

Original Article

Digital Telerehabilitation for Lumbar Disc Herniation: Real-World Evidence and Protocol Development

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Abstract

Digital telerehabilitation may improve access to conservative treatment for patients with low back pain by supporting continuity of therapeutic exercise, remote monitoring, and structured clinical follow-up. This article analyzes real-world outcomes from a Romanian digital telerehabilitation platform in patients with valid baseline and final low back pain scores and links these outcomes to the development of a standardized online physiotherapy protocol for lumbar disc herniation. A retrospective analysis was performed on 93 patients with low back pain who completed paired pain assessments. Mean low back pain decreased from 5.23 to 3.49 points, with a mean reduction of 1.73 points. A clinically relevant improvement of at least two points was observed in 53.76% of patients. The greatest improvements were recorded in patients with severe baseline pain. These findings support the feasibility of digital telerehabilitation and justify prospective validation of a pathology-specific online protocol.

1. Introduction

Low back pain is one of the most common musculoskeletal conditions and represents a major cause of disability, limitation of daily activities, and reduced quality of life. Its clinical relevance is determined not only by pain intensity, but also by its recurrent nature, tendency toward chronicity, and interaction between biological, psychological, and social factors. The global burden of low back pain has been repeatedly emphasized in the scientific literature, as it is considered one of the leading causes of years lived with disability worldwide (Hartvigsen et al., 2018). Therefore, the development of accessible, structured, and sustainable

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rehabilitation models remains an important priority in contemporary musculoskeletal care.

Lumbar disc herniation is a common clinical entity within the broad spectrum of low back pain, particularly when lumbar symptoms are associated with radicular pain, paresthesia, reduced tolerance to movement, or functional limitation. However, lumbar disc pathology should not be interpreted exclusively through the lens of imaging findings. Disc degeneration, protrusion, and other structural changes may also be identified in asymptomatic individuals, especially with increasing age (Brinjikji et al., 2015). This highlights the importance of correlating magnetic resonance imaging findings with clinical examination, pain intensity, neurological signs, and functional status.

Conservative treatment is recommended as the first therapeutic option in most cases of low back pain and lumbar disc pathology, except in situations involving severe neurological deficits, cauda equina syndrome, or a clear surgical indication. The clinical guideline of the American College of Physicians supports the use of non-invasive interventions in the management of acute, subacute, and chronic low back pain (Qaseem, Wilt, McLean, & Forciea, 2017). In this context, therapeutic exercise is a central component of conservative management, aiming to reduce pain, restore mobility, improve neuromuscular control, and increase functional capacity.

Exercise therapy has been shown to have beneficial effects in chronic low back pain, particularly when programs are structured, progressive, and adapted to the patient's functional status (Hayden, Ellis, Ogilvie, Malmivaara, & Van Tulder, 2021). In patients with lumbar disc herniation, physiotherapy should target not only local symptoms, but also lumbopelvic motor control, segmental stability, mobility, progressive loading, and the gradual restoration of confidence in movement. The therapeutic process should therefore integrate biomechanical, neuromuscular, and behavioral components.

The biopsychosocial model of low back pain further supports the need for an integrated approach to rehabilitation. Pain is not determined solely by anatomical or structural changes, but also by cognitive, emotional, and behavioral factors. Fear of movement, illness-related anxiety, and avoidance behaviors may contribute to persistent disability and reduced adherence to rehabilitation. The fear-avoidance model explains how perceiving movement as threatening can lead to reduced activity, physical deconditioning, and chronic disability (Leeuw, Goossens, Linton, Crombez, Boersma, & Vlaeyen, 2007). For this reason, rehabilitation programs for lumbar disc pathology should include patient education, progressive exposure to movement, and strategies that increase confidence in physical activity.

In parallel with the development of conservative rehabilitation strategies, digital health technologies have created new possibilities for delivering therapeutic interventions outside the conventional clinical setting. Telemedicine and telerehabilitation can improve access to care, reduce geographical barriers, and support treatment continuity for patients with chronic or recurrent musculoskeletal conditions. Telehealth has been described as an important model for improving

access and maintaining continuity of care, especially when patients face barriers related to distance, mobility, time, or availability of specialized services (Bouabida, Lebouché, & Pomey, 2022; Garfan et al., 2021).

Telerehabilitation refers to the delivery of rehabilitation services through information and communication technologies. In musculoskeletal care, it may include video-guided therapeutic exercises, digital monitoring, remote feedback, patient education, and structured follow-up. This model is particularly relevant for low back pain because successful rehabilitation depends on repeated exposure to exercise, correct progression, adherence, and long-term behavioral change. Unlike an isolated medical consultation, rehabilitation is a longitudinal process that requires continuity, monitoring, and adaptation.

Evidence from systematic reviews and meta-analyses suggests that telerehabilitation may produce outcomes comparable to conventional face-to-face rehabilitation for several musculoskeletal conditions. Cottrell, Galea, O'Leary, Hill, and Russell (2017) concluded that real-time telerehabilitation for musculoskeletal conditions can be effective and comparable with standard practice in improving pain and physical function. Similarly, Seron et al. (2021), in a rapid overview of telerehabilitation in physical therapy, reported favorable effects across several clinical populations, while also emphasizing the need for better methodological quality and standardized interventions.

In chronic low back pain, digital rehabilitation programs have also shown promising results. A recent randomized controlled trial reported that telerehabilitation may improve pain and disability in patients with chronic low back pain, supporting its potential role as a non-invasive therapeutic model (Villatoro-Luque et al., 2025). However, the literature remains heterogeneous regarding patient selection, intervention content, exercise dosage, level of supervision, and outcome assessment tools. Many studies analyze low back pain as a general category and do not clearly isolate patients with imaging-confirmed lumbar disc herniation.

This methodological limitation is important because lumbar disc herniation has specific clinical features that may require pathology-adapted rehabilitation. Patients may present with local low back pain, radicular symptoms, reduced neural mobility, protective muscle tone, altered lumbopelvic control, and fear of movement. Therefore, a digital intervention for lumbar disc herniation should not be a simple collection of general exercises. It should be a structured, progressive, and clinically monitored protocol adapted to symptom severity, functional capacity, and the presence or absence of radicular signs.

Another relevant gap concerns the limited integration of real-world data into the development of digital rehabilitation protocols. Randomized controlled trials remain essential for evaluating efficacy, but real-world evidence can provide valuable information regarding feasibility, adherence, patient follow-up, clinical engagement, and patient response patterns in routine practice. Digital platforms generate operational and clinical data that can help identify patient subgroups that respond better, the frequency with which patients complete final assessments, and

the level of engagement associated with better outcomes.

The present article addresses this gap by analyzing a specific subgroup of patients with low back pain treated through a Romanian digital telerehabilitation platform. From the available platform data, the analysis was restricted to patients who had valid baseline and final low back pain scores. This decision was made to align the retrospective real-world analysis with the clinical objective of developing a standardized online physiotherapy protocol for lumbar disc herniation.

The analyzed subgroup included 93 patients with low back pain and valid paired pain assessments. In this subgroup, mean low back pain decreased from 5.23 to 3.49 points, corresponding to a mean reduction of 1.73 points. Furthermore, 53.76% of patients achieved a clinically significant improvement of at least two points. The largest reductions were observed in patients with severe baseline low back pain. These findings suggest that digital telerehabilitation may be associated with clinically relevant pain reduction in selected patients with low back pain and may provide a useful empirical basis for future protocol development.

The two-point threshold was selected because interpretation of pain outcomes must consider not only statistical change, but also clinical relevance for the patient. Recommendations for chronic pain trials emphasize the importance of interpreting therapeutic outcomes according to clinically meaningful thresholds (Dworkin et al., 2008). In low back pain research, the minimal important change is essential for determining whether an observed pain reduction is meaningful in practice and not merely a numerical change (Ostelo et al., 2008).

Although the retrospective dataset analyzed in this article focuses on low back pain and does not confirm lumbar disc herniation by imaging in all patients, the results are clinically relevant for the development of a prospective protocol. The doctoral project connected with this article proposes a six-month online physiotherapy intervention for patients with lumbar disc herniation confirmed by magnetic resonance imaging. The proposed protocol includes pain assessment, lumbar mobility assessment, clinical tests for radicular irritation, adherence monitoring, psychological assessment, and imaging follow-up.

Therefore, the aim of this article is twofold. First, it analyzes real-world outcomes in 93 patients with low back pain who completed baseline and final low back pain assessments through a digital telerehabilitation platform. Second, it uses these outcomes to support the development of a standardized online physiotherapy protocol for patients with lumbar disc herniation. By combining real-world evidence with protocol development, this article contributes to the scientific foundation of telerehabilitation as a complementary model in the conservative management of lumbar disc pathology.

2. Material and methods

Study Design

This article was designed as a retrospective real-world evidence analysis combined with the development of a standardized online physiotherapy protocol for lumbar disc herniation. The retrospective component focused on patients with

low back pain who used a Romanian-origin digital telerehabilitation platform operating within the European Union and who had valid paired pain assessments. The methodological component used these results to support the development of a pathology-specific prospective interventional protocol for patients with magnetic resonance imaging-confirmed lumbar disc herniation.

The study was structured in two complementary stages. The first stage consisted of a retrospective analysis of platform data, limited to patients with valid baseline and final low back pain scores. The second stage consisted of the development of a standardized online physiotherapy protocol grounded in the clinical evolution observed in the low back pain subgroup and in current principles of conservative rehabilitation for lumbar disc pathology.

This design was chosen because digital real-world data can provide important information regarding feasibility, patient engagement, and clinical response patterns in routine practice. At the same time, retrospective data alone cannot establish causality and cannot replace prospective validation. Therefore, the article uses real-world analysis as a foundation for protocol development, while acknowledging the need for future prospective testing in a clearly defined population of patients with lumbar disc herniation.

Aim of the Research

The aim of this study was to analyze pain-related outcomes in a subgroup of patients with low back pain treated through a digital telerehabilitation platform and to use these findings to develop a standardized online physiotherapy protocol for lumbar disc herniation.

The specific objectives were:

- identifying patients with valid baseline and final low back pain scores from the digital platform database;
- analyzing the change in low back pain intensity after participation in the telerehabilitation pathway;
- determining the proportion of patients who achieved a clinically significant reduction in pain;
- exploring the influence of baseline pain severity on the magnitude of improvement;
- developing a structured online physiotherapy protocol for future prospective validation in patients with imaging-confirmed lumbar disc herniation.

Research Hypotheses

The retrospective analysis was guided by the following working hypotheses:

Hypothesis 1. Digital telerehabilitation is associated with a reduction in low back pain intensity in patients with valid baseline and final low back pain scores.

Hypothesis 2. A clinically significant reduction in low back pain, defined as a decrease of at least two points, can be observed in a relevant proportion of patients.

Hypothesis 3. Patients with severe baseline low back pain show a greater reduction in pain compared with patients with mild or moderate baseline pain.

Hypothesis 4. Real-world findings regarding low back pain can support the development of a standardized online physiotherapy protocol for patients with

lumbar disc herniation.

These hypotheses are exploratory and descriptive. Because the study used retrospective observational data and did not include a control group, the analysis was not designed to demonstrate causality.

Data Source and Participants

Data were extracted from the RestartiX digital telerehabilitation platform, a Romanian platform that provides remote musculoskeletal rehabilitation services. The platform allows patients to access online consultations, receive personalized rehabilitation plans, follow video-guided therapeutic exercises, report perceived pain, and monitor treatment adherence and progress remotely.

The initial platform database included patients with different painful musculoskeletal regions. For the present article, the analysis was restricted to patients with low back pain who had valid paired pain assessments. This decision was made to align the retrospective analysis with the clinical objective of developing a standardized online protocol for lumbar disc herniation.

The inclusion criteria for the retrospective analysis were:

- presence of a baseline low back pain score;
- presence of a final low back pain score;
- pain values within the valid range from zero to ten points;
- participation in a digital telerehabilitation pathway through the platform.

The exclusion criteria were:

- absence of a baseline low back pain score;
- absence of a final low back pain score;
- invalid pain values outside the accepted range from zero to ten;
- incomplete data that did not allow pre-post comparison.

After applying these criteria, the final analyzed sample included 93 patients with low back pain and valid paired low back pain scores. This subgroup represents the main analytical sample of the present article.

Although the retrospective subgroup was defined by the presence of low back pain rather than by systematic magnetic resonance imaging confirmation of lumbar disc herniation, it was considered relevant for the methodological development of the proposed protocol. The prospective protocol described in this article will specifically target patients with imaging-confirmed lumbar disc herniation.

Analyzed Indicators

The primary indicator was the change in low back pain intensity between the baseline and final assessments. Pain intensity was assessed using the visual analogue scale, expressed on a numerical range from zero to ten, where zero represents no pain and ten represents maximum pain intensity.

The following indicators were analyzed:

- baseline low back pain score;
- final low back pain score;
- mean change in low back pain;
- median change in low back pain;

- proportion of patients with any pain improvement;
- proportion of patients with clinically significant improvement;
- proportion of patients with unchanged pain;
- proportion of patients with pain worsening.

Pain change was calculated as follows:

Baseline low back pain score minus final low back pain score.

A positive value indicated improvement, a zero value indicated no change, and a negative value indicated worsening.

Clinically significant improvement was defined as a reduction of at least two points on the pain scale. This threshold was selected based on recommendations emphasizing the importance of interpreting pain outcomes according to clinically relevant changes, not only numerical or statistical variations (Dworkin et al., 2008; Ostelo et al., 2008).

Stratification According to Baseline Pain Severity

To explore whether baseline pain intensity influenced therapeutic response, patients were divided into three groups according to low back pain severity at baseline:

- mild pain: zero to three points;
- moderate pain: four to six points;
- severe pain: seven to ten points.

This classification allowed comparison of pain evolution according to the initial symptom level. Stratification was considered clinically relevant because patients with low baseline pain have limited numerical potential for improvement, whereas patients with severe baseline pain may have greater potential for clinically significant reduction.

The subgroup analysis was exploratory and was used to identify response patterns that may guide patient selection and future protocol development.

Digital Telerehabilitation Pathway

Patients included in the retrospective analysis received care through a digital telerehabilitation pathway. The platform enabled the delivery of therapeutic exercise programs through video-guided sessions and remote monitoring. Patients could receive rehabilitation plans adapted to their clinical needs and perform the exercises at home according to recommendations provided through the platform.

The digital pathway included the following components:

- clinical orientation or remote consultation;
- allocation of a rehabilitation plan;
- access to video-guided therapeutic exercises;
- completion of prescribed exercise sessions;
- digital monitoring of plan progress;
- reassessment of pain intensity at follow-up.

The retrospective data showed that this digital pathway was used not only for exercise delivery, but also for continuity of care and patient monitoring. In the analyzed lumbar subgroup, the mean number of consultations was 2.42 per patient,

and the mean number of rehabilitation plans was 3.63 per patient. These operational indicators suggest that the intervention was not limited to passive access to exercise videos, but involved repeated clinical interaction and structured rehabilitation planning.

Development of the Standardized Online Physiotherapy Protocol

The second component of the study consisted of developing a standardized online physiotherapy protocol for lumbar disc herniation. This protocol was grounded in the real-world results observed in the 93 patients with low back pain and in the doctoral project focused on online physiotherapy for patients with lumbar disc herniation.

The proposed protocol is intended for patients aged 45 to 65 years who are diagnosed with lumbar disc herniation confirmed by magnetic resonance imaging. The planned intervention duration is six months, with baseline and final assessments.

The proposed inclusion criteria for the prospective protocol are:

- diagnosis of lumbar disc herniation confirmed by magnetic resonance imaging;
- low back pain with or without radicular symptoms;
- age between 45 and 65 years;
- ability to use the digital platform;
- willingness to participate in an online rehabilitation program.

The proposed exclusion criteria are:

- immediate surgical indication;
- severe neurological deficits;
- spinal surgery within the last two years;
- associated severe neurological conditions;
- medical contraindications to therapeutic exercise.

The protocol includes assessment of clinical, functional, psychological, and imaging indicators. Pain intensity is assessed using a standardized pain scale. Lumbar mobility is assessed through digital goniometry and functional movement tests. Radicular irritation is assessed through clinical tests such as Lasègue and Slump. Psychological factors are assessed through standardized tools for anxiety, illness-related concern, or fear of movement. Imaging assessment is performed by magnetic resonance imaging at the beginning and end of the intervention.

The doctoral project underpinning this protocol proposes a six-month intervention that includes progressive therapeutic exercise, digital monitoring, functional assessment, adherence monitoring, and imaging follow-up.

Structure of the Proposed Intervention

The proposed online intervention is progressively structured and adapted to the clinical characteristics of lumbar disc herniation. Progression follows several methodological principles:

- from unloading positions to loading positions;
- from basic motor control to dynamic stability;

- from small, controlled ranges of motion to functional ranges;
- from symptom reduction to functional reintegration;
- from guided execution to self-regulated movement.

The first phase of the intervention focuses on symptom reduction and basic neuromuscular re-education. It includes relaxation techniques, gentle mobility exercises, controlled lumbopelvic movements, neurodynamic mobilizations when indicated, and activation of the deep stabilizing musculature. Exercises are performed predominantly in unloading or low-load positions, such as supine lying, side lying, or quadruped position.

The second phase focuses on dynamic stability and functional progression. It includes lumbopelvic stabilization, strengthening of the gluteal musculature, hip movement control, trunk control, anti-rotation exercises, and functional exercises performed in sitting and standing positions. The objective is to improve load tolerance, coordination, and confidence in movement.

The final phase focuses on consolidation of results and prevention of recurrence. Exercises are adapted according to symptom evolution, functional capacity, and patient tolerance. The objective is to maintain mobility, improve stability, reduce fear of movement, and support long-term self-management.

In case of symptom worsening, the protocol allows regression by reducing range of motion, decreasing exercise volume, returning to unloading positions, and emphasizing symptom-control strategies. This safety mechanism is particularly important in online rehabilitation, where patient self-regulation must be clearly guided.

Statistical Analysis

The analysis was descriptive and exploratory. Mean values were calculated for baseline low back pain, final low back pain, and pain reduction. The proportion of patients with any improvement, clinically significant improvement, unchanged pain, and pain worsening was also calculated.

Subgroup analysis was performed according to baseline pain severity. Results were interpreted in relation to clinical relevance, with special attention to the proportion of patients who achieved a pain reduction of at least two points.

Because the study was retrospective, observational, and did not include a control group, no causal conclusions were formulated. Results were used to identify clinical response patterns from real-world practice and to support the methodological development of a standardized prospective protocol.

Ethical Considerations

The retrospective analysis used anonymized operational and clinical data extracted from the digital telerehabilitation platform. No information allowing personal identification of patients was included. The proposed prospective protocol will require informed consent, ethical approval, and compliance with data protection regulations before implementation.

The interpretation of retrospective results was performed with caution, given the observational design, incomplete follow-up in the broader platform population, and the absence of systematic imaging confirmation in all patients included in the

low back pain subgroup.

3. Results and Discussions

The present analysis focused exclusively on patients with low back pain who had valid baseline and final low back pain scores. After applying the inclusion criteria, the final sample included 93 patients. This decision was made to provide a clinically coherent analysis centered on low back pain and to create a methodological link to the development of a standardized online physiotherapy protocol for lumbar disc herniation.

The main indicator analyzed was the change in low back pain intensity between the baseline and final assessments. The mean baseline low back pain score was 5.23 points, whereas the mean final score was 3.49 points. The mean reduction in low back pain was 1.73 points. The median reduction was 2 points, indicating that at least half of the patients achieved a reduction that may be considered clinically relevant according to commonly used thresholds for interpreting pain outcomes (Dworkin et al., 2008; Ostelo et al., 2008).

Table 1. *Evolution of low back pain in patients with valid paired assessments*

Indicator	Value
Number of patients	93
Mean baseline low back pain score	5.23
Mean final low back pain score	3.49
Mean pain reduction	1.73
Median pain reduction	2.00
Patients with pain improvement	62
Percentage of patients with pain improvement	66.67%
Patients with clinically significant improvement	50
Percentage with clinically significant improvement	53.76%
Patients with unchanged pain	18
Patients with pain worsening	13

The results indicate that digital telerehabilitation was associated with a clinically relevant reduction in low back pain in this subgroup. A total of 62 patients, representing 66.67% of the sample, showed some degree of pain improvement. More importantly, 50 patients, representing 53.76% of the sample, achieved a reduction of at least two points. This threshold is relevant because changes in pain intensity must be interpreted not only statistically, but also according to the minimal clinically important difference perceived by the patient (Dworkin et al., 2008; Ostelo et al., 2008).

These results are consistent with previous evidence suggesting that telerehabilitation can be effective in musculoskeletal conditions. Cottrell et al. (2017) reported that real-time telerehabilitation for musculoskeletal disorders can produce outcomes comparable to conventional face-to-face rehabilitation in terms of pain and physical function. Similarly, Seron et al. (2021) concluded that

telerehabilitation in physical therapy can provide favorable clinical outcomes in different patient populations, although the authors emphasized the need for better standardization of interventions.

The present findings are also compatible with the broader evidence supporting exercise therapy in low back pain. Hayden et al. (2021) showed that exercise therapy has beneficial effects in chronic low back pain, especially when programs are structured and adapted to the patient's condition. In the present analysis, the digital pathway included therapeutic exercise plans, repeated clinical interaction, and monitoring through the platform, aspects that may explain the observed reduction in pain intensity.

A particularly relevant aspect of the results is the proportion of patients who achieved clinically significant improvement. More than half of the analyzed patients had a pain reduction of at least two points. This suggests that, for a selected subgroup of patients with low back pain, digital telerehabilitation may be more than a logistical alternative to clinic-based rehabilitation. It may represent a useful clinical model when the intervention is structured, monitored, and associated with repeated therapeutic engagement.

However, the presence of 18 patients with unchanged pain and 13 patients with pain worsening indicates that the response to digital telerehabilitation was not uniform. This heterogeneity is clinically important and supports the need for better patient selection, standardized progression criteria, and closer monitoring of patients who do not improve. Low back pain is a multifactorial condition influenced by biological, psychological, and behavioral factors, and not all patients are expected to respond in the same way to the same digital pathway (Hartvigsen et al., 2018; Leeuw et al., 2007).

Results According to Baseline Pain Severity

To better understand the response pattern, patients were divided into three groups according to baseline low back pain severity: mild pain, moderate pain, and severe pain. This analysis highlighted important differences between groups.

Table 2. *Evolution of low back pain according to baseline pain severity*

Baseline severity	n	Baseline pain	Final pain	Reduction	Clinically significant
Mild pain	20	2.25	2.40	-0.15	30.00%
Moderate pain	46	5.04	3.93	1.11	41.30%
Severe pain	27	7.74	3.56	4.19	92.59%

The most important improvement was observed in patients with severe baseline pain. In this subgroup, the mean pain score decreased from 7.74 to 3.56 points, corresponding to a mean reduction of 4.19 points. Furthermore, 92.59% of patients with severe baseline pain achieved a clinically significant reduction of at least two points.

This finding is clinically important because it suggests that patients with a greater initial symptom burden may have greater potential for improvement

through digital telerehabilitation. It is also possible that patients with severe pain are more motivated to follow the therapeutic pathway, more likely to engage with the prescribed exercises, or more receptive to structured guidance. However, because the study was retrospective and observational, these interpretations remain exploratory.

Patients with moderate baseline pain also improved, but to a lesser extent. Their mean pain score decreased from 5.04 to 3.93 points, corresponding to a mean reduction of 1.11 points. In this subgroup, 41.30% achieved a clinically significant improvement. This suggests that digital telerehabilitation may also benefit patients with moderate low back pain, although the magnitude of improvement appears smaller than in patients with severe baseline pain.

By contrast, patients with mild baseline pain did not show mean improvement. Their mean score changed from 2.25 to 2.40 points, corresponding to a small negative mean change of -0.15 points. This may be explained by a lower-floor effect. When baseline pain is already low, the numerical possibility of achieving a large decrease is limited. In addition, patients with mild symptoms may be less adherent, less motivated, or may experience natural fluctuations in symptoms that are not necessarily related to the intervention.

Differences between severity groups support the importance of baseline stratification in future telerehabilitation research. If all patients are analyzed together, the overall mean change may underestimate clinically relevant effects in certain subgroups. In the present study, the overall reduction of 1.73 points becomes more meaningful when interpreted together with the subgroup of patients with severe pain, where the mean reduction exceeded four points.

This finding has direct relevance for the proposed prospective protocol for lumbar disc herniation. Patients with imaging-confirmed lumbar disc herniation may present with different levels of baseline pain, radicular symptoms, and functional limitations. Therefore, the future protocol should include baseline severity stratification and should analyze whether baseline pain intensity, radicular involvement, or psychological factors predict response to online physiotherapy.

Operational Indicators of the Digital Telerehabilitation Pathway

The analyzed subgroup also provides useful information regarding the operational feasibility of digital telerehabilitation. Among the 93 patients with low back pain, the mean number of consultations was 2.42 per patient, and the median number of consultations was 2. The mean number of rehabilitation plans was 3.63 per patient. In this subgroup, a total of 137,760 exercises were prescribed, with a mean of 1,565 prescribed exercises per patient with plan data.

The mean progress of the last rehabilitation plan was 41.89%, while the median progress was 36%. The mean interval between the baseline and final assessments was 102 days, and the median interval was 81 days. These indicators suggest that the digital pathway was not limited to a single interaction or passive access to an exercise library. On the contrary, patients received repeated plans and were followed over a period of approximately three months.

Table 3. *Operational indicators in the subgroup of patients with low back pain*

Indicator	Value
Mean number of consultations per patient	2.42
Median number of consultations	2
Patients with rehabilitation plan data	88
Mean number of rehabilitation plans per patient	3.63
Total prescribed exercises	137,760
Mean prescribed exercises per patient with plan data	1,565
Mean progress of the last plan	41.89%
Median progress of the last plan	36.00%
Mean interval between baseline and final assessment	102 days
Median interval between baseline and final assessment	81 days

These results are important because telerehabilitation should not be understood as a simple replacement of face-to-face sessions with exercise videos. The analyzed data suggest a digitally supported care model that includes consultation, prescription, education, adherence monitoring, and reassessment. This distinction is essential for clinical interpretation. A platform that provides the technological support required for the delivery of telerehabilitation services may produce different results than a platform that only provides access to an exercise library, because the former offers a pathway that includes professional guidance and repeated clinical contact.

The mean number of consultations may have contributed to the positive outcomes observed in the subgroup. Repeated clinical interaction can support adherence, clarify exercise execution, adjust therapeutic progression, and increase patient confidence. This is consistent with the idea that rehabilitation is not merely a set of exercises, but a guided behavioral and functional process.

However, the median progress of the last plan was only 36%, indicating that adherence remains a challenge. This finding is consistent with the broader digital health literature, where long-term engagement and adherence are frequently reported as major implementation barriers. In future protocols, adherence should be monitored more precisely, and strategies such as automated reminders, scheduled reassessments, motivational feedback, and clinician alerts should be considered, together with AI-based technical support.

Interpretation in Relation to Protocol Development for Lumbar Disc Herniation

Although the retrospective subgroup included patients with low back pain and not exclusively patients with magnetic resonance imaging-confirmed lumbar disc herniation, the results are highly relevant for protocol development. The observed reduction in low back pain suggests that a structured digital pathway can support clinical improvement in selected patients with lumbar symptoms.

The proposed online physiotherapy protocol for lumbar disc herniation should start from these findings, but it must address the limitations of the retrospective dataset. First, future studies should include imaging confirmation in all participants. Second, pain outcomes should be complemented by functional measures, such as lumbar mobility, disability scores, and tests for radicular irritation. Third, psychological factors, such as fear of movement and illness-related anxiety, should be assessed because they may influence adherence and clinical outcomes.

This direction is aligned with the doctoral project, which proposes a six-month online intervention for patients with magnetic resonance imaging-confirmed lumbar disc herniation. The protocol includes pain assessment, lumbar mobility testing, clinical tests for radicular irritation, adherence monitoring, psychological assessment, and imaging follow-up.

Real-world results support the need for such a protocol. Subgroup analysis showed that patients with severe baseline low back pain had the greatest reductions. This suggests that future research should not report only average outcomes, but should identify patient profiles that respond favorably. Patients with severe pain, radicular symptoms, increased anxiety, or reduced adherence may require different progression strategies, different monitoring intensity, or additional clinical contact.

Discussions

Comparison with the Scientific Literature

The findings of the present analysis are generally consistent with previous evidence supporting telerehabilitation in musculoskeletal conditions. Cottrell et al. (2017) reported that real-time telerehabilitation can achieve outcomes comparable to conventional rehabilitation in terms of pain and physical function in musculoskeletal conditions. The present analysis extends this perspective by providing real-world data from a Romanian digital platform and by focusing specifically on patients with low back pain.

Seron et al. (2021) emphasized that telerehabilitation can be effective in physical therapy, but also noted the need for standardized protocols and better methodological quality. The present article responds to this need by linking retrospective platform results with the development of a standardized online physiotherapy protocol for lumbar disc herniation.

In relation to low back pain, Hayden et al. (2021) confirmed the beneficial role of exercise therapy, while Qaseem et al. (2017) recommended non-invasive therapeutic strategies for low back pain. The present results support the feasibility of delivering this type of conservative exercise-based care through a digital platform, at least in selected patients with low back pain.

The findings are also consistent with the results reported by Villatoro-Luque et al. (2025), who investigated telerehabilitation in chronic low back pain and reported improvements in pain and disability. However, the present analysis differs because it is based on routine platform data and not on a randomized controlled trial. This distinction is important. The current results should be interpreted as

signals of feasibility and real-world effectiveness, not as definitive evidence of efficacy.

Clinical Relevance and Practical Implications

The most clinically relevant finding of this analysis is that more than half of the patients with paired low back pain assessments achieved a clinically significant pain reduction. This suggests that digital telerehabilitation may be particularly useful when the patient is correctly selected, receives structured guidance, and remains engaged in the therapeutic process.

For clinical practice, the results support several implications. First, patients with low back pain should be stratified according to baseline pain severity. Second, severe pain should not automatically exclude patients from digital rehabilitation, as long as red flags and surgical indications are excluded. In fact, the present data suggest that patients with severe baseline pain may substantially benefit from structured digital care.

Third, telerehabilitation should include monitoring and follow-up, not only exercise prescription. The improvement observed in the analyzed subgroup must be interpreted in the context of repeated consultations, multiple rehabilitation plans, and longitudinal follow-up. This supports the idea that digital rehabilitation should be organized as a care pathway, not as a passive library of digital exercises.

Fourth, future protocols for lumbar disc herniation should integrate clinical, functional, psychological, and imaging indicators. Pain reduction is important, but it is not sufficient for a complete assessment of therapeutic impact. Mobility, disability, radicular signs, confidence in movement, and imaging evolution may provide a more comprehensive understanding of patient progress.

Limitations of the Results

The results must be interpreted with caution. First, the study was retrospective and observational, which means that causal relationships cannot be established. Second, there was no control group; therefore, the observed improvements cannot be attributed exclusively to the digital intervention. Natural recovery, additional treatments, medication use, or changes in daily activities may have contributed to symptom evolution.

Third, the analyzed subgroup included patients with low back pain, but not all patients had systematic imaging confirmation of lumbar disc herniation. Therefore, the results cannot be directly generalized to all patients with confirmed lumbar disc herniation. Instead, they should be considered a real-world foundation for the development and testing of a future pathology-specific protocol.

Fourth, the primary indicator was pain intensity. Although pain is clinically important, it does not fully describe functional recovery. Future studies should include disability questionnaires, lumbar mobility measurements, radicular tests, psychological scales, and imaging outcomes.

Fifth, adherence was measured through platform progress indicators, which may not fully capture exercise execution quality, effort intensity, or the patient's level of engagement outside the platform. This limitation is particularly relevant in

digital rehabilitation, where exercise execution quality may vary substantially between patients.

Despite these limitations, the present analysis provides relevant real-world evidence. It shows that a subgroup of patients with low back pain can achieve clinically relevant improvement through a digital telerehabilitation pathway and supports the development of a more rigorous prospective protocol for lumbar disc herniation.

4. Conclusions

The present study analyzed real-world outcomes from a digital telerehabilitation platform in a subgroup of 93 patients with low back pain who had valid baseline and final low back pain assessments. The results showed a mean reduction in low back pain from 5.23 to 3.49 points, corresponding to a mean improvement of 1.73 points. More than half of the patients achieved a clinically significant reduction of at least two points, suggesting that digital telerehabilitation may be associated with relevant pain improvement in selected patients with lumbar symptoms.

The most important finding was observed in patients with severe baseline low back pain. In this subgroup, the mean pain reduction was 4.19 points, and 92.59% of patients achieved clinically significant improvement. This result suggests that baseline pain severity may influence the magnitude of therapeutic response and should be considered in future telerehabilitation protocols and patient stratification strategies.

Operational data also support the feasibility of a digitally assisted rehabilitation pathway. Patients benefited from repeated consultations, multiple rehabilitation plans, and structured exercise prescription over a follow-up period of approximately three months. These findings indicate that telerehabilitation should not be reduced to passive access to exercise videos, but should be understood as a guided digital care pathway that includes clinical orientation, therapeutic planning, monitoring, education, and reassessment.

However, the results must be interpreted with caution. The study was retrospective and observational, without a control group, and the analyzed subgroup included patients with low back pain, not exclusively patients with imaging-confirmed lumbar disc herniation. Therefore, the results cannot demonstrate causality and cannot be directly generalized to all patients with confirmed disc pathology. Instead, they should be considered real-world evidence supporting the feasibility and potential clinical relevance of digital telerehabilitation for low back pain.

The findings provide a data-based justification for the development and prospective validation of a standardized online physiotherapy protocol for lumbar disc herniation. Future research should include patients with magnetic resonance imaging-confirmed diagnosis, standardized clinical and functional assessments, validated disability scales, psychological assessment, adherence monitoring, and imaging follow-up. Such a protocol could clarify which patients benefit most from

digital rehabilitation and under which clinical conditions online physiotherapy can become a reliable complementary model in the conservative management of lumbar disc herniation.

In conclusion, digital telerehabilitation appears to be a feasible and potentially useful model for selected patients with low back pain. The observed pain reduction, especially in patients with severe baseline symptoms, supports the development of structured online rehabilitation pathways. Prospective studies are required to validate the proposed protocol and determine its effectiveness in patients with confirmed lumbar disc herniation.

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