

Ukrainian Neurosurgical Journal. 2026;32(2):51-57  
doi: 10.25305/unj.347678

## Redcord Neurac therapy in the neurorehabilitation of patients with moderate and severe paresis after lumbar microdiscectomy

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Received: 22 December 2025

Accepted: 14 January 2026

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It is well known that over 800,000 microdiscectomies are performed worldwide each year. A significant number of patients undergo surgical treatment only after a sufficiently long period of progression of neurological symptoms lasting months or even years. Consequently, patients with paresis, including plegia of the distal lower extremities, are frequently encountered. In many cases, these neurological deficits persist for several years, resulting in a poor prognosis for postoperative recovery of motor function, despite complete or substantial relief of pain syndrome after surgery. Standard treatment for such patients includes drug therapy, physiotherapy methods (electrostimulation, magnetic stimulation), exercise therapy, massage, etc.

One of the modern neurorehabilitation techniques is Redcord Neurac therapy - an innovative technology of neuromuscular activation. Neurac (Neuromuscular Activation) is a physical therapy technique that uses specific exercises and techniques to activate the nervous and muscular systems. This method is based on the interaction between the nervous and muscular systems, as well as the principles of functional training.

**Objective:** To study the immediate and long-term treatment outcomes in patients with paresis after lumbar microdiscectomy using the Redcord Neurac therapy technique.

**Materials and methods:** A study was conducted to evaluate the effectiveness of treatment in 38 patients with moderate or profound paresis after lumbar microdiscectomy in the period from 2022 to the first half of 2025, who underwent treatment at the Lamed Rehabilitation Clinic, Dnipro, Kyiv.

**Results:** There were 15 men and 23 women, the age of the patients ranged from 35 to 50 years (average 39.9 years), the duration of the disease was from 4 to 10 years. At the beginning of neurorehabilitation, all 38 (100%) patients had movement disorders and foot dysfunction during the Neurac test, whereas there were no movement disorders in the knee joint or thigh muscles. After a month of treatment, 76% (29 patients) demonstrated significant recovery of foot flexion or extension function, while 24% (9 patients) had no positive effect. After 6 months of neurorehabilitation, good outcomes were observed in (84%) 32 patients, whereas unsatisfactory results were reported in (16%) 6 patients.

**Conclusions:** Redcord Neurac therapy is a modern highly effective method of neurorehabilitation for patients with moderate and deep paresis after lumbar microdiscectomy. In combination with traditional rehabilitation methods, Redcord Neurac therapy allows to achieve 84% of positive results.

**Keywords:** Redcord; Neurac; kinesiotherapy; neurorehabilitation; microdiscectomy

### Introduction

With over 800,000 procedures executed annually on a global scale, microdiscectomy represents one of the most prevalent spinal interventions [1,2]. According to various authors, the rate of favorable outcomes reaches 85–90% when patients are appropriately selected for surgical treatment [1–8]. However, a considerable proportion of patients agree to surgical intervention only after a prolonged progression of neurological symptoms [2]. Consequently, patients with paresis, including distal plegia persisting for several years, are

frequently encountered, leaving little expectation for postoperative recovery of motor function, although pain syndrome usually resolves or markedly decreases. Such patients often consider surgery insufficiently effective, despite receiving preoperative explanations regarding the potential for recovery of motor and sensory deficits after the intervention [2]. Standard treatment for these patients includes pharmacotherapy, physiotherapeutic modalities (electrostimulation, magnetic stimulation), therapeutic exercise, massage, and related approaches. The search for novel restorative neurosurgical and



neurorehabilitation methods capable of maximizing the reduction of paresis, even after its prolonged persistence, remains ongoing [1–8]. One such neurorehabilitation approach is Redcord Neurac therapy, an innovative neuromuscular activation technology with high therapeutic efficacy developed by Norwegian physicians [9–16]. Neurac (Neuromuscular Activation) is a physical therapy method that employs specific exercises and techniques to activate the nervous and muscular systems. It is based on the understanding of the interaction between the nervous and muscular systems, as well as on the principles of functional training [9–11]. The principal concept of Neurac is the creation of conditions for muscle activation through the formation of an unstable environment in which muscles must function to maintain balance and body stability. The Neurac concept involves influencing the body through slings connecting body segments by means of elastic ropes. These ropes generate additional resistance during movement, thereby increasing muscular load and activating the nervous system, which contributes to improved motor coordination, enhanced muscle strength and flexibility, and reduced pain. The use of suspension systems enables patients to perform exercises in a safe and controlled environment. The devices are connected to the upper ends of special elastic suspensions fixed to the ceiling, thereby creating an “anti-gravity” effect. This allows patients to perform movements that might otherwise be excessively painful or impossible under conventional conditions [12–15]. Intensification of neuromuscular interaction promotes activation of the nervous system and improves muscular function, thereby reducing pain and enhancing motor capacity. The treatment system includes both assessment and therapeutic intervention [9–16]. Rehabilitation according to the Neurac system engages hypoactive deep muscles through the combination of sustained tension and intensive stimulation of mechanoreceptors [11–14]. The primary objective of the Neurac method is restoration of proper musculoskeletal function. This is achieved through specialized exercises with body-weight unloading combined with intensive stimulation of the nervous system. Such a restores the connection between the body musculature and the central nervous system, thereby creating conditions for the recovery of lost function [9–16].

Neurac therapy is indicated for patients after stroke, trauma, and surgical interventions. An important requirement during Neurac therapy is continuous supervision by a specialist in physical and rehabilitation medicine throughout each exercise session. When necessary, the physician corrects the initial body position and monitors the accuracy of movement execution [13]. With regular training, Redcord therapy restores normal interaction between local and global muscle groups through the sequential formation of appropriate neuromuscular connections. Stable positive outcomes are often observed after as few as 10 sessions performed at intervals of 2–3 days [13].

According to various authors, indications for Neurac therapy include:

- osteochondrosis, scoliosis, flatfoot deformity, and intervertebral disc herniation;
- scapulohumeral peri-arthritis, myositis, myalgia, and muscle spasms;
- instability of the cervical and lumbosacral spine;

- postoperative rehabilitation after spinal surgery;
- rehabilitation after hip and knee arthroplasty;
- post-competition rehabilitation in athletes;
- rehabilitation after injuries and trauma.

The exercises are particularly effective in patients with motor and sensory disorders of vertebrogenic and neurogenic origin, including paresthesia, paresis, radicular and myofascial syndromes, and post-stroke motor impairments [13–15].

According to the protocol, both therapy and diagnostics are based on the kinetic chain principle. Prior to training and development of the rehabilitation program, mandatory testing is performed. Functional assessments using Neurac suspension systems identify weak links requiring targeted training. Exercises are selected individually, taking into account the patient’s complaints, diagnosis, and individual characteristics, including age, body weight, and comorbidities [13–15].

Contraindications to Redcord therapy include acute infections, septic processes, exacerbations of chronic diseases, and recent injuries accompanied by ligament or tendon rupture. Suspension therapy is contraindicated in osteoporosis, spinal ankylosis, severe cardiac and respiratory failure, coagulation disorders, and oncological diseases. Relative contraindications include pregnancy, breastfeeding, and menstruation [13–15].

**Objective:** To investigate the short- and long-term treatment outcomes of patients with paresis after lumbar microdiscectomy using Redcord Neurac therapy.

## Materials and methods

### Study design

The effectiveness of treatment was evaluated in 38 patients with moderate or severe paresis after lumbar microdiscectomy who underwent treatment between 2022 and the first half of 2025.

The study protocol was approved by the Biomedical Ethics Committee of Kherson State University (Minutes No. 11 dated December 18, 2025).

### Study participants

The study included patients with moderate or severe paresis after lumbar microdiscectomy in the lumbar spine who underwent treatment at “Lamed” Rehabilitation Clinic (Cities of Dnipro and Kyiv).

### Inclusion criteria

Moderate or severe paresis after lumbar microdiscectomy in the lumbar spine.

### Exclusion criteria

The following conditions were predefined as limitations of the method: acute infections, septic processes, exacerbation of chronic diseases, osteoporosis, severe cardiac and respiratory failure, coagulation disorders, and oncological diseases.

### Parameters analyzed

The following parameters were analyzed: sex, age, disease duration, herniation level, Neurac test results.

### Therapeutic intervention technique

The Redcord device is a treatment table equipped with a system of straps and slings (**Fig. 1**) designed for exercises performed in a suspended position. The unstable support surface generates vibrations that require activation of stabilizing muscles to maintain balance. The risk of injury is minimal, as the “Redcord” suspension system stabilizes the limbs and trunk,

**Table 1.** Neurac test of myofascial chains

Test	Side			
	Left		Right	
Selected exercise	0 1 2 3	P D F	0 1 2 3	P D F

Depending on the obtained results (0 – reduced or absent function; 1 – normal function; 2 – above average; 3 – “athlete” level; P – pain; D – discomfort; F – normal), the exercise program, session duration, number of sets, and repetitions are selected individually.



**Fig. 1.** The Redcord suspension system

thereby reducing gravitational load on damaged structures. Redcord therapy does not cause discomfort and has no restrictions related to age or level of physical fitness. Pain elimination is considered an essential prerequisite for the formation of appropriate neuromuscular connections and restoration of motor function. At the beginning of treatment, each patient undergoes a Neurac test assessing myofascial chains, which determines the scope of subsequent treatment (**Table 1**). The test is performed over 120 s.

**Statistical analysis**

Statistical analysis of the study data was performed using Python v3.9.5 (<https://www.python.org/downloads>) in the JupyterLab development environment (<https://jupyter.org/install>). Fisher’s exact test was applied for comparisons between independent groups. The significance threshold was set at 0.0001. A value of  $p < 0.0001$  was considered statistically significant for all types of analyses.

**Results and discussion**

*Patient characteristics.* Patients were evaluated before the initiation of neurorehabilitation and at 1 and 6 months thereafter. Outcomes were assessed using the Neurac test. This method is routinely used at “Lamed” Rehabilitation Clinic for the treatment and rehabilitation of patients with a wide range of pathologies according to the aforementioned indications.

The study cohort included 15 men and 23 women. Patient age ranged from 35 to 50 years (mean age, 39.9 years). Disease duration ranged from 4 to 10 years.

In all cases, Redcord Neurac therapy was combined with conventional treatment. During neurorehabilitation, patients received Neuromidin, 1 tablet twice daily for 1 month, together with a course of electroneuromyostimulation (**Fig. 2**). Electroneuromyostimulation was performed using the “BTL-4000 Premium” device (United Kingdom).

The neurorehabilitation program was conducted over 1 month. Treatment sessions were performed 6 days per week (excluding Sundays). Pharmacological treatment was administered daily, whereas Redcord Neurac therapy and electroneuromyostimulation were performed on alternating days (Monday, Wednesday, Friday – Redcord therapy; Tuesday, Thursday, Saturday – electroneuromyostimulation). Thus, each patient underwent 12 sessions using the “Redcord” system.

Four exercises were selected for rehabilitation: flexion and extension of the knee joint, as well as dorsiflexion and plantar flexion of the ankle joint. In cases of severe paresis, the straps were positioned more proximally to the joint, whereas with improvement in motor activity (moderate paresis) and increased muscle strength, the straps were positioned more distally.

Rehabilitation using the “Redcord” system is aimed at restoration of the muscular corset, activation of deep muscles, and correction of motor stereotypes. The method reduces spinal load, activates weakened muscles without pain, and gradually improves coordination and stability. Even in cases of severe paresis, it enables activation of agonist muscles, improvement of motor function through compensation by other

muscle groups, and formation of new neuromuscular patterns. Therefore, rehabilitation included not only ankle flexion and extension exercises. As is known, the L5 nerve root innervates the extensor hallucis longus and extensor digitorum brevis muscles, and its impairment leads to difficulty with ankle dorsiflexion. The S1 nerve root innervates the peroneal muscles and the triceps surae muscle, and its impairment leads to difficulty with plantar flexion. Consequently, knee joint exercises were also incorporated to engage all muscles of the lower limb, increase their strength and endurance, and facilitate the formation of new motor patterns. Each exercise was initially performed in 2 sets of 3 repetitions, with gradual progression to 4 sets of 6 repetitions by increasing the load and adding vibration stimulation to accelerate the formation of new neuromuscular patterns.

Microdiscectomy for L4–L5 disc herniation was performed in 16% of patients, whereas L5–S1 disc herniation surgery was performed in 84% ( $p < 0.0001$ ). Thus, the majority of patients had S1 nerve root involvement.

*Immediate outcomes.* Before initiation of neurorehabilitation, all patients demonstrated motor impairment and foot dysfunction according to the Neurac test results, whereas no movement disorders in the knee joint (thigh muscles) were observed (**Table 2**).

After 1 month, significant recovery of ankle flexion or extension function was observed in 29 (76%) patients, whereas no positive effect was noted in 9 (24%) patients (**Table 3**).

Six months after neurorehabilitation, 32 (84%) patients demonstrated good outcomes, whereas the remaining patients had unsatisfactory results (**Table 4**).



**Fig. 2.** “BTL-4000 Premium” electrical stimulation device

**Table 2.** Results of the Neurac test before neurorehabilitation

Exercise	Parameter						
	0	1	2	3	P	D	F
Knee flexion	0	38	0	0	0	0	38
Knee extension	0	38	0	0	0	0	38
Ankle flexion	6	0	0	0	0	6	0
Ankle extension	32	0	0	0	0	32	0

**Table 3.** Results of the Neurac test after 1 month of neurorehabilitation

Exercise	Parameter						
	0	1	2	3	P	D	F
Knee flexion	0	38	0	0	0	0	38
Knee extension	0	38	0	0	0	0	38
Ankle flexion	2	4	0	0	0	2	4
Ankle extension	7	25	0	0	0	7	25*

Note. \* – The difference was statistically significant ( $p < 0.0001$ ) compared with the dysfunction parameter.

**Table 4.** Results of the Neurac test after 6 months of neurorehabilitation

Exercise	Parameter						
	0	1	2	3	P	D	F
Knee flexion	0	38	0	0	0	0	38
Knee extension	0	38	0	0	0	0	38
Ankle flexion	2	4	0	0	0	2	4
Ankle extension	4	28	0	0	0	4	28*

Note. \* – The difference was statistically significant ( $p < 0.0001$ ) compared with the parameter in patients with unsatisfactory outcomes.

**Clinical case**

Patient K., 38 years old, had suffered from low back pain radiating to the right lower extremity along the posterior surface to the great toe for 8 years. The disease course was progressive, with frequent relapses. Conservative treatment had previously produced positive effects.

In March 2022, the patient was forced to relocate to another region of Ukraine. She subsequently noted a marked deterioration in her condition, with intensification of pain and the development of foot weakness. Over the following 3 years, her condition progressively worsened; however, the patient refused surgical intervention until her condition became “critical.” On June 27, 2025, she was urgently admitted to the hospital with a diagnosis of “right-sided posterolateral L5–S1 intervertebral disc herniation, right S1 radiculopathy, severe pain and muscle-tonic syndromes, and moderate paresis of the right foot.” On the same day, surgical treatment consisting of right-sided L5–S1 microdiscectomy was performed. After surgery, the pain syndrome decreased, although motor deficits persisted. After returning to her permanent place of residence, the patient sought further treatment at “Lamed” Rehabilitation Clinic.

At the beginning of neurorehabilitation, the patient complained of mild pain in the lumbar spine, difficulty with extension, and numbness of the right foot.

The patient was prescribed daily pharmacological treatment combined with alternating Redcord Neurac therapy and electroneurostimulation every other day for 1 month.

Neurorehabilitation using the “Redcord” platform is illustrated by the example of knee extension exercises (**Fig. 3**).

During the month of neurorehabilitation, the patient demonstrated positive clinical dynamics: mild pain completely resolved, muscle strength in the foot improved, and the patient regained independent ambulation without additional support, with restoration of weight-bearing on the foot. A home exercise program for daily training was recommended. At the 6-month follow-up examination, a stable positive effect without deterioration over time was documented.

*Comparison with the results of other researchers.* B. D. Dannelly *et al.* (2011) conducted a study involving 26 women (13 participants in the conventional training group and 13 in the sling-therapy group using the Redcord platform), including assessment of lower-limb strength improvement. Training sessions were performed 6 times per week for 13 weeks. The authors demonstrated that Redcord Neurac therapy significantly increased lower-limb strength compared with conventional training [6]. K. Kowalik *et al.* (2025) described a case of successful rehabilitation of a patient with transverse myelitis after vaccination using Redcord Neurac therapy combined with electroneurostimulation [21].

**Prospects for further research.** Redcord Neurac therapy is a modern and highly effective neurorehabilitation method following lumbar microdiscectomy, particularly in patients with moderate and severe paresis. The advantages of the method include high efficacy, absence of overload, individualized approach, versatility, and restoration of neuromuscular control. Its limitations include the need for highly qualified specialists in physical and rehabilitation medicine, high equipment cost, limited availability mainly in specialized centers, prolonged rehabilitation duration, and the impossibility of independent training.



**Fig. 3.** Neurorehabilitation using the Redcord platform: A – preparation for exercises; B and C – placement of suspension slings; D – knee extension exercises; E – knee extension of the unaffected limb; F – suspended extension with vibration

Further studies should focus on identifying new combinations and types of exercises that provide maximal restorative effects, as well as the most effective pharmacological and surgical recovery methods in combination with Redcord Neuromuscular Activation therapy.

### Conclusions

1. Redcord Neurac therapy is a modern and highly effective neurorehabilitation method for patients with moderate and severe paresis after lumbar microdiscectomy.

2. In combination with conventional treatment methods, Redcord Neurac therapy enabled positive outcomes to be achieved in 84% of cases.

3. According to various authors, Redcord Neurac therapy accelerates patient rehabilitation and improves treatment outcomes.

#### Disclosure

##### *Conflict of interest*

The authors declare no conflict of interest.

##### *Ethical standards*

All procedures performed in patients during the study were conducted in accordance with the ethical standards of the institutional and national research committees and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

##### *Informed consent*

Informed consent was obtained from each patient.

##### *Funding*

The study received no external financial support.

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