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Original article

Short-term effect of neural mobility technique in people with chronic low back pain: A quasi-experimental study

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ABSTRACT

Background & Aim: Chronic low back pain (CLBP) is a highly prevalent musculoskeletal condition and one of the leading causes of disability worldwide. Conservative management frequently involves physiotherapy-based interventions. This study aims to identify the short-term effects of the Slump neural mobilization slide technique on pain, neurological symptoms, and lumbar mobility in individuals with CLBP.

Methods: A quasi-experimental study was conducted with a convenience sample of 30 adults with CLBP currently undergoing physiotherapy. Pain intensity (NPRS): standing, sitting, and during the Modified Schober Test, neurological symptoms (DN4), and lumbar range of motion (Modified Schober Test) were assessed immediately before and after the intervention. Non-parametric analyses (Wilcoxon test) were performed with a 95% confidence interval. Effect sizes (r) were estimated from reported p-values.

Results: Statistically significant short-term improvements were observed in all outcomes following the intervention. Pain decreased in standing ($p<0.01$; $r=0.47$), sitting ($p<0.001$; $r=0.60$), and during the Modified Schober Test ($p<0.01$; $r=0.50$). Lumbar mobility improved significantly ($p<0.01$; $r=0.55$), and DN4 scores decreased ($p<0.01$; $r=0.40$), indicating moderate to large effects. Improvements were consistent across different Slump technique components.

Conclusions & Recommendations: The Slump slide technique appears to produce favourable immediate effects on pain, lumbar mobility, and neurological symptoms in individuals with CLBP. These findings suggest that neurodynamic interventions may support symptom modulation in patients presenting with altered neural mechanosensitivity. This study used a small convenience sample, lacked a control group, and evaluated only immediate effects, limiting causal interpretation and generalisability. Nevertheless, the results indicate that neural mobilisation may be considered as an adjunct to evidence-based physiotherapy interventions in individuals with neurodynamic impairments. Further controlled studies with larger samples and long-term follow-up are required to determine clinical efficacy, durability of effects, and its potential integration into CLBP management guidelines.

Keywords: *chronic low back pain, neurodynamics, neural mobilization, slump slide technique*

Introduction

Chronic low back pain (CLBP) is a musculoskeletal condition defined by pain persisting for more than 12 weeks and is widely recognised as a multifactorial disorder influenced by biological, psychological, and social factors (1). CLBP substantially impairs quality of life and represents a leading cause of work absenteeism and early retirement, generating considerable socioeconomic costs (2,3). It may be classified as specific or non-specific, with non-specific cases comprising the majority and lacking an identifiable structural cause (4,5). Individuals with CLBP commonly present with persistent pain, reduced lumbar mobility, functional limitations, and neurological symptoms such as paraesthesia, tingling, or numbness (6,7). These manifestations contribute to disability and activity restriction.

Clinical assessment should therefore incorporate a thorough history and physical examination (8,9), as alterations in neural mobility are frequently observed and may underlie many neurological features (10,11). Neurodynamic tests, including the Slump Test, evaluate the mechanical and sensory behaviour of neural tissues (12,13), helping to identify mobility restrictions and levels of neural irritability (14).

The response to the Slump Test informs clinical decision-making, guiding the selection of the appropriate neurodynamic mobilisation techniques based on symptom irritability and behaviour (15). Neural mobilisation aims to restore neural tissue movement and reduce symptoms through sliding and tension-based techniques (16,17). Sliding techniques enhance neural mobility and vascular perfusion without provoking symptoms and are recommended for individuals with high irritability (18,19). Tensioning techniques apply controlled elongation to improve viscoelastic properties and are indicated when irritability is low (20, 21). Technique selection should be based on clinical reasoning and tailored to the individual's symptom profile (22).

In lumbar conditions, Slump-based mobilisation is commonly employed due to its influence on both central and peripheral neural structures, including the sciatic nerve and its distal branches (23). Although neural mobilisation is widely taught and routinely applied in physiotherapy practice (12,24), evidence concerning the short-term effects of Slump-based sliding techniques on pain, neurological symptoms, and lumbar mobility in individuals with CLBP remains limited, representing a clear gap in the literature. Addressing this gap, the present study aimed to examine the short-term effects of a Slump sliding mobilisation technique on pain, neurological symptoms, and lumbar mobility in individuals with CLBP.

Methods

Study design and sample

This study was performed using a quasi-experimental design, in a hospital-based sample of individuals, of both sexes, diagnosed with CLBP, currently undergoing physiotherapy sessions.

A convenience sample was used. Participants were recruited at a private Portuguese hospital, based on admission records of individuals referred for physiotherapy with a medical diagnosis of chronic low back pain (CLBP). Those who agreed to participate signed an informed consent form and underwent an initial screening to verify eligibility according to the inclusion and exclusion criteria. Adults aged between 18 and 65 years, with low back pain for at least 12 weeks, able to understand and follow instructions, and currently undergoing physiotherapy treatment were included. Pregnant women or women who had recently given birth, individuals with cognitive deficits, a history of spinal surgery, other conditions affecting the

neuromusculoskeletal system, neurological or systemic diseases, as determined by clinical records or self-report, were excluded. In the present study, no formal analysis was performed due to the exploratory nature of the quasi-experimental study and the use of a convenience sample. However, the sample size (n=30) is comparable to that of similar studies investigating the same area and is considered adequate for the proposed objectives.

Instruments and data collection

Data collection was performed using a sociodemographic questionnaire that collected data on weight, age, sex, and body mass index (BMI), as well as clinical information such as duration since CLBP diagnosis, current medication, and duration of ongoing physiotherapy treatment. Pain symptoms were assessed using the Numerical Pain Rating Scale (NPRS), adapted from the Visual Analogue Scale (25), which rates pain intensity from 0 (no pain) to 10 (worst imaginable pain). The NPRS demonstrates excellent test–retest reliability (ICC > 0.9) and high sensitivity to detect clinically meaningful changes in individuals with chronic low back pain. Neuropathic symptoms were assessed using the Douleur Neuropathique 4 (DN4) questionnaire, a brief tool used to differentiate neuropathic pain from other types. The DN4 comprises 10 items- seven based on the patient's description of pain and three based on the evaluator's sensory examination. A score ≥4 indicates a high likelihood of neuropathic pain (26). The DN4 has shown strong diagnostic validity, with a sensitivity of approximately 82% and a specificity of 90% for identifying neuropathic pain. Lumbar flexion range of motion was measured using the Modified Schober Test. A mark was made 10 cm above and 5 cm below the line connecting the participant's posterior superior iliac spines (15 cm distance between points). The participant was then asked to perform lumbar flexion, and the change in distance was recorded. This test is widely recognized as a valid and reliable measure of lumbar mobility, with intraclass correlation coefficients (ICC) typically above 0.8. During this test, participants were also asked to report pain intensity on the NPRS (27).

Procedures

Data collection was conducted in the hospital's physiotherapy department before each participant's treatment session. After obtaining demographic and clinical information, baseline assessments were completed for pain (NPRS in standing, sitting, and during the Modified Schober Test), neuropathic symptoms (DN4), and range of motion (Modified Schober Test). All assessments followed standardized procedures, and outcomes were recorded immediately before and after the intervention. A single physiotherapist performed all assessments and the intervention to ensure procedural consistency.

Slump test: Subsequently, the participant performed a Slump test to assess neural mobility. The technique was performed actively and in the non-symptomatic range. In case of symptoms at rest, the corresponding change was recorded during the procedure. The participant was instructed to sit on the examination table with the knee joints in flexion (90º), without any rotation, abduction or adduction of the hip, with the feet hanging down and the hands behind the back (Figure 1-0).

1. Slump position: the participant was asked to place their hands behind their back and perform lumbar and thoracic flexion, keeping their head in a neutral position (slump movement shoulders towards the hips). Symptoms were assessed. (Figure 1 – 1)

2. Cervical flexion: the participant was asked to perform cervical flexion ('bring your chin to your chest'). Symptoms were assessed. (Figure 1 – 2)

3. Knee extension: the participant was asked to 'actively extend the knee on the affected side' (the affected side corresponded to the location

of the reported pain in one leg, unilateral lower back pain, or the side with the most lower back complaints), while maintaining that position. Symptoms were assessed. (Figure 1 – 3)

4. Dorsiflexion: the participant was asked to add active dorsiflexion ("pull the foot towards you"). Symptoms were assessed. (Figure 1 – 4)

Sliding Slump Technique: Based on the test results, the sliding technique was applied using movements at both ends of the neural system, according to the test position in which symptoms were reproduced. Tension was increased in one component while the other was released (cephalic neural mobilisation), followed by the same procedure in the opposite direction (caudal neural mobilisation). If symptoms reproduced in test position 1 – used only Slump, with active movement in sub-painful range.

- If symptoms reproduced in test position 2 – used Slump alternating with cervical flexion, with active movement in sub-painful range.
- If symptoms reproduced in test position 3 – used knee extension alternating with cervical flexion, maintaining *Slump,* with active movement in sub-painful range.
- If symptoms reproduced in test position 4 – used dorsiflexion alternating with cervical flexion, maintaining *Slump*, with active movement in sub-painful range.

This technique was performed actively by the participant within the available range, without manifesting symptoms. Thirty repetitions were performed. At the end of the procedure, participants were re-evaluated using the same methods initially used (pain, neural symptoms, and lumbar flexion mobility). Participants were categorised into groups 1, 2, 3, or 4, according to the intervention performed.

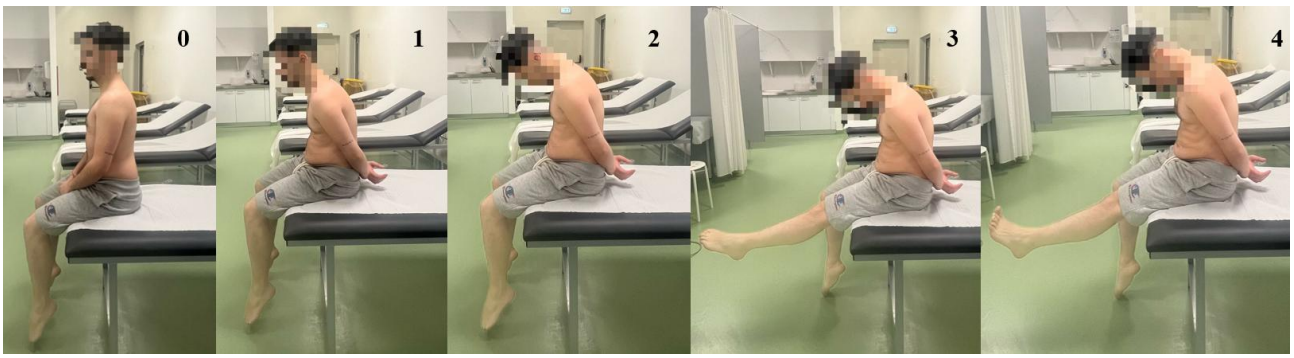

Figure 1. Sequence of components used in the assessment of neural mobility.

Ethical procedure

The study was submitted to the Ethics Committee of the Santa Maria School of Health and approved on 19 December 2024 (code 2024/17). Written informed consent was provided to all participants. To ensure anonymity, the evaluator completed the questionnaire individually with each participant, without collecting any identifying information. Each participant was assigned a unique code used throughout the study, ensuring that the investigator could not link participants to their data. Data were encrypted, accessible only to the research team, and permanently deleted within three months, in full compliance with ethical and data protection standards.

Pilot study

A pilot study was conducted to verify the applicability and understanding of the questionnaire and procedures by individuals. This pilot study involved six individuals who were not part of the main study sample but had similar characteristics to those in the sample.

These individuals were also recruited on a hospital basis, through the diagnosis of admission for treatment (CLBP) records. This pilot study and a preliminary descriptive statistical analysis, resulted in the reformulation of the collection of some variables in the sociodemographic questionnaire; it was possible to improve the questionnaire, the assessment and intervention procedures and study protocol.

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) Statistics software, version 28.0. A 95% confidence interval was adopted, and results were considered statistically significant when $p<0.05$. The assumption of normality was assessed using the Shapiro–Wilk test. As most variables did not follow a normal distribution, non-parametric statistical methods were applied. Categorical variables were analysed using absolute and relative frequencies. Continuous variables were described using the median and the 25th and 75th percentiles (P25–P75).

To compare baseline and post-intervention values of pain intensity, lumbar range of motion, and neurological symptoms, the Wilcoxon signed-rank test for paired samples was used. The measurements were repeated within the same participants, and the normality assumption was not met. To analyse differences in the magnitude of change between groups according to the number of Slump test components involved in the neural mobilisation technique, the Kruskal-Wallis test was applied. This test was chosen due to the non-normal distribution of the data, the independence of the groups, and the small sample size.

Effect sizes were calculated for non-parametric tests. For the Wilcoxon signed-rank test, effect size (r) was computed, and for the Kruskal–Wallis test, eta-squared (η^2_h) was estimated. Where applicable, 95% confidence intervals for effect sizes were reported to provide an estimate of the magnitude and precision of the observed effects.

Results

From an initial sample of 36 potential participants, four were excluded, resulting in a final sample of 30 participants. From the excluded sample, 4 participants had lumbar spine surgery history and presence of other conditions affecting the neuromusculoskeletal system with actual symptoms. The study sample consisted mainly of women (n=19,63.3%), with a median age of 45 years. Regarding height, the median height was 1.68 m, and the median weight was 74.50 kg. The median Body Mass Index (BMI) calculated was 26.75 kg/m².

Regarding participants' clinical characteristics, most individuals were not using medication (n=19, 63.3%). Among the 11 participants (36.7%) who reported medication use, non-steroidal anti-inflammatory drugs (NSAIDs) were the most commonly used (n=13, 56.7%), followed by simple analgesics (n=5, 16.7%), opioids (n=3, 10%), muscle relaxants (n = 2, 7.7%), and antidepressants (n=1, 3.3%). Concomitant use of multiple medications was reported by 23.3% of participants. The median duration since diagnosis of chronic low back pain (CLBP) was 4 years (interquartile range [IQR]: 1.75–8.25). The median number of treatment sessions completed was 25 (IQR: 18–36) (Table 1).

Table 1. Descriptive analysis of the sociodemographic and clinical characteristics of the sample

Characteristic	Mean	Standard deviation (SD)	Percentile 25	Percentile 75
Age (years)	45	9.94	39	52.25
Height (m)	1.68	0.08	1.60	1.73
Weight (kg)	74.50	10.52	67	85
BMI (kg/m²)	26.75	2.73	25.58	28.50
Years since CLBP diagnosis	4	4.30	1.75	8.25
Number of physiotherapy sessions completed	25	15.22	18	36

BMI: body mass index, CLBP: chronic low back pain

The assessment of pain, range of motion, and neurological symptoms before and after the Slump test is described in Table 4. Although a stratified analysis was considered, no differences in sample characteristics were observed between sexes. Additionally, due to the small sample size, we opted not to stratify the data by sex.

Regarding pain, three points were assessed: in sitting, standing, and after performing the Modified Schober test. All measurements showed significant changes between the initial and final assessments ($p<0.05$). A detailed, case-by-case analysis indicated that the most pronounced change occurred during the Modified Schober test, with pain decreasing from a median of 6 at baseline to a median of 4 NPRS at follow-up. Regarding range of motion, a statistically significant improvement was observed ($p<0.05$). During lumbar flexion measured with the Modified Schober test, the median increased from 2 cm (IQR: 1.75–4) at baseline to 5.5 cm (IQR: 4–8) at follow-up.

Neurological symptoms assessed with the DN4 questionnaire were generally low at baseline, below the neuropathic pain threshold of 4. Despite the median remaining at 1 (IQR: 1–4 at baseline; 0–2 at follow-up), a statistically significant reduction in overall scores was observed. These data are summarized in Table 2 and illustrated in Figure 2.

Table 2. Characteristics of pain, range of motion, and neurological symptoms before and after intervention

	Baseline Median (P25; P75)	Final Median (P25; P75)	*p* value	Effect Size r	95% CI
Pain in standing	6 (5-7)	5.5 (3-7)	<0.01*	0.47	0.25–0.68
Pain in sitting	7 (5-8)	5.5 (3-8)	<0.001**	0.60	0.38–0.79
Pain during Modified Schober Test	6 (5-8)	4 (2-7)	<0.01*	0.50	0.28–0.71
Range of Motion (Modified Schober Test)	2 (1.75-4)	5.5 (4-8)	<0.01*	0.55	0.32–0.76
Neurological Symptoms (DN4)	1 (1-4)	1 (0-2)	<0.01*	0.40	0.18–0.63

P25: 25th percentile, P75: 75th percentile, CI: confidence interval, DN4: Douleur Neuropathique 4

**Statistically significant at p<0.01, **Statistically significant at p<0.001*

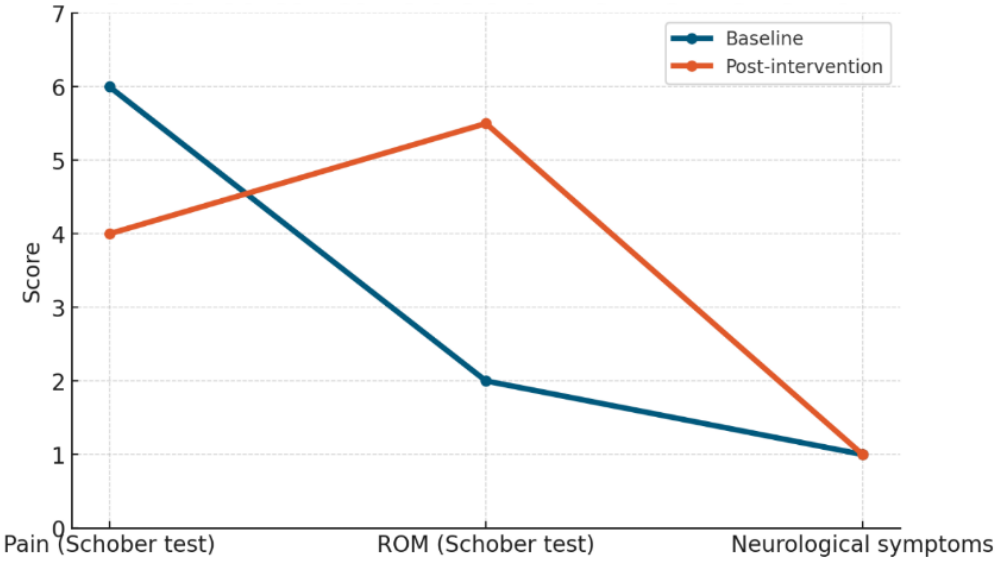

Figure 2. Pain, range of motion, and neurological symptoms at baseline and post-intervention

In addition to understanding the total DN4 score, we sought to understand specific neurological symptoms. By analysing Table 4, it is possible to verify a symptomatic change in the DN4 Questionnaire from the initial moment to the final moment. The percentage of participants without symptoms increased from 13.3% to 33.3%. Symptoms such as 'tingling' decreased from 46.7% to 80%; stinging sensations decreased from 63.3% at the initial moment to 80% at the final moment; there was also a decrease in the relative frequency of burning sensations, which initially manifested a presence of 30% and, at the end, 20%.

The symptoms of 'itching' and pain caused by light friction remained virtually unchanged between the different assessment moments (Table 3).

Stratified analysis was conducted based on the number of components used in the Slump neural mobility technique to explore whether changes in pain, range of motion (ROM), and neurological symptoms varied according to the technique applied. Participant allocation resulted in no members in Group 1, one in Group 2, and 13 and 16 participants in Groups 3 and 4, respectively. Given the extreme imbalance and the presence of a subgroup with only one participant, inferential statistical comparisons were deemed methodologically inappropriate. Therefore, the analysis is presented descriptively and exploratorily. Median changes suggest that greater component involvement was associated with improvements in pain, ROM, and neurological symptoms were observed across groups with greater component involvement. However, these findings should be interpreted cautiously due to the small, uneven subgroup sizes and the quasi-experimental design (Table 4).

Discussion

Chronic low back pain (CLBP) significantly affects quality of life and functionality (28). Current physiotherapy guidelines recommend education, exercise, and, in some cases, manual therapy (29). Although neurodynamic techniques are frequently used in physiotherapy practice, high-level evidence supporting their use as standard interventions for CLBP is still lacking (17).

In this study, applying the Slump sliding technique was associated with short-term improvements in pain, range of motion (ROM), and neurological symptoms, immediately after the intervention, in

individuals with CLBP. Participants reported a significant reduction in pain intensity, consistent with González et al., who identified neural mobilisation as an effective strategy for immediate pain reduction (30). This may be explained by reduced mechanical load and inflammation around the peripheral nerve, decreasing nociceptor hyperexcitability and allowing the central nervous system to interpret stimuli more accurately (31).

ROM also improved significantly after neural mobilisation, possibly reflecting decreased neural tension, increased nerve mobility, and improved vertebral movement. Although the effect on vertebral mobility remains hypothetical, lumbar mobility was found to be significantly improved in patients with CLBP (32). These findings suggest that the Slump technique may influence both neural and vertebral components. However, as this study lacked a control group, observed improvements may partly reflect non-specific factors, such as placebo effects. Controlled trials are needed to determine whether the changes can be attributed specifically to neural mobilisation.

Table 3. Characteristics of Neuropathic Symptoms according to the DN4 domains

			Baseline No. (%)	Final No. (%)
Painful symptoms		With symptoms	26 (86.7%)	20 (66.7%)
		Without symptoms	4 (13.3 %)	10 (33.3 %)
Pain characteristics	Burning	Absent	21 (70%)	24 (80%)
		Present	9 (30%)	6 (20%)
	Painful Cold Sensation	Absent	0 (0%)	0 (0%)
		Present	0 (0%)	0 (0%)
	Electric Shock	Absent	23 (76.7 %)	27 (90%)
		Present	7 (23.3%)	3 (10%)
Other symptoms	Tingling	Absent	14 (46.7%)	24 (80%)
		Present	16 (53.3%)	6 (20%)
	Needles	Absent	19 (63.3%)	24 (80%)
		Present	11 (36.7%)	6 (20%)
	Numbness	Absent	17 (56.7%)	20 (66.7%)
		Present	13 (43.3 %)	10 (33.3%)
	Itching	Absent	27 (90%)	28 (93.3%)
		Present	3 (10%)	2 (6.7%)
	To touch		0 (0%)	0 (0%)
	To puncture		0 (0%)	0 (0%)
Pain is triggered or worsened by light "brushing"		Absent	28 (93.3%)	28 (93.3%)
		Present	2 (6.7%)	2 (6.7%)

DN4: Douleur Neuropathique 4

Data are presented as frequency (n) and percentages (%)

Table 5. Stratified analysis according to the number of components used in the Slump slide technique

		No. (%)	Median of Differences (final-baseline) (P25; P75)	*p* value	η²_H	95% CI η²_H
Pain (Modified Schober Test)	Group 1	0 (0%)	0	<0.01*	0.18	0.06–0.31
	Group 2	1 (3.3%)	N/A			
	Group 3	13 (43.3%)	2 (0-2)			
	Group 4	16 (53.3%)	2.5 (1-4)			
ROM (Modified Schober Test)	Group 1	0 (0%)	0	<0.01*	0.22	0.10–0.36
	Group 2	1 (3.3%)	N/A			
	Group 3	13 (43.3%)	2 (2-3)			
	Group 4	16 (53.3%)	4 (2-5)			
Neurological symptoms	Group 1	0 (0%)	0	<0.01*	0.08	0.00–0.19
	Group 2	1 (3.3%)	N/A			
	Group 3	13 (43.3%)	1 (0-2)			
	Group 4	16 (53.3%)	0(0-1)			

P25: 25th percentile, P75: 75th percentile, CI: confidence interval, ROM: range of motion

**Statistically significant at p<0.01*

We also observed reductions in neurological symptoms, suggesting a link between improved lumbar mobility and decreased neural irritation. Pain-free movement strategies may enhance ROM even without directly targeting neural tissues, while neural mobilisation may allow smoother nerve excursion relative to adjacent structures, reducing symptoms such as tingling and "electric shocks" (33). Similarly, Findlay et al. reported that increased lumbar mobility can reduce neurological symptoms in CLBP (34). These improvements may reflect decreased neural irritability or non-specific effects, though the underlying mechanisms remain unclear (35). Although evidence on neural mobilisation in CLBP is limited, recent studies are encouraging, showing that both neural mobilisation and vertebral manipulation can reduce pain and disability (36).

Similarly, combining Slump neural mobilisation with conventional physiotherapy has been shown to provide greater benefits than conventional therapy alone (37). Neural mobilisation is more effective for pain relief and function when combined with exercise (38). Together, these findings suggest that neurodynamic techniques can complement multimodal rehabilitation approaches. The physiological mechanisms underlying these effects remain speculative. Neural sliding may relieve nerve interfaces, decrease adhesions, and enhance nerve mobility without imposing excessive mechanical stress, while respecting symptom thresholds (39). Neural gliding techniques appear more effective than neural tension techniques in reducing pain, disability, and neural sensitisation in chronic pain patients (40). Moreover, the mobility of vascular components accompanying nerves may also contribute to symptom improvement (41).

One challenge in this study was variability in performing the Slump test and technique components. Stratified analysis suggested better results with greater component involvement, although even smaller combinations produced positive changes in pain, ROM, and neurological symptoms. The Slump slide technique was tailored to each participant's neurodynamics, with the final

pain-free position used to perform the sliding technique, avoiding activation of protective neural mechanisms and promoting a favourable environment for neuroplasticity and nerve mobility (42). Different combinations of limb and segment movements can elicit neural mobility effects (12). However, interface release techniques prior to sliding were not used, which could have enhanced outcomes (12,43). Complementary neurodynamic assessments, such as the femoral Slump test, were not included, possibly limiting detection of broader neurodynamic changes (44).

The intervention was conducted without contralateral comparison or structural differentiation, and no consensus exists in the literature regarding the optimal number of repetitions. Following Shacklock's guidelines helped minimise bias and standardise application (12). Overall, these findings suggest that neural mobilisation techniques may benefit pain modulation and lumbar mobility. These techniques should be integrated with evidence-based interventions, including patient education, therapeutic exercise, and manual therapy, as part of multimodal rehabilitation strategies (45). When performed within pain-free limits, the Slump sliding technique may help create conditions that promote neuroplastic adaptation and functional improvement.

This study has several limitations. The small, single-centre sample limits generalisability, and the absence of a control group and randomisation prevents determining whether improvements resulted from the intervention itself or from non-specific factors (46). Only immediate outcomes were assessed, so long-term effects cannot be inferred. Stratified analysis should be interpreted cautiously given small subgroup sizes. Potential confounding factors such as medication, psychosocial influences, or concurrent physiotherapy were not controlled, which may have affected results. In conclusion, immediate post-intervention improvements in pain, ROM, and neurological symptoms were observed following the Slump sliding technique. However, it remains uncertain whether these changes are attributable to the intervention itself or other uncontrolled factors. Future controlled studies are warranted to clarify mechanisms, evaluate long-term outcomes, and determine whether this neurodynamic approach should be incorporated into clinical guidelines for CLBP with neural mobility deficits.

Conclusions

Chronic low back pain (CLBP) is a highly prevalent musculoskeletal condition with a significant impact on individuals' functionality and quality of life. Impaired neural mobility is common in individuals with CLBP and may contribute to their symptoms.

In this study, the Slump neural mobilisation technique, applied as a sliding technique, produced favourable short-term effects on pain, vertebral mobility and neurological symptoms in individuals with CLBP.

Understanding individual specificities and patient characteristics may help integrate neurodynamic techniques into physiotherapy management alongside other evidence-based interventions for CLBP.

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Author Declarations

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