

# Clinical and Experimental Functional Studies of the Musculoskeletal System

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**Abstract** An important criterion in assessing the degree of damage to the root is the study of temperature and pain sensitivity. The methodological basis for the study of temperature and pain sensitivity was a subjective assessment of temperature perception in response to local heating of a certain dermatome, that is, a limited area of the skin, activated by skin afferent fibers of the spinal cord root.

**Keywords** Current state of the problem of surgical treatment, Of patients with spondylolisthesis, Various ways of correction and stabilization

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## 1. Introduction

The esthesiometric study was conducted in the clinical and experimental Department of Functional research of the Musculoskeletal system by Doctor of Biological Sciences E.N. Shchurova (Head of the department, MD, prof. V.A. Shchurov), for which the author is greatly grateful. The temperature sensations were distributed in two gradations: "warm" and "hot pain". The study was performed on an electric esterometer with simultaneous recording of skin temperature (Nihon Kohden, Japan). The contact area of the thermal sensor was 1 cm<sup>2</sup>, the temperature range ranged from 10 ° to 50 °, and the rate of temperature change was 2 °/min. All measurements were carried out symmetrically on the right and left on the dermatomes, which corresponded to certain roots. A study of temperature and pain sensitivity at admission was conducted in 76 patients, which accounted for 95% of the total number of patients.

## 2. Results and Analyzes

All the examined patients showed violations of temperature and pain sensitivity at admission. In 40 (52.6%) patients, the changes were expressed in a predominant violation of thermal sensitivity, while the pain thresholds were slightly changed. Negative changes in thermal sensitivity manifested themselves in the form of absence, or a sharp increase in thresholds. In 49 (64.5%) cases, the level of sensory disorders corresponded to the level of compression, in 27 (35.5%) it was 1-2 dermatomes higher. In 60 (79%) cases, changes in

both thermal and pain sensitivity were recorded in the form of an increase in the thresholds of perception of temperature sensations by 3-5 °. Moreover, in 41 (54%) of the examined patients, the level of sensory disorders was 1-2 segments higher than the location of the hernia. We attribute the discrepancy between the compression level and the level determined clinically to dysgemic disorders that occur both in the conflict zone and adjacent areas due to impaired venous outflow and the addition of local epiduritis. Thus, in this group of patients, significant disorders of temperature and pain sensitivity were detected in 30% of cases, although clinically mild skin sensitivity disorders (hypesthesia) were detected only in 55 (68.75%) patients. Consequently, the determination of sensitivity using an electrical esthesiometer gives a more accurate picture of the lesion of nervous structures than a clinical examination [1,3,5,7,9,11,13,15,16].

An electromyographic examination provides additional information to the clinical examination data. Electroneuromyography makes it possible to objectify clinical data, which is important for dynamic monitoring of the patient (before and after surgical treatment, as well as in the near and long term). The electroneuromyographic study was conducted in the clinical and experimental Department of functional research of the Musculoskeletal system by Candidate of Medical Sciences A.A. Skripnikov (Head of the department, MD, prof. V.A. Shchurov), for which the author is very grateful. The developed electroneuromyographic diagnosis is based on the principle of a polyparametric analysis of the functional state of the affected root(s). It includes a set of electrophysiological techniques that test the functional state of the motor and sensory fibers of the spinal cord roots according to somatosensory evoked potentials, characteristics of muscle potentials caused by transcranial magnetic stimulation of the corresponding parts of the motor cortex of the cerebral hemispheres and patterns of voluntary

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reticulation of motor units of muscles, the motor neural conductors of which are localized. They are called in the zone of discoradicular conflict.

50 patients (28 male, 22 female) aged from 21 to 52 years (average age -  $41.3 \pm 3.1$  years) who were admitted to the Department of Vertebrology and Neurosurgery of the RSC "WTO" were examined. The registration and analysis of the bioelectric activity of muscles was performed using the Viking He EMG system (Nicolet company, USA). The method of global electromyography (EMG) was used under the conditions of the "maximum arbitrary voltage" test. The object of the study is ch. tibialis anterior, m. rectus femoris, m. gastrocnemius (c.L), m. biceps femoris. A bipolar type of lead was used to divert the bioelectric activity of these muscles (the diameter of the electrodes is 8 mm, the interelectrode distance is 10 mm). The analyzed indicator is the average amplitude (CA) of the total EMG recorded at the peak of the maximum voluntary tension of the tested muscle. The maximum values obtained during two or three attempts were selected for analysis. To reliably objectify the results of the study, patients were identified who were examined at all stages: before surgery, before discharge from the hospital, and during the control periods from 4 months to 24 months after the end of treatment. There are 66 surveys in total. During the processing of the obtained results, the EMG data were grouped according to the literalization of radicular syndrome - 90% of patients had left-sided compression, and 10% had right-sided compression. 40 patients underwent an EMG examination before surgery, which made it possible to characterize in detail neurological disorders in patients with a herniated lumbar intervertebral disc. The severity of violations of the considered electrophysiological parameters was determined using control values (N) obtained during EMG examinations of 32 neurologically healthy individuals, comparable in age and gender with the study sample of patients. To assess the reliability of changes in the analyzed quantitative characteristics, a package of nonparametric statistical methods "MegaStat for Excel" was used using the criterion of randomization of components for independent as well as for related samples. Prior to surgery, a pronounced (from slight to moderate) decrease in CA EMG was detected in all leads from the muscles of the lower extremities. So, according to the discharge from M. tibialis anterior on the affected side, this indicator was moderately reduced relative to the standard values and amounted to  $0.45 \pm 0.10$  mV with a norm of  $0.65 \pm 0.03$  mV, that is, the decrease was 30.8%. The same indicator on the contralateral limb was slightly reduced - by 10.8% (absolute value  $0.58 \pm 0.08$  mV). In the lead from m. rectus femoris on the affected side of the CA averaged  $0.23 \pm 0.05$  mV (43.9% lower than N), and on the contralateral limb -  $0.26 \pm 0.05$  mV (36.6% lower). For this muscle, the norm is  $0.41 \pm 0.04$  mV. Before surgery, the CA in the lead from m. gastrocnemius (p.1.) on the affected side averaged  $0.21 \pm 0.04$  mV, and on the contralateral limb -  $0.32 \pm 0.08$  mV, that is, it was reduced by 47.5% and 20.0%, respectively ( $N=0.40 \pm 0.05$  mV). A moderate decrease was characterized by the CA index for removal from m. biceps femoris of the

affected limb -  $0.42 \pm 0.10$  mV with a norm of  $0.62 \pm 0.08$  mV (a decrease of 32.3%), while the decrease in the opposite limb was insignificant (by 16.1%), as the indicator was  $0.52 \pm 0.10$  mV. The presented data indicate that patients with intervertebral disc herniations suffer from both lower extremities, despite the patient's complaints of only pain and muscle weakness in one of the limbs [2,4,6,8,10,12,14,16].

As is known, the intensity of global EMG, which is directly proportional to the magnitude of the maximum voluntary effort, is largely limited by the severity of pain in the lumbosacral spine, which is sharply aggravated by the conditions of the motor test we use. General and local unloading of the muscles of the lower extremities according to the so-called The "antalgic" type leads to their progressive "reflex" hypertrophy, which secondarily alters their activation and contractile properties.

In a sample of 40 patients examined before surgery, it was revealed that according to the indicator "average amplitude of total EMG" (CA), there was a moderate decrease in values in all the leads under consideration, both on the affected and on the conditionally intact limb. So, in particular, M. tibialis anterior CA EMG on the affected limb was recorded before surgery at the level of  $0.50 \pm 0.05$  mV, which is 76.9% of the standard values (N) (absolute value  $0.65 \pm 0.03$  mV). On the contralateral limb, this indicator was  $0.54 \pm 0.04$  mV - 83.1% of N. According to the derivation from M. rectus femoris, the motor deficit turned out to be slightly higher - the average amplitude on the affected side was 61.0% (absolute value  $0.25 \pm 0.03$  mV) of the level recorded in healthy subjects ( $0.41 \pm 0.04$  mV), on the conditionally intact side - 68.3% ( $0.28 \pm 0.04$  mV). The most reduced of all leads was the analyzed index of the affected M. gastrocnemius (p.1.), fixed at  $0.23 \pm 0.03$  mV and amounting to 57.5% of N, while on the contralateral -  $0.31 \pm 0.03$  mV (77.5% of the standard  $0.40 \pm 0.05$  mV). Before CA treatment, EMG m. biceps femoris was reduced moderately and amounted to 64.5% (affected limb) and 66.1% (conditionally intact limb) of the values obtained in the control group. The absolute values were  $0.40 \pm 0.05$  mV and  $0.41 \pm 0.04$  mV, respectively, with a norm of  $0.62 \pm 0.08$  mV. The frequency of total EMG fluctuations in most leads on both the affected and contralateral limbs was close to normal. The only exception was the values of m. rectus femoris on the conditionally intact lower limb, which amounted to 89.7% (absolute value  $213.8 \pm 6.2$  kol./s) from the standard level of  $238.3 \pm 17.9$  kol./s.

### 3. Conclusions

The presented data indicate that patients with herniated discs suffer from both lower extremities, despite the complaints made by patients only about pain and weakness of the muscles of one of the limbs. As is known, the intensity of global EMG, which is directly proportional to the magnitude of the maximum voluntary effort, is significantly limited by the severity of pain in the lumbosacral spine, which sharply worsens under the conditions of the motor test we use. General and local loading of the muscles of the lower

extremities according to the so-called The "antalgic" type leads to their progressive "reflex" hypotrophy, which secondarily alters their activation and contractile properties. Thus, these data confirm the presence of pronounced changes in the motor activity of the muscles of the lower extremities.

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