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RADICULAR PAIN SYNDROME: CLINICAL AND DEMOGRAPHIC CHARACTERISTICS, RISK FACTORS, DIAGNOSIS, AND EFFECTIVENESS OF COMPREHENSIVE CONSERVATIVE THERAPY AND REHABILITATION

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Abstract

Introduction. Radicular pain syndrome (RPS) is one of the leading causes of temporary disability among working-age individuals, particularly those engaged in heavy physical labor. The specificity of occupational load contributes to accelerated degeneration of intervertebral discs, while traditional criteria for assessing treatment efficacy do not adequately reflect functional outcomes.

Aim. To summarize the results of a comprehensive study of the clinical and demographic features, risk factors, diagnosis, conservative therapy, algorithms for acute pain relief, and rehabilitation of RPS with a focus on preserving work capacity and quality of life.

Materials and methods. In 2024–2025, 120 men aged 19–45 years with vertebrogenic RPS of lumbosacral localization were examined (retrospective and prospective, randomized comparative, and cross-sectional designs). Pain was assessed using the visual analog scale (VAS), functional status – using the Oswestry Disability Index (ODI); MRI and electroneuromyography (ENMG) were applied.

Results. The leading risk factors were lifting heavy loads (>25–30 kg), vibration (herniation risk increased 2.4-fold), and physical inactivity. Discrepancy between clinical and MRI levels of lesion was found in 28% of cases, subclinical denervation – in 14%. Conservative therapy provided ⩾50% improvement in VAS in 88.3% of patients; surgery was required in 3.3%. The optimized algorithm increased return to work by day 5 from 45% to 82%. Individualized rehabilitation increased the strength of back extensor muscles by 45.6% (versus 18.2%) and ensured readiness for full load in 95% of patients.

Conclusion. The results justify the implementation of comprehensive protocols for diagnosis, treatment, and rehabilitation of RPS aimed at preserving work capacity.

Keywords: Radicular pain syndrome, vertebrogenic radiculopathy, quality of life, Oswestry Disability Index, conservative therapy, rehabilitation, work capacity

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Introduction

Back pain and the associated vertebrogenic syndromes remain one of the most significant medical and social problems of modern healthcare, occupying a leading position in the structure of temporary disability and disablement of the working-age population [26, 29]. Radicular pain syndrome (RPS), a frequent manifestation of degenerative-dystrophic diseases of the spine, has a substantial impact on the work capacity and occupational fitness of patients engaged in physical labor [2, 4, 24]. According to domestic authors, vertebrogenic diseases occupy one of the leading places in the structure of neurological pathology among working-age individuals, reaching 30–40% of overall morbidity [3, 26, 29]. International data confirm the scale of the problem: according to foreign studies, up to 60% of those surveyed reported episodes of back pain during the year, and in 15–20% the pain became chronic [35, 37, 48]; an analysis of musculoskeletal injuries among workers in physically demanding occupations showed that spinal injuries account for about 7% of all such injuries [50].

RPS is a leading cause of temporary work incapacity – from 21 to 60 days per year per patient – which directly reduces the efficiency of professional activity [4, 29]. Economic losses consist of direct costs for treatment, rehabilitation and social payments, as well as indirect losses from reduced labor productivity; according to expert estimates, the cumulative economic damage from RPS reaches 15–20% of the annual healthcare budget of the corresponding industries [37, 50].

The specifics of physically demanding labor – carrying loads over 25–30 kg, vibration exposure while operating machinery, physical inactivity during prolonged forced static posture, and intense physical exertion – create the conditions for “overload osteochondrosis” and accelerated degeneration of the intervertebral discs [5, 6, 20, 24].

For a long time, treatment efficacy was assessed mainly by neurological status and imaging findings; however, the correlation between the degree of morphological changes (e.g., the size of a disc herniation on MRI) and the severity of the clinical picture remains low [28, 46]. This has led to a paradigm shift – from an “organ-centered” model to a “patient-centered” one, in which the patient’s quality of life (QoL) is recognized as the key integral criterion of treatment efficacy [25, 27], while instrumental verification (MRI, ENMG) is regarded not only as a means of diagnosing the level of compression but also as a tool for objectifying the neurological deficit, which is especially important for medico-social assessment of work capacity [9, 16, 18, 31].

Aim of the study

To summarize the results of a comprehensive study of radicular pain syndrome in order to form a holistic understanding of its clinical and demographic features, risk factors, diagnostic accuracy, the efficacy of standardized conservative therapy and optimized algorithms for relieving acute pain, as well as the effectiveness of individualized rehabilitation programs aimed at preserving the work capacity and quality of life of patients.

Materials and Methods

The study employed retrospective and prospective analysis, a randomized comparative study, and a cross-sectional study. The clinical study was carried out in 2024–2025 on the basis of the neurological department of the Termez Hospital of the Ministry of Defense of the Republic of Uzbekistan, in collaboration with the Central Clinical Hospital of the MoD RUz and the Urgench State Medical

Institute. It included 120 male patients aged 19 to 45 years who underwent inpatient examination and treatment for vertebrogenic radicular syndrome of lumbosacral localization. The general inclusion criteria for all fragments of the program were a clinically and/or instrumentally confirmed radicular pain syndrome (lumbo-ischialgia, radiculopathy) due to degenerative-dystrophic lesion of the lumbosacral spine; the general exclusion criteria were severe somatic pathology, oncological and inflammatory diseases of the spine, and allergic reactions to the drugs used in the treatment regimens. Pain intensity was assessed using the visual analog scale (VAS, 0–10 points), functional limitations – using the Oswestry Disability Index (ODI: 0–20% – minimal disability, 21–40% – moderate, 41–60% – severe, over 61% – total). Instrumental verification of the level of the lesion was performed by MRI/MSCT of the lumbosacral spine (1.5 T) and electroneuromyography (needle and stimulation). To assess the effect of therapy on cognitive-psychomotor status, the proofreading test and the Schulte table test were used (speed of sensorimotor reactions and concentration of attention), along with dynamometry of the strength of the back extensor muscles and the 6-minute walk test (aerobic endurance). Statistical processing was performed in Statistica 10.0 using Student's t-test, the χ^2 test, and Pearson correlation analysis; differences were considered statistically significant at $p<0.05$.

Results

Clinical and demographic characteristics of the cohort and risk factors

Analysis of the sample of 120 patients (2021–2024) showed the following age structure: age ranged from 19 to 44 years, mean age 32.0±6.2 years, median 31.5 years, mode 28 years; the most numerous age group was 26–35 years (55.0%). The mean duration of inpatient treatment was 11.4±3.7 days (median 11.0; range 4–25 days).

Structure of clinical diagnoses: discogenic lumbo-ischialgia – 65.0% (including with radicular syndrome – 54.2%), vertebrogenic lumbago/lumbo-ischialgia without an overt radicular component – 22.5%, discogenic/vertebrogenic radiculopathy – 9.2%, vertebrogenic cervicobrachialgia/cervicolumbalgia – 3.3%. The side of the lesion was documented in 87.5% of patients, with a predominance of left-sided localization (54.3% versus 34.3% right-sided). A pronounced muscular-tonic component was noted in 37.3% of patients, asthenic syndrome in 28.3%. Concomitant somatic pathology was recorded in 56.7% (n=68) of patients, most often chronic prostatitis (13.2%), osteoarthritis of the knee joints (11.8%) and urolithiasis (11.8%).

According to MRI/MSCT data (available in 72.5% of patients), osteochondrosis of the lumbosacral spine was confirmed in all those examined; intervertebral disc herniations were found in 92.0%, protrusions in 56.3%, spinal canal stenosis in 9.2%. The dominant levels of the lesion were L4–L5 (95.0% of hernia cases) and L5–S1 (88.8%); disc herniation sequestration was recorded in 3.8% of cases.

Risk-factor analysis established a direct relationship between the specifics of physically demanding labor and the frequency of RPS exacerbations. In 78% of those examined, exacerbation was associated with carrying loads over 25–30 kg, which shifts the center of gravity forward and increases the load on the posterior parts of the discs and facet joints. In individuals whose occupational activity involves operating machinery (drivers, operators of special vehicles), the risk of developing intervertebral disc herniation was 2.4 times higher than in the rest of those examined, owing to low-

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frequency vibration. Physical inactivity during prolonged forced static posture led to impaired microcirculation of the paravertebral muscles. The predominant localization was lumbosacral (87% of cases); among the levels, L5–S1 (45%) and L4–L5 (35%) predominated. The baseline pain intensity on the VAS was 7.2±1.4 points, the mean Oswestry index was 38%. A feature of the pain syndrome in the patients examined was a pronounced autonomic component (coldness of the limb, skin hyperthermia, dermographism), and 34% of patients showed an atypical, "pseudo-visceral" course of pain, which complicated early diagnosis.

Evidence base for diagnosis: comparison of the clinical picture, MRI and ENMG

In 120 patients, a comprehensive three-stage examination (clinical examination, lumbosacral MRI, ENMG) was carried out to verify the true level and severity of root involvement. Comparison of the clinically suspected level with MRI data (Table 1) revealed a discrepancy in 28% of cases (34 patients): in 26 cases, a herniation at the L4–L5 level clinically presented as an L5 root syndrome due to anatomical displacement of the root, and in 8 cases a "double compression" (herniation plus stenosis above the level) was observed, obscuring topical signs. ENMG revealed signs of active subclinical denervation of the paraspinal and limb muscles in 11 patients (9%) with minimal clinical manifestations (indicating a high risk of deficit progression under load), whereas in 17 patients (14%) with pronounced complaints, no signs of denervation were found on ENMG, indicating a predominantly myofascial nature of the pain and a favorable prognosis.

Table 1. Diagnostic value of individual methods and their combination (n=120)

Diagnostic method	Concordance between clinical and instrumental level	Detection of hidden deficit (no clinical signs)	Confirmation of organic origin of pain	Value for medico-social assessment
Clinical examination	72% (86/120)	0%	60% (subjective)	65%
MRI	100% (visualizes hernia)	0% (does not assess function)	90% (visual control)	85%
ENMG	88% (by nerve level)	14% (17/120)	95% (objective data)	95%
Combination (clinical + MRI + ENMG)	100%	14%	100%	100%

Thus, only comprehensive diagnosis – a combination of clinical examination, neuroimaging and electroneuromyography – provides full verification of the level and severity of the lesion, which is crucial for choosing treatment tactics and issuing an expert opinion on work capacity.

Efficacy of standardized conservative therapy

In 120 patients, a comprehensive conservative therapy protocol was used: NSAIDs (meloxicam 15 mg/day or celecoxib 200 mg/day) for 7–10 days, muscle relaxants (tolperisone 150 mg/day) for 10–14 days, gabapentin 300–900 mg/day for a neuropathic component (n=34), paravertebral blockades with diprospan for acute inflammation (n=28), as well as non-pharmacological methods: exercise

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therapy from day 3, physiotherapy (a course of 7 procedures), manual therapy with soft techniques (n=45).

Table 2. Dynamics of pain (VAS) and functional status (Oswestry) by treatment method (n=120)

Patient group	n	VAS before	VAS after	VAS decrease	ODI before, %	ODI after, %	p
All patients	120	7.8±1.2	3.2±1.5	4.6±1.1	48.3±12.7	22.6±9.8	<0.001
With blockades added	28	8.1±1.0	2.8±1.2	5.3±0.9	–	–	<0.001*
Without blockades	92	7.7±1.3	3.4±1.6	4.3±1.2	–	–	<0.001
With manual therapy	45	7.9±1.1	3.0±1.4	4.9±1.0	–	–	<0.001*
Without manual therapy	75	7.7±1.3	3.3±1.6	4.4±1.3	–	–	<0.001

** – differences statistically significant compared with the group without this method (p<0.05).*

The shortest duration of hospitalization was noted in the groups with blockades (9.8±2.1 days) and manual therapy (10.2±2.8 days) versus 12.0±3.9 and 12.1±3.8 days, respectively, in the comparison groups ($p<0.05$); concomitant pathology increased treatment duration by 3.8 days, and asthenic syndrome by 3.0 days. An improvement of ≥50% on the VAS was achieved in 88.3% of patients overall, and in the subgroups with blockades and manual therapy – in 96.4% and 95.6%, respectively ($p<0.05$ compared with the subgroups without these methods) (Table 2). Surgical treatment was required in only 3.3% of patients (4 of 120), exclusively in cases of disc herniation sequestration (100% of cases in this subgroup versus 0.9% in its absence), which underscores the importance of early MRI diagnosis for selecting candidates for surgery.

Optimization of the algorithm for relieving acute radicular pain syndrome

In 120 patients with acute RPS (duration up to 7 days, VAS >6 points), standard therapy (control group, n=60: diclofenac, muscle relaxants, centrally acting analgesics, physiotherapy, blockades for strict indications) was compared with an optimized algorithm (main group, n=60: selective NSAIDs without a sedative effect, gabapentinoids for a neuropathic component, early ultrasound-guided paravertebral blockades if pain remained >5 points on day 2, and early initiation of exercise therapy).

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Table 3. Dynamics of clinical parameters in the main and control groups (n=120)

Parameter	Main group, before	Main group, after	Control group, before	Control group, after	p (between groups, after)
VAS, points	8.1±0.6	1.8±0.4*	7.9±0.7	3.5±0.5*	<0.05
Lasègue sign, °	30±5	70±5*	32±4	55±6*	<0.05
Schulte test, sec	55.0±2.0	48.0±1.5*	54.0±2.2	62.0±2.5*	<0.05
Oswestry index, %	42.0±3.0	12.0±2.0*	40.0±2.5	24.0±3.0*	<0.05
Bed-days	–	5.2±1.1	–	8.4±1.5	<0.05
Return to work, %	0	82	0	45	<0.05

** – differences significant compared with the "before treatment" value within the group (p<0.05).*

A critically important result was the preservation of cognitive and psychomotor functions in the main group: according to the proofreading test and the Schulte table test, the speed of sensorimotor reactions and concentration of attention not only did not decrease but tended to improve as pain-related stress decreased (Table 3). In the control group, CNS inhibition (a 15–20% slowing of reaction, drowsiness, mild disorientation) was recorded in 11 patients (18.3%) as a side effect of high doses of muscle relaxants and centrally acting drugs, which impeded the performance of duties requiring heightened vigilance. By day 5, 82% of patients in the main group met the criteria for return to full occupational activity, versus 45% in the control group, with a reduction in the length of inpatient treatment of 3.2 days on average.

Dynamics of quality-of-life indicators during therapy

In 120 patients with disc herniations and radicular syndrome receiving standard conservative therapy (NSAIDs, central muscle relaxants, B-group vitamins, physiotherapy, exercise therapy), the dynamics of pain (VAS) and quality of life (Oswestry index) were assessed at three stages: at baseline, at 14 days, and at 30 days (Table 4).

Table 4. Dynamics of pain and quality of life during therapy (n=120, M±m)

Parameter	Before treatment	After 14 days	After 30 days
VAS, points	7.8±0.4	4.2±0.3*	3.1±0.3*
ODI (Oswestry), %	42.6±3.2	28.4±2.5*	18.4±2.1*

** – differences statistically significant compared with baseline (p<0.05).*

Correlation analysis revealed a strong direct relationship between the reduction in VAS pain and the decrease in the ODI (Pearson coefficient r=0.78; p<0.01), confirming that pain relief is the main driver of quality-of-life recovery in this category of patients. By the end of the treatment course, the Oswestry index decreased from the level of "severe disability" (>40%) to the level of "minimal

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disability" (18.4%): 45% of patients reported full recovery of work capacity without restrictions, and another 40% reported the ability to work with minimal restrictions.

Individualized rehabilitation programs for restoring functional reserve

In 120 patients in remission of acute RPS (VAS <4 points), standard rehabilitation (gentle exercise therapy, massage, magnetotherapy; n=60) was compared with an individualized three-stage program for restoring functional reserve (n=60): 1) motor control – isometric tension of deep muscles without axial load (days 1–3); 2) stabilization – exercises on an unstable support with biofeedback (days 4–7); 3) functional loading – strength exercises, resistance training with a gradual weight increase from 5 to 15 kg, ergometry (days 8–14).

Table 5. Dynamics of functional status during rehabilitation (n=120, M±m)

Parameter	Main group, before	Main group, after	Control group, before	Control group, after	p (between groups, after)
Oswestry index, %	38.4±3.1	10.2±1.5*	39.1±2.8	22.5±2.1*	<0.05
Back extensor strength, kg	48.5±4.2	70.6±5.1*	47.9±3.8	56.6±4.5*	<0.05
6-min walk test, m	420±15	560±20*	425±16	480±18*	<0.05
VAS, points	3.8±0.5	0.8±0.2*	3.9±0.6	2.1±0.4*	<0.05
Readiness for full load, %	0	95	0	65	<0.05

** – differences significant compared with the "before treatment" value within the group (p<0.05).*

The strength of the back extensor muscles in the main group increased by 45.6% versus 18.2% in the control group; aerobic endurance (6-minute walk test) increased from 420±15 to 560±20 m, versus an increase from 425±16 to 480±18 m in the control group. The ability to meet physical fitness standards without pain was achieved in 95% of patients in the main group versus 65% in the control group, confirming the inadequacy of standard passive exercise therapy for full recovery of the deep muscular system, which is critical for protecting the spine under physical loads (Table 5).

Discussion

Summarizing the results of a series of studies makes it possible to present a holistic clinical model for managing a patient with radicular pain syndrome – from risk factors and precise topical diagnosis to relief of acute pain and restoration of quality of life and functional reserve. A common feature across all fragments of the program was confirmation that the specifics of physically demanding labor (carrying loads, vibration, physical inactivity, physical overload) act as an independent and modifiable risk factor for accelerated degeneration of the lumbosacral spine [5, 6, 20, 24], while the culture of pain tolerance characteristic of this category of patients contributes to delayed presentation for care and a more severe clinical picture [29, 50].

Data on diagnostic accuracy (a discrepancy between the clinical and MRI level of the lesion in 28% of cases, detection of subclinical denervation on ENMG in 14% of patients) demonstrate that reliance on clinical examination alone is insufficient for making sound decisions – both therapeutic and expert [28, 31]. This is consistent with the general trend in modern vertebrology toward comprehensive,

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multimodal diagnostic verification [9, 15, 18] and echoes the provisions of current clinical guidelines on discogenic lumbosacral radiculopathy, adapted by this group of authors for practicing physicians [5, 7, 20, 32].

The results of the comparative assessment of treatment efficacy show a clear hierarchy of interventions. At the stage of acute pain relief, the pharmacological profile of the drugs used is decisive: replacing non-selective NSAIDs and sedative muscle relaxants with selective NSAIDs and early paravertebral blockades not only accelerates pain relief (a 50% reduction in VAS occurring faster than with standard therapy, already by day 3) but also – critically for preserving work capacity – does not suppress the patient's cognitive and psychomotor functions [36, 41, 44]. At the stage of planned inpatient therapy, the greatest gain in efficacy comes from adding paravertebral blockades and manual therapy to the basic drug regimen [27, 36, 42], confirmed both by a more pronounced reduction in pain (5.3 and 4.9 points versus 4.3–4.4 points) and by a 2–3-day reduction in hospitalization time. Pathogenetically, this is explained by the rapid relief of inflammation and edema in the root zone by blockades [36, 44] and the elimination of biomechanical blocks and muscular-tonic syndromes by manual therapy [27].

It is notable that improvement in objective and subjective pain measures correlates closely with recovery of quality of life (r=0.78 between the dynamics of VAS and ODI), and the Oswestry index itself, with adequate therapy, naturally progresses from "severe" to "minimal" disability within 30 days [25, 38]. At the same time, pain relief alone is not equivalent to restoration of occupational fitness: the rehabilitation data show that standard passive methods (massage, magnetotherapy, gentle exercise therapy) provide only partial recovery of back extensor muscle strength (+18.2%) and endurance, whereas an individualized program involving the formation of a "muscular corset," proprioception training on an unstable support, biofeedback and graded physical loading increases muscle strength almost twice as effectively (+45.6%) and allows 95% of patients to return to full occupational activity versus 65% with the standard approach [43, 47, 49, 51].

The question of indications for surgical treatment deserves special attention. Across all fragments of the program in which this endpoint was assessed, the proportion of patients requiring surgery remained low (3.3%) and was strictly associated with disc herniation sequestration (100% of operated patients in this subgroup versus 0.9% in its absence), which underscores the value of early MRI verification not so much for selecting candidates for conservative therapy as for the timely identification of patients in whom a conservative approach is a priori ineffective [39, 45, 46].

The findings overall are consistent with the literature on the high efficacy of non-pharmacological methods (exercise therapy, manual therapy) as the basis of treatment for chronic back pain [35,43,51] and on the modest, mostly short-term efficacy of isolated drug therapy and epidural steroid injections [36, 40, 44, 48]. At the same time, the patient cohort studied has a number of distinctive features – young age with a high baseline functional reserve, the need for the fastest and most complete possible recovery of work capacity, and a high prevalence of comorbidity (56.7%) and asthenic syndrome (28.3%) that prolong treatment duration [1, 2, 3, 4, 12, 30] – which justify the appropriateness of a more active, pathogenetically oriented tactic (early blockades, individualized kinesiotherapy) compared with general-population protocols [8, 10, 11, 13, 14, 17, 19, 21, 22, 23, 33, 34].

Limitations of the overall research program include differences in the design of individual fragments (with a uniform sample size of 120 patients), the predominantly single-center nature of the

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observations, and the absence of a single end-to-end randomization protocol for all stages of patient management [38]. This underlines the promise of further multicenter prospective studies with a unified protocol covering the entire patient pathway – from diagnosis to return to work – as well as an economic analysis of the proposed algorithms at the healthcare-system level.

Conclusions

1. Patients with RPS are predominantly individuals aged 26–35 years; the leading morphological substrates are herniations and protrusions of the L4–L5 and L5–S1 discs, and high comorbidity (56.7%) together with muscular-tonic/asthenic syndrome account for the prolonged hospitalization and the need to personalize therapy.
2. The leading modifiable risk factors for RPS are carrying loads over 25–30 kg, vibration exposure (a 2.4-fold increase in herniation risk among machinery operators), and physical inactivity, which justifies the need for ergonomic correction of working conditions and specialized exercise-therapy programs.
3. Comprehensive diagnosis (clinical examination + MRI + ENMG) is mandatory, since a discrepancy between the clinical and instrumental level of the lesion is found in 28% of cases, and subclinical denervation in 14%, which is crucial for choosing treatment tactics and for medico-social assessment of work capacity.
4. Pain relief is the main driver of quality-of-life recovery (r=0.78 between the dynamics of VAS and ODI), while the Oswestry index, with adequate therapy, decreases from severe to minimal disability within 30 days.
5. An optimized algorithm for relieving acute pain, based on selective NSAIDs and early blockades, provides twice as fast pain relief without suppressing cognitive function and increases the proportion of patients returning to work by day 5 from 45% to 82%.
6. Standardized conservative therapy for RPS is highly effective: an improvement of ≥50% on the VAS is achieved in 88.3% of patients, surgery is required in only 3.3% (exclusively in cases of herniation sequestration), and the addition of blockades and manual therapy increases the effect and shortens hospitalization by 2–3 days.
7. Individualized three-stage rehabilitation programs are almost twice as effective as standard methods in restoring the strength of the back extensor muscles (+45.6% versus +18.2%) and allow 95% of patients to return to full occupational activity.
8. The findings justify the introduction of differentiated, pathogenetically oriented protocols for the diagnosis, treatment, and rehabilitation of RPS, aimed at preserving the work capacity and quality of life of patients.

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