control group mean values of the pain threshold was 8.65±0.98mmbefore and reduced to 7.08±1.09mmafter treatment. Differences between two experimental groups in both in final measurements were statistically significant (p<0.05) (Fig. 1. D.).

**Discussion**

Back pain is the most common reason for people visiting health specialists (Flachs et. al. 2015) and globally responsible for more years lived with disabilities than any other reason (Hartvigsen et al. 2018). Low back pain is the health problem with a major socioeconomic impact (Brandão Pinto de Castro et.al. 2020). Almost one of five patients who consult a doctor for back pain, there is a strong constant pain (Kongsted et. al. 2015). Single episodes of back pain usually resolves rapidly but recurrent episodes are very common (Kongsted et. al. 2017; Kongsted et. al. 2016). Despite advances in assessment and treatment methods in recent years, chronic spine pain continues to be a serious challenge (Stoyanov et.al. 2020; Vlaeyen, et.al, 2018) and affects individuals of all ages (Mitova et.al. 2016). Patients with persistent back pain describe its state as negatively affecting their life, leaving them concerned that the results of consultation with the health professionals often insufficient (MacNeela et. al. 2015).

Numerous systematic studies summarize the results obtained so far after the application of various manual methods for non-specific lumbar pain. The majority of studies do not report a long-term solution to the problem (Chenot, et. al. 2017). This studyaimed to determine the effectiveness of a comprehensive approach to musculoskeletal dysfunction in the spine. The complex approach include - MLS-laser therapy, manually soft tissue mobilization, analytical exercise, post-isometric relaxation techniques, specific McKenzie exercise and common exercise for mobility of the spine for the experimental group. The control group received all the same therapy except MLS-laser applications. In our previous study the obtain results show a high reduction of the pain and increased the range of movement in the cervical and lumbar area of the spine after application of MLS therapy.The results obtain in this study confirm this again. MLS-therapy (laser acupuncture) in patients with

spinal musculoskeletal dysfunctions has proven effectiveness and positive effect reducing pain symptoms and muscle spasm in the course of the treatment (Mitovaet.al. 2020).

The results show a positive healing effect of manual therapy combined with MLS-laser to reduce pain intensity, especially in experimental group. For patients of experimental group pain significantly reduce, and this in turn leads to improvement in range of movement and functionality of the spine. The reduction of pain for participants of the control group is much less. We believe that this is due to the analgesic and anti-inflammatory effect of laser therapy. Complex treatment with MLS-laser,manualsoft tissue mobilization and specialized exercise applied in experimental group provide better pain relief and localization of the pain in the spine. This reduces the protective muscle spasm and promotes muscle relaxation. Despite the small number of procedures, complex approach to musculoskeletal dysfunctions give good results in terms of mobility of the spine and reduce the intensity of pain.

The results obtained in our study shows a strong reduction of the pain in patients in experimental group. This is especially important, as it is one of the main limiting factors and leads to increase the range of movement and functionality in the lumbar spine (Zaho, et. al. 2017). A number of other studies have reported a positive effect on pain symptoms after manual therapy (Hersman, et.al. 2017; Lesi, et.al. 2016).

The reduction of the pain and improvement of the range of movement in lumbar spine is due to the enclosed massage methods, which combine massage with active and passive movements. Manual-soft tissue mobilization with its profound impact increases hyperemia and trophic treated structures, which helps anesthesia by removing metabolic products. On the other hand, causes reflex and reduce regional nociception. Pain reduction leads to a reduction of the protective muscle spasm and tends to normalize muscle tone. Improved trophic and restoration of normal mobility in the region interrupting pathological afferationfrom the affected area.Therefore, we can argue the positive effect of MLS-laser therapy on pain reduction. We also believe that better results are due to the combination of the laser with manual mobilization techniques in experimental group. The primary way in which mobilization act is mechanical. The manual mobilization restores voluntary movements, contributes trophic cartilage, improve the metabolism of soft tissue structures and improves the speed and quality of the regeneration of joints.Neurological effects of the mobilization are reduced acute pain and muscle spasm reflector (Björnsdóttir, Kumar, 1997).

Included in the experimental protocol exercise for stretching and relaxation of the shortened muscles in conjunction with analytical exercise post-isometric relaxation techniques, specific McKenzie exercise increase mobility of the spine and contribute to the reduction of muscle imbalance.

**Conclusion:**

As a result of the study, several main conclusions can be drawn:

In the course of the study we found that the pain was significantly reduced from 9.0 ± 0.99 mm to 1.52 ± 0.85 mm for the subjects of the experimental group ($p < 0.001$ ***). As a result, we reported an improvement in the range of movement in the thoracic and lumbar region in these patients.

The differentiated selection of specialized methods included in the complex approach for musculoskeletal dysfunctions in the spine area has a positive effect on pain and improves its mobility.

The strong reduction in symptoms o pain and muscle spasm in experimental group improves range of movement, function and quality of life. The integrated approach not only helps overcome the painful symptoms typical of musculoskeletal pathologies, but also a valuable tool for rehabilitation.

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**Conflicts of interest:**

There have been no conflict of interest situations in the course of the research and the publication of the manuscript. The proposed manuscript is original, has not been published before and is not being considered for publication elsewhere. The experimental work meets the ethical requirements concerning research and involving the participation of people asset for the Helsinki Declaration.

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