



APPLICATION OF HAND-HELD DYNAMOMETER FOR MONITORING FUNCTIONAL RECOVERY IN PATIENTS WITH CERVICAL RADICULOPATHY

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ABSTRACT:

Cervical radiculopathy is common in clinical practice. It is the main reason to neck pain. Depending on the severity, neck pain can interfere with daily activities. In this regard, in order to identify the symptoms and to undertake optimal treatment of the problem, a full clinical and functional examination must be performed. The most commonly used and imposed test in practice to assess the condition of the muscles is manual muscle testing (MMT). Recent studies of muscle dysfunction in various neuromuscular disorders have focused on the use of apparatus methods to assess and monitor functional recovery. For this reason, based on the successful results of the use of a manual electronic dynamometer, we applied in a clinical setting testing with Hand-Held Dynamometer (HHD) to monitor functional recovery in patients with cervical radiculopathy.

Aim: The aim of the study was: to monitor and compare changes in muscle strength during functional recovery in patients with cervical radiculopathy using standard Manual Muscle Testing and Hand-Held Dynamometer.

Materials and methods: The study was conducted in the period from December 2019 to April 2020. They were selected 16 patients of different origins of pain in the neck portion (osteocondrosis, spondylosis, disk herniation). Functional, hardware and statistical methods were used to monitor and evaluate the results. HDD-muscle testing was also included in the experimental group.

Results: The practical experience of using a Hand-Held electronic dynamometer proved to be facilitation not only for the researcher but also for the patients. The inclusion of an HHD in the conducted research allowed fast and accurate assessment of the physical function and the weakened muscle groups. This allowed individual dosing and targeted exercise of weakened muscle groups in each individual patient.

Conclusion: The use of HHD to assess muscle strength leads to objectification and a more rational presentation of the results of muscle strength testing.

Keywords: Neck Pain, Cervical Radiculopathy, Manual Muscle Testing, Hand-Held Dynamometer, Physical Therapy,

INTRODUCTION:

Neck pain is a common complaint, with many possible causes. The specific diseases of the spine, including radiculitis, spondylosis, disc herniation, discopathy and others, are among the most common medical problems in complaints of neck pain. Nearly 80% of people suffer from neck pain at some point in their lives. Sometimes the pain is transient, but in most cases, it can be severe and persistent and have serious health consequences [1].

According to some studies, neck pain is a leading cause of injury to people under the age of 45 globally. In fact, a third of specialist visits are for the treatment of neck pain, which is a much higher rate than for any other disease [1].

However, the diseases of the cervical spine exceed the pain in the neck. The degenerative process can cause irradiation of pain symptoms, as well as numbness and weakness in the shoulders, arms, and fingers. This discomfort and loss of mobility can have a major impact on the work and household, family, and quality of life of those affected [2, 3].

Most people with neck pain consciously avoid moving their head during daily work and household activities in the belief that they cannot perform them or for fear of exacerbating the pain symptoms. This, in turn, is a prerequisite for gradual muscle weakness, joint stiffness and overall dysfunction of the spine and neck.

Cervical radiculopathy is a major contributor to neck pain and has high medical and socio-economic significance. The good news is that most patients can recover without the need for surgery. Early diagnosis and determination of the severity of the problem are extremely important for the selection of appropriate therapeutic measures. This, in turn, is the basis for achieving full functional recovery, preventing the chronicity of pain symptoms and the development of complications [4].

In this regard, in order to identify the symptoms and to undertake optimal treatment of the problem, a full clinical and functional examination must be performed. It is necessary to establish early the painful movements and the degree of weakness of the respective muscle groups. This information is essential to identify the root causes of neck pain, as well as to determine the most accurate approach to treatment and prevention of the problem.

The most commonly used and imposed test in practice to assess the condition of the muscles is Manual Muscle Testing (MMT). MMT is a functional method for determining the degree of muscle weakness, which is extremely important in the process of diagnosing the type and degree of a number of motor disorders and a basis for determining the need for treatment. Despite the established rules in testing, the main drawback of the test is the lack of sufficient objectivity in the assessment. The test cannot provide an accurate quantitative assessment but only a qualitative difference relative to the strength of normal muscles [5, 6].

Recent studies of muscle dysfunction in various neuromuscular disorders have focused on the use of instrumental methods to assess and monitor functional recovery. This type of apparatus testing allows for quantitative assessment of muscle strength and creates a prerequisite for refining the manual test [6].

For this reason, based on the successful results of the use of a manual electronic dynamometer, we applied in a clinical setting testing with Hand-Held Dynamometer to monitor functional recovery in patients with cervical radiculopathy.

The idea was to examine whether the use of the Hand-Held Dynamometer assessment of muscle strength and track functional recovery in patients with cervical radiculopathy will contribute to optimising the diagnostic and therapeutic process.

The **aim** of the study was: to monitor and compare changes in muscle strength during functional recovery in patients with cervical radiculopathy using standard Manual Muscle Testing and Hand-Held Dynamometer.

The **object** of study is the use of a Hand-Held Dynamometer to monitor functional recovery in patients with cervical radiculopathy.

The **subject** of study is the effect of the introduction of instrumental testing on the accuracy of functional diagnostics and monitoring the results of physical therapy.

MATERIALS AND METHODS:

The study was conducted in the period from December 2019 to April 2020. They were selected 16 patients of different origins of pain in the neck portion (osteochondrosis, spondylosis, disk herniation).

Control group A included 8 patients (6 women and 2 men) treated with a standard physical therapy program with added neuromuscular techniques.

Experimental group B was also formed by 8 patients (7 women and 1 man), treated by the same physical therapy method in the University Hospital - "Medica" Ruse. In addition to the standard functional tests, a dynamometer test was used for muscle testing.

Diagrams 1 and 2 show that female patients predominated in the groups, as in the control group - A: 25% were male, 75% female, and in an experimental group B: 12% men, 88% women.

Diagram 1. Sex distribution – Control group A

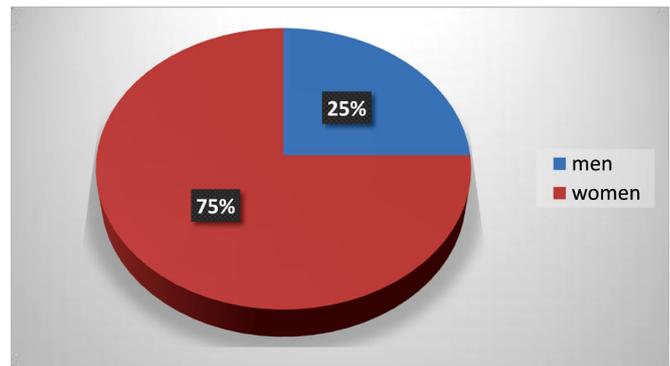
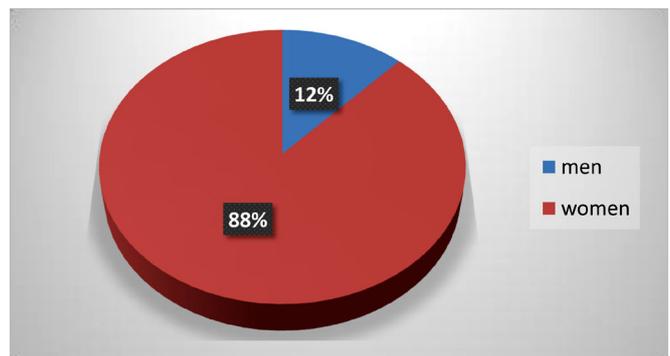
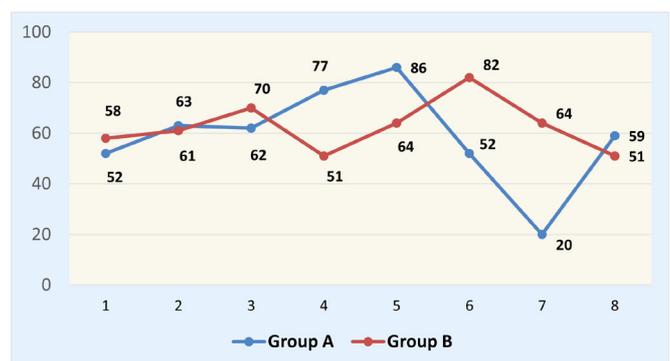


Diagram 2. Sex distribution – Experimental group B



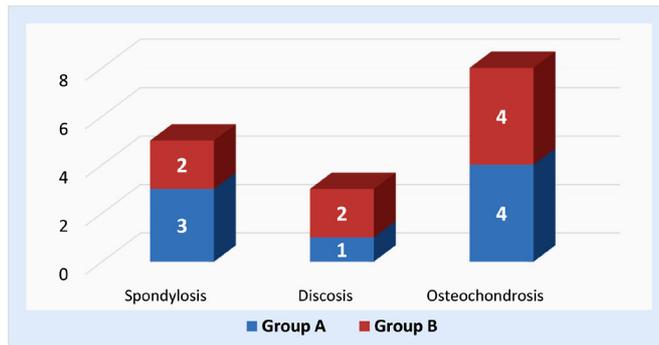
The mean age of patients in control group A was 55 years, while that of experimental group B was 60 years (Diagram 3). The youngest patient in Control group A was 20 years old, and in the experimental group, B was 51 years old. In both groups, the oldest patients were 86 years of age.

Diagram 3. Age distribution of patients– Control group A and Experimental group B



The prevalent diseases in both groups are spondylosis and osteochondrosis. After calculations, it was found that there were no patients with discosis in the experimental group (Diagram 4).

Diagram 4. Distribution of clinical diagnoses Control group A and Experimental group B



Functional, apparatus and statistical methods have been used to monitor and evaluate the results.

The movements of the cervical region were measured centimeters in three planes: frontal - left and right slope; sagittal - flexion and extension; horizontal - rotation to the left and right. The pain self-assessment was performed by the Visual Analog Scale (VAS) with scores from 0 to 10. MMT of the muscle groups of the upper limb was also applied.

Apparatus muscle testing with a Hand-Held Dynamometer was also included in the experimental group. The manual muscle test with a dynamometer is a new muscle test system, which is a portable device for objective quantitative assessment of muscle strength. This is a powerful and multifunctional device that has the advantage that it can fit in the palm of the tester. During the study, patients were pleasantly tuned to this new and different test. The examination does not take time, and the patient feels calm.

The physical therapy program of control group A and experimental group B included breathing gymnastics, active exercises, occipital exercises, sitting exercises, isometric gymnastics, applied daily during the clinical rehabilitation course. Given the pain in the neck, the main tasks of physical therapy were aimed at pain relief. The complex included generally developing exercises for the neck, shoulder girdle, trunk, lower limbs. Avoiding were sharp movements in the neck and stress loads on the spine. The physical therapy was conducted at least twice a day. The duration of each procedure was 10-15 minutes, maximum of 30 minutes, depending on the patient's condition and tolerability. In addition to the physical therapy program, both groups included Karel Levitt's musculoskeletal techniques for overcoming muscle imbalance. These techniques use isometric, isotonic-concentric and isotonic-eccentric contractions. Resistance can be applied as an agonist and antagonist with the aim of toning, relaxing and balancing individual muscles and muscle groups.

RESULTS:

The main focus of the analysis of results was placed on the evaluation of the results of the study of muscle strength, but data for other indicators were analyzed.

The results of the centimeter measurement in the cervical spine ("beard - sternum") show some differences in

the flexion mobility of the patients from both groups. At the end of the therapeutic course, there was a significant improvement in the condition of all patients, but the Growth rate(Gr) was higher in the experimental group.

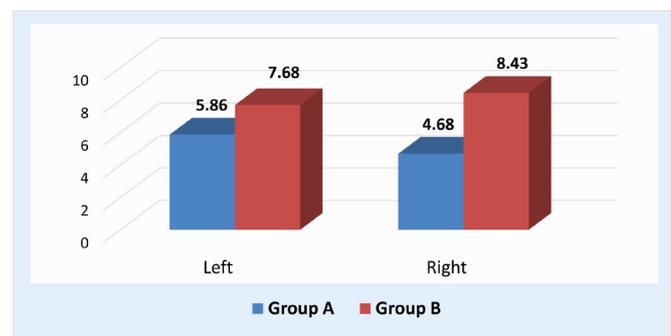
With regard to the average values of the indicator "lateral slope", a lower average value was observed in the patients of group B, which in this case reflects the improvement in the condition of the patients, as the lower values of this indicator indicate an increase in the mobility of the spine. Such results are also observed with respect to the left and right lateral slopes for both groups.

The positive effect of the applied therapy is confirmed by the results of the indicator - flexion with rotation in the cervical region. The values reflecting the rotational mobility in the experimental group show greater dynamics compared to the control group.

The pain syndrome in the patients of both groups also decreased, and in the experimental group, the decrease was more significant. This is related to the positive effect of the therapy on the individual perceptions of the patient and the reduction of the unpleasant sensations associated with pain.

Diagram 5 reflects the dynamics in the recovery of muscle strength for each examined muscle group of the left and right upper limb, as well as the growth rate of the indicators compared to the initial estimates from the measurements.

Diagram 5. MMT examination of the upper limb (Gr)



The average values of the growth rate show significantly higher dynamics of recovery in the experimental group of patients. The better results are interpreted with a more focused and dosed exercise of the weakened muscle groups and the emotional element of the therapy with the innovative use of the instrumental testing method.

The study of muscle strength in experimental group B was also performed with a dynamometer, and the muscle strength was set in Newton. Flexion, extension, inclination and rotation in the cervical region were studied.

When comparing the generalized average values, a growth rate of 22.2 was established. The growth rate in manual testing was 20.3. This shows a certain difference in values, which is explained by the possibility of more accurate reporting of the results in the study with an HHD (Diagram 6).

Diagram 6. Examination of the upper limb with a Hand-Held Dynamometer (Gr)



Despite the relatively short study period and the limited number of monitored patients, the results showed positive changes in the degree of pain symptoms and the functional status of the patients in both study groups. Table 1 presents the average results of the study of muscle strength by manual and hardware muscle testing. The growth rate in apparatus muscle testing is significantly higher, but this is explained by the different units of measurement used to report the results. This makes it difficult to compare the results of the two research methods.

Table 1. Comparison of results (average values)

Movement	Manual muscle testing			Muscle testing with an HHD		
	\bar{x}_1	\bar{x}_2	Gr	\bar{x}_1	\bar{x}_2	Gr
Flexion of neck	3,81	4,52	17,05	32,71	40,42	21,09
Extension of neck	3,64	4,35	17,77	27,84	35,5	24,19
Lateral flexion to the left	3,56	3,78	5,99	24,05	27,6	13,75
Lateral flexion to the right	3,42	3,65	6,51	22,45	26,56	16,77
Flexion with rotation to the left	3,34	3,57	6,66	20,5	25,3	20,96
Flexion with rotation to the right	3,84	4,05	5,32	23,45	26,51	12,25
Average values	3,6	3,99	9,88	25,17	30,32	18,17

However, the practical experience of using a hand-held electronic dynamometer proved to be facilitation not only for the researcher but also for the patients. The inclusion of an HHD in the conducted research allowed fast and accurate assessment of the physical function and, in particular, of the weakened muscle groups. This allowed individual dosing and targeted exercise of weakened muscle groups in each individual patient.

DISCUSSION:

Based on the study, it can be concluded that the role of apparatus testing for the study and follow-up of the recovery process in patients with cervical radiculopathy has not been well studied to date, making it difficult to select precise criteria for analysis in the present study.

However, there is evidence that the method is characterized by the fact that it provides increased reliability of the assessment and results in contrast to the subjectivity of manual testing.

In addition, it allows for accurate logging and periodic monitoring of the recovery process.

CONCLUSION:

In conclusion, can be deduced:

- The use of an apparatus dynamometer testing to assess the functional status facilitates exceptional work of research and allows for easy and accurate tracing of the

recovery process;

- The use of HHD to assess muscle strength leads to objectification and a more rational presentation of the results of muscle strength testing;

- The assessment of muscle strength performed by the dynamometer allows for a more functional diagnosis. It excludes the subjectivism of the human factor and gives a real quantitative assessment of the strength of the studied muscle group;

- The HHD-testing arouses patients' increased interest in innovations in functional diagnostics, which had a positive impact on their motivation to actively participate in the recovery process.

As a recommendation, we offer the use in the practice of the Hand-Held Dynamometer as a tool for functional diagnosis and monitoring of the recovery process in cervical radiculopathy.

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