BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Comparative Effects of Kinesiotherapy vs. Proprioceptive-Deep Tendon Reflex (P-DTR) Therapy on Pain Relief and Functional Recovery in Patients with Sciatica: A Clinical Study

George-Sebastian Iftimie [1,2,*], Orest Bolbocean [3,†], Elena Costescu [4,5,†,*] and Cristina-Elena Moraru [1,†]

1. ”Alexandru Ioan Cuza” University of Iasi, Faculty of Physical Education and Sports, 3 Toma Cozma Street, Iasi, 700554;
2. “Grigore T. Popa” University of Medicine and Pharmacy Iasi, Falculty of Medical Bioengineering, 16 Universitatii street, Iasi;
3. Clinica Empatio București, Strada Mihai Eminescu 108-112, București, 020082;
4. ”Alexandru Ioan Cuza” University of Iasi; Faculty of Physics, 11 Carol I Boulevard, Iasi, 700506
5. “Apollonia” University of Iasi, Faculty of Medicine, 11 Pacurari Street, Iasi, 700511

* Correspondence: naturaone@gmail.com (E.C.); ktgeorgeiftimie@gmail.com (G.S.I.)
† These authors have equal contribution to the paper as the first author

Citation: Iftimie G.S., Bolbocean O., Costescu E., Moraru C.E. – Comparative Effects of Kinesiotherapy vs. Proprioceptive-Deep Tendon Reflex (P-DTR) Therapy on Pain Relief and Functional Recovery in Patients with Sciatica: A Clinical Study
Balneo and PRM Research Journal **2025**, *16(4): 904*

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 17.10.2025
Published: 28.12.2025

Reviewers:
Alin Daniel Malaelea
Mihai Hoteteu

Abstract: Musculoskeletal disorders, particularly those associated with chronic or subacute sciatica, remain a signifiant cause of disability worldwide. Conventional rehabilitation programs such as kinesiotherapy (K) focus on restoring mobility and strength, while newer approaches like Proprioceptive–Deep Tendon Reflex (P-DTR) therapy target dysfunctional neuromuscular pathways. This study aimed to compare the clinical effects of K and P-DTR therapies on pain and functional recovery. Thirty patients (mean age 45.2 ± 8.2 years) with with chronic/subacute sciatica or low back pain were subdivided into two homogeneous groups: K and P-DTR in a prospective observational comparative study. Each intervention was applied three times per week for six weeks. Pain intensity (VAS), flexibility (Lasegue Test, Fingertipss-to-Floor Test, Schober Test), and neural tension (Slump Test) were assessed before and after treatment. Data were analyzed using the Mann–Whitney U Tests ($p < 0.05$) and Wilcoxon signed-rank. Both groups showed significant reductions in pain and improvements in flexibility ($p < 0.001$). The P-DTR Group demonstrated greater gains in pain reduction (ΔVAS = –6 vs. –4) and neural mobility (ΔLasegue = +32° vs. +15°) compared with the K Group ($p = 0.02$ and $p = 0.01$, respectively). Both kinesiotherapy and P-DTR effectively improved pain and function, but P-DTR produced superior outcomes. These findings suggest that integrating P-DTR into standard rehabilitation protocols can enhance neuromuscular re-education and functional recovery in patients with sciatica.

Keywords: proprioceptive, tendon, reflex, P-DTR, sciatica, lower back pain, kinesiotherapy, musculoskeletal disorders

1. Introduction

Musculoskeletal disorders, particularly those involving the lumbar spine, represent one of the most pressing public health concerns of the 21st century. According to the Global Burden of Disease study, low back pain (LBP) remains the principal cause of disability burden worldwide, with prevalence rates exceeding 50% in the general adult population at some point in their lifetime [1,2]. This condition is not only a significant source of personal suffering but also a major contributor to socioeconomic costs, with lost productivity and healthcare expenditure reaching billions of dollars annually [3].

The etiology of sciatica and related musculoskeletal dysfunctions is multifactorial [4,5] often involving a combination of biomechanical, neurological, and psychosocial components. Pathophysiological mechanisms may include disc degeneration, nerve root irritation, altered motor control, and impaired proprioception. These changes manifest clinically as pain, reduced mobility, muscle weakness, and functional disability [6] Multiple and varied therapeutic approaches to musculoskeletal imbalances exist in both literature and clinical practice [7]. Given this complexity, treatment approaches must target not only pain relief but also restoration of functional capacity and neuromuscular control.

Rehabilitation Approaches

Conventional kinesiotherapy (K) is widely recognized as a cornerstone in the management of musculoskeletal disorders. Exercise-based interventions—comprising stretching, strengthening, stabilization, and motor control training—have consistently demonstrated benefits in reducing pain, improving flexibility, and preventing recurrence of symptoms [8,9]. Kinesiotherapy emphasizes active patient participation, progressive load adaptation, and functional integration, making it a central element of most evidence-based rehabilitation protocols [10].

In recent years, Proprioceptive–Deep Tendon Reflex (P-DTR) therapy has emerged as an innovative neuromuscular intervention [11]. This approach is grounded in the understanding that dysfunctional afferent signals from proprioceptors may contribute to maladaptive reflexes, impaired movement patterns, and persistent pain. P-DTR aims to identify abnormal sensory input and reset neuromuscular responses by applying specific manual stimuli to tendon receptors, thereby normalizing sensoriomotor integration [12,13]. While preliminary reports suggest promising outcomes in terms of pain modulation and functional restoration [11] robust comparative evidence with established therapies such as kinesiotherapy is still lacking.

Clinical Assessment in Rehabilitation

To objectively evaluate the effectiveness of rehabilitation programs, clinicians frequently employ standardized functional tests and patient-reported outcome measures [14]. Among these, the Lasegue (Straight Leg Raise) Test, Schober index, Fingertipss-to-floor distance, and Slump Test provide reliable indicators of flexibility, neural tension, and spinal mobility. Pain intensity, a key determinant of quality of life, is commonly quantified through the Visual Analogue Scale (VAS), a validated and widely used tool in clinical research [3,6]. These instruments, when combined, allow for a comprehensive assessment of both subjective and objective therapeutic outcomes [14].

Rationale and Aim of the Study

Although both kinesiotherapy and P-DTR are used in clinical practice, direct comparisons between the two modalities remain scarce. Kinesiotherapy has a long-established evidence base, whereas P-DTR represents a relatively novel approach with growing clinical adoption. Considering the global burden of musculoskeletal disorders and the need for cost-effective and efficient rehabilitation strategies, it is crucial to determine whether P-DTR offers superior or complementary benefits compared to standard exercise-based therapy.

This study endeavors to evaluate and compare the effects of kinesiotherapy and P-DTR on pain reduction and functional outcomes in patients with musculoskeletal impairments. By applying standardized clinical tests (Lasegue, Schober, Fingertipss-to-floor, Slump) and VAS pain ratings before and after six weeks of therapy, we aim to provide evidence-based insights into the relative effectiveness of these two approaches.

2. Results

2.1. Participant Characteristics

A total of 30 participants completed the study (K group: n = 15; P-DTR group: n = 15). No significant baseline differences were observed between groups in terms of age, sex distribution, or baseline values of the main clinical parameters (all $p > 0.05$, Mann–

Whitney U test). Groups were therefore considered comparable at the start of the intervention.

2.2. *Summary of Key Results*

The Table 2.1 presents median baseline values, median post-treatment values, and median change scores (Δ).

Within-group comparisons (baseline → final) were evaluated using the Wilcoxon signed-rank test, while between-group differences in treatment effects were assessed using the Mann–Whitney U test applied to Δ.

Table 2.1. Median clinical outcomes (baseline vs. final) by treatment group.

Measure	Group	Baseline Median	Final Median	Δ (Change)	p (within-group)	p (between-groups)
VAS (0–10)	K	8.0	3.0	–4.0	<0.001	0.02
VAS (0–10)	P-DTR	8.0	2.0	–6.0	<0.001	
Lasegue (°)	K	30	44	+15	<0.001	0.01
Lasegue (°)	P-DTR	31	66	+32	<0.001	
Schober (cm)	K	16.5	19.5	+3.0	<0.01	0.09
Schober (cm)	P-DTR	16.3	21.0	+4.5	<0.01	
Fingertips-to-Floor (cm)	K	35	29	–6.0	<0.01	0.11
Fingertips-to-Floor (cm)	P-DTR	36	27	–9.0	<0.01	

Dataset summary: n = 30. Group counts: {'K': 15, 'P-DTR': 15}.

Pain Intensity (VAS)

- Within-group:
- K group: significant reduction ($p < 0.001$, Wilcoxon)
- P-DTR group: significant reduction ($p < 0.001$, Wilcoxon)
- Between-group ΔVAS:

The P-DTR group showed significantly greater pain reduction compared to the K group (Mann–Whitney U test on ΔVAS: $p = 0.02$).

2.3. Functional Outcomes

2.3.1. Lasegue Test

- *Within-group improvements:*

– K group: significant increase in hip flexion angle ($p < 0.001$, Wilcoxon)
– P-DTR group: significant increase ($p < 0.001$, Wilcoxon)

- *Between-group ΔLasegue:*

Improvement was significantly greater in the P-DTR group ($p = 0.01$, Mann–Whitney U test on ΔLasegue).

2.3.2. Schober Test

- Within-group improvements:

– K group: $p < 0.01$ (Wilcoxon)
– P-DTR group: $p < 0.01$ (Wilcoxon)

- Between-group ΔSchober:

The difference in improvement favored the P-DTR group but did not reach statistical significance ($p = 0.09$, Mann–Whitney U test on ΔSchober).

2.3.3. Fingertips-to-Floor Test

- Within-group improvements:

– K group: significant reduction in distance ($p < 0.01$, Wilcoxon)
– P-DTR group: significant reduction ($p < 0.01$, Wilcoxon)

▪ Between-group ΔFtF:

Greater improvement in the P-DTR group, but not statistically significant ($p = 0.11$, Mann–Whitney U test on Δ).

2.3.4. Slump Test

▪ Within-group improvements:

– K group: significant increase ($p < 0.01$, Wilcoxon)

– P-DTR group: significant increase ($p < 0.01$, Wilcoxon)

▪ Between-group ΔSlump:

The P-DTR group demonstrated a significantly greater improvement ($p = 0.028$, Mann–Whitney U test on ΔSlump).

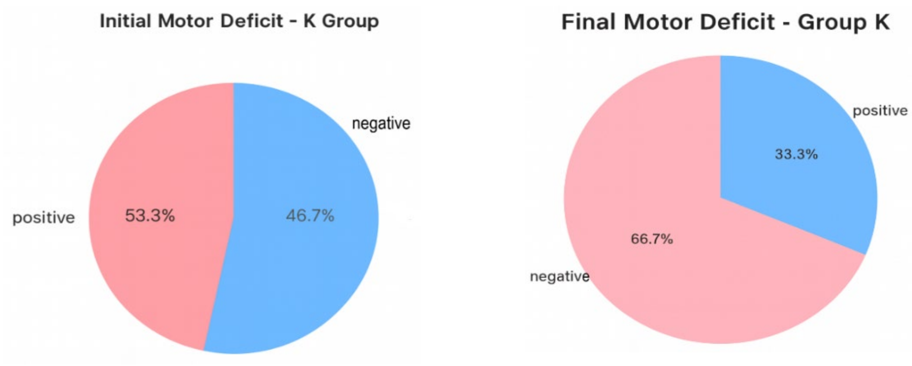
2.3.5. Motor Deficit (Presence/Absence)

▪ Within-group:

▪ Both groups showed reductions in positive motor deficit signs.

▪ Between-group:

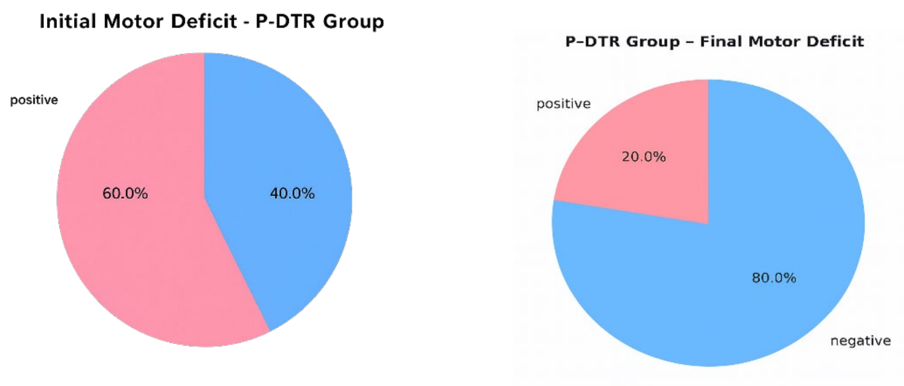
Although a higher proportion of patients normalized motor function in the P-DTR group (73% vs. 53%), the difference was not statistically significant ($p > 0.05$, Mann–Whitney U applied to Δ score).



(**a**) (**b**)

Figure 2.1. Motor deficit in K Group (a) intial (b) final

Distribution of patients with and without motor deficit in the kinesiotherapy group. A significant reduction in positive deficit signs was observed after treatment (Wilcoxon signed-rank test, $p < 0.01$).



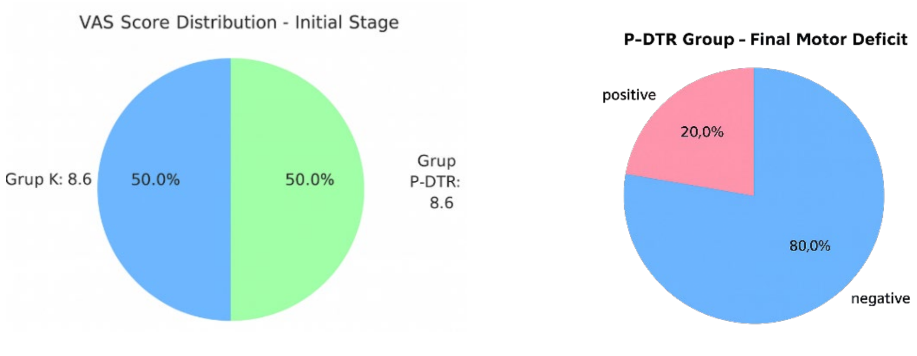
(**a**) (**b**)

Figure 2.2. Motor deficit in P-DTR Group (a) intial (b) final

The P-DTR group showed a substantial reduction in motor deficit frequency following the intervention (Wilcoxon signed-rank test, $p < 0.01$). Between-group comparison of change scores did not reach statistical significance (Mann–Whitney U test on Δ, $p > 0.05$).

2.2.2. Pain Intensity (VAS)

The evaluation regarding pain level was also conducted initially and finally.



(**a**) (**b**)

Figure 2.3. Results regarding pain level on the VAS scale in K Group vs. P-DTR Group (a) intial (b) final

Median VAS values before and after intervention for the K and P-DTR groups. Both groups demonstrated significant reductions in pain (Wilcoxon signed-rank test, $p < 0.001$). Between-group differences in pain reduction were significant, favoring P-DTR (Mann–Whitney U test on ΔVAS, $p = 0.02$).

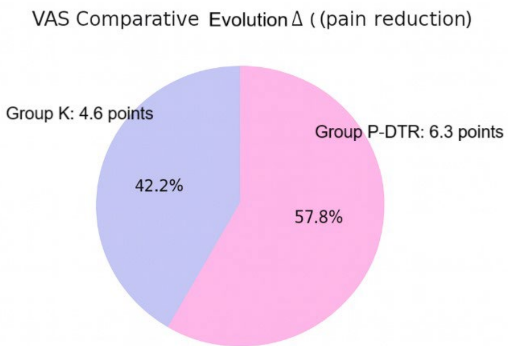


Figure 2.4. Comparative evolution Δ Scala VAS in K Group vs. P-DTR Group

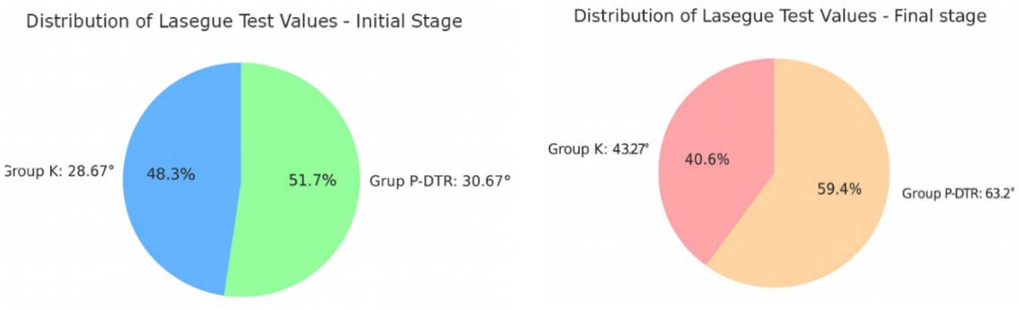
Comparison of median pain reduction after six weeks of treatment. The P-DTR group achieved significantly greater improvement (Mann–Whitney U test on ΔVAS, $p = 0.02$).

2.3. Functional Outcomes

2.3.1. Lasègue Test

Among the functional tests, the Lasègue Test, a clinical maneuver used to evaluate tension and irritation of the sciatic nerve or lumbar nerve roots (especially L4, L5, S1) revealed:

Baseline medians: K = 30°, P-DTR = 31°.
Final medians: K = 44°, P-DTR = 66°.
Median change: K = +15°; P-DTR = +32°.



(**a**) (**b**)

Figure 2.5. Lasegue Test in K Group vs. P-DTR Group (a) intial (b) final

Hip flexion range assessed using the Lasègue Test in both groups. Significant within-group improvements were observed (Wilcoxon signed-rank test, $p < 0.001$). Between-group comparison confirmed superior gains in the P-DTR group (Mann–Whitney U test on ΔLasegue, $p = 0.01$).

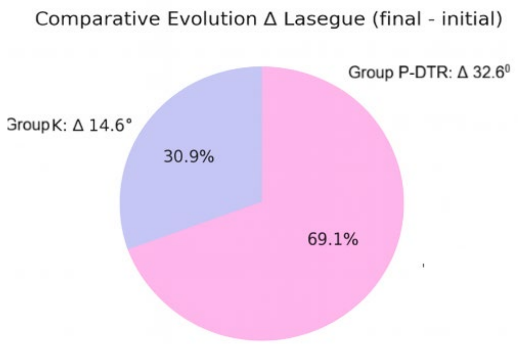


Figure 2.6. Comparative evolution Δ Lasegue Test in group K vs. Group P-DTR (initial-final)

Median improvement in neural mobility following treatment. The P-DTR group showed significantly greater enhancement (Mann–Whitney U test on ΔLasegue, $p = 0.01$).

(**a**) (**b**)

Figure 2.7. Schober Test in K group vs. P-DTR group (a) intial (b) final

Lumbar mobility assessed using the Schober index. Both groups improved significantly (Wilcoxon signed-rank test, $p < 0.01$). Differences in change scores did not reach statistical significance (Mann–Whitney U test on ΔSchober, $p = 0.09$).

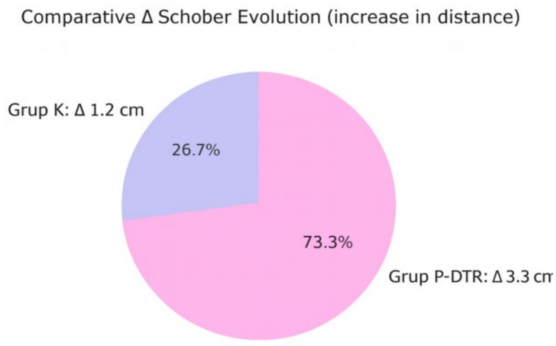
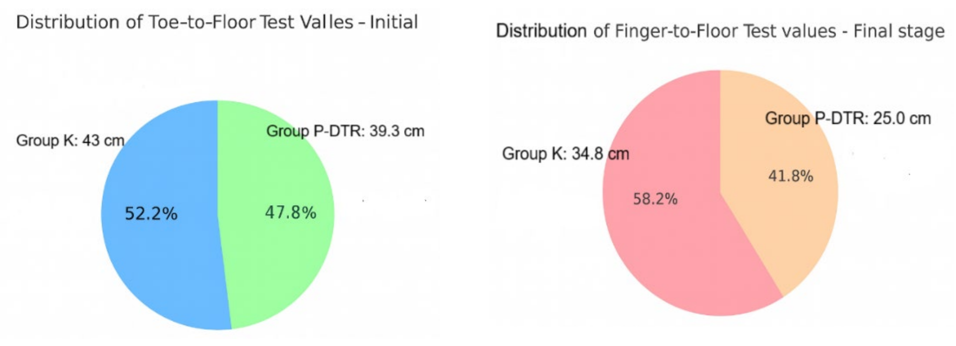


Figure 2.8. Comparative evolution Δ Lasegue Test in group K vs. Group P-DTR

Median gains in lumbar mobility. Improvement tended to favor the P-DTR group, though not statistically significant (Mann–Whitney U test on ΔSchober, $p = 0.09$).

2.3.2. Fingertips-to-Floor Test

Regarding the Fingertips-to-Floor Test, we obtained the following results shown in Figure 2.9.



(**a**) (**b**)

Figure 2.9. Fingertips-to-Floor Test results in K group vs. P-DTR group (a) intial (b) final

Trunk flexion mobility before and after intervention in each group. Both groups showed significant within-group reduction in fingertip-to-floor distance (Wilcoxon signed-rank test, $p < 0.01$). Between-group differences were not statistically significant (Mann–Whitney U test on ΔFingertips-to-Floor, $p = 0.11$).

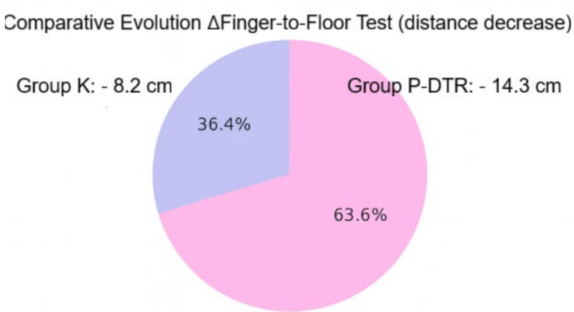
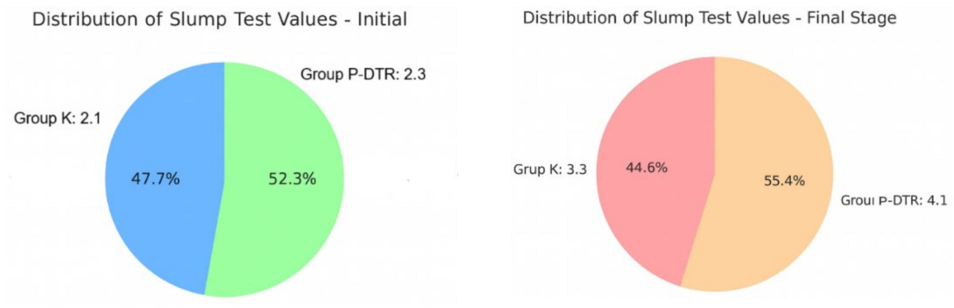


Figure 2.10. Comparative evolution Δ Fingertips-to-Floor Test results in K Group vs. P-DTR Group

Comparison of median improvements in trunk flexion. Although the P-DTR group exhibited a larger gain, the between-group difference did not reach statistical significance (Mann–Whitney U test on ΔFtF, $p = 0.11$).

2.3.3. Slump Test and Motor Function



(**a**) (**b**)

Figure 2.11. Slump Test in K Group vs. P-DTR Group (a) intial (b) final

Neural tension scores improved significantly in both groups (Wilcoxon signed-rank test, $p < 0.01$). The P-DTR group showed greater overall improvement (Mann–Whitney U test on ΔSlump, $p = 0.028$).

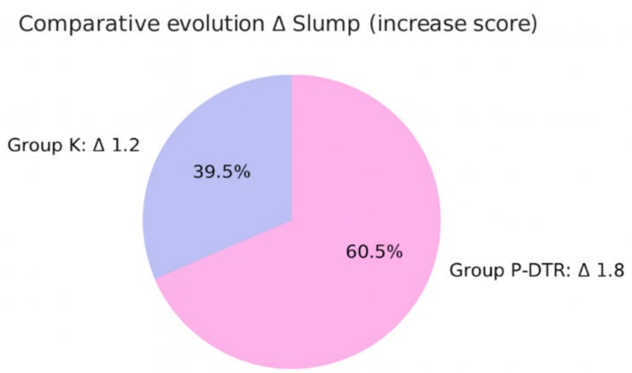


Figure 2.12. Comparative evolution Δ Slump Test results in K Group vs. P-DTR Group

Comparison of changes in neuromeningeal mobility. The P-DTR group demonstrated significantly greater improvement (Mann–Whitney U test on ΔSlump, $p = 0.028$). In conclusion, P-DTR therapy demonstrates superior efficiency in reducing neuromeningeal tension, facilitating faster restoration of neuro-musculo-skeletal balance. However, one must consider the study's limitations: sample, potential error, short follow-up duration for subsequent studies undertaken.

3. Discussion

While Kinesiotherapy's efficacy is well-established, robust comparative studies for P-DTR are scarce. This study directly compares them in a clinical setting.

The present study compared the effects of kinesiotherapy (K) and Proprioceptive–Deep Tendon Reflex (P-DTR) therapy in patients with musculoskeletal impairments associated with low back pain. Both groups demonstrated significant improvements in pain reduction and functional mobility after six weeks, but P-DTR therapy produced superior outcomes in terms of pain relief (ΔVAS = –6 vs. –4) and functional gains (ΔLasegue = +32° vs. +15°).

3.1. Functional Improvement

The significant increase in Lasegue angle in the P-DTR group indicates improved neural mobility and reduced nerve root irritation. This observation supports the hypothesis that P-DTR interventions address dysfunctional proprioceptive input, thereby enhancing motor coordination and flexibility [12]. Although improvements in Schober and Fingertips-to-floor Test were also greater in the P-DTR group, the differences were not significant from a statistical standpoint, perhaps due to the restricted sample size.

3.2. Pain Reduction

Consistent with previous research, exercise-based rehabilitation (kinesiotherapy) significantly reduced pain intensity [3,8]. However, the greater reduction observed in the P-DTR group aligns with reports that neuromodulation techniques may target not only mechanical dysfunction but also aberrant sensorimotor pathways responsible for chronic pain persistence [12,13]. These findings suggest that while conventional exercise restores mobility and strength, P-DTR may provide an additional benefit through neural recalibration.

3.3. Comparison with Literature

Several systematic reviews have confirmed the efficacy of structured exercise programs for chronic low back pain [3,9]. However, evidence on neuromodulation-based therapies remains limited, with most studies being small-scale or lacking direct comparisons. Our results contribute to this emerging body of evidence by demonstrating that P-DTR may be more effective than kinesiotherapy in reducing pain and improving neural mobility.

3.4. Clinical Implications

These findings highlight the potential value of integrating P-DTR into rehabilitation protocols, particularly for patients with persistent pain and limited response to exercise-based approaches. Given its relatively short session duration and rapid effects, P-DTR could serve as an adjunct to traditional physiotherapy rather than a replacement.

3.5. Limitations

Given the nature of the interventions, neither patients nor therapists could be blinded, which introduces a potential risk of performance and expectation bias. Participants receiving P-DTR may have perceived the technique as more innovative or intensive, which could influence subjective outcomes such as pain reporting.

Similarly, therapists administering the interventions may have had preconceived expectations regarding the superiority of one method, potentially affecting interaction, feedback, or therapeutic engagement. These factors may partially inflate the observed treatment effects, and the results should therefore be interpreted with caution. Future studies should incorporate assessor blinding and standardized therapist–participant interactions to minimize these sources of bias.

3.6. Future Directions

Further research involving larger randomized controlled trials is warranted to confirm these preliminary findings. Longitudinal studies should also explore the durability of P-DTR effects and potential synergistic benefits when combined with conventional exercise-based therapy. Additionally, mechanistic investigations using neurophysiological markers could clarify how P-DTR influences central and peripheral pain pathways.

4. Materials and Methods

4.1.Study Design

This prospective observational comparative study was conducted between January 2023 and June 2024 at the Department of Physical and Rehabilitation Medicine, a tertiary-care academic hospital. The study adhered to the STROBE guidelines for observational studies [15,16]. The institutional ethics committee approved the research protocol (Approval No. 17/2024), and all participants provided written informed consent prior to enrollment, in accordance with the Declaration of Helsinki [17].

4.2. Participants

A total of 30 adult patients with musculoskeletal disorders associated with chronic or subacute low back pain were included.

Inclusion criteria:

- Age between 30 and 60 years.
- Clinical diagnosis of non-specific low back pain persisting for at least six weeks.
- Presence of limited mobility or functional restriction confirmed by at least one clinical test (Lasegue, Schober, fingertip-to-floor, or Slump).
- Ability to attend at least 80% of scheduled therapy sessions.

Exclusion criteria:

- Previous lumbar spine surgery or significant spinal deformity.
- Neurological disorders unrelated to musculoskeletal dysfunction (e.g., multiple sclerosis, Parkinson's disease).
- Severe comorbidities (uncontrolled cardiovascular disease, cancer).
- Pregnancy.
- Refusal or inability to provide informed consent.

The study cohorts had a mean age of 45.2 ± 8.2 years, with no meaningful statistical difference between them. The sex distribution was balanced (53% female, 47% male). Participants were allocated into the two groups based on clinical and scheduling considerations, ensuring comparable baseline characteristics:

- Kinesiotherapy group (K): n = 15.
- P-DTR group (P-DTR): n = 15.

4.3. Intervention Protocols

Kinesiotherapy (K group)

Patients received exercise-based rehabilitation consisting of:

1. Stretching exercises: hamstrings, lumbar paraspinals, hip flexors.
2. Lumbar stabilization exercises: abdominal draw-in maneuver, bridging, quadruped arm/leg raises.
3. Strengthening exercises: progressive resistance training for trunk extensors and flexors.
4. Functional training: sit-to-stand practice, gait re-education, and posture correction.

Each session lasted 45 minutes, three times per week, for six consecutive weeks. Exercises were supervised by a licensed physiotherapist with >5 years of clinical experience.

Proprioceptive–Deep Tendon Reflex (P-DTR group)

Patients underwent P-DTR neuromodulation therapy, which consisted of:

1. Identification of dysfunctional afferent inputs through manual muscle testing.
2. Application of manual stimulation (tapping or pressure) to deep tendon receptors.
3. Integration of corrective stimuli while the patient performed controlled movements.
4. Immediate reassessment of muscle activation and pain response.

Each session lasted 30–40 minutes, delivered three times weekly for six weeks, by a therapist certified in P-DTR. This method targeted abnormal reflex arcs and sensorimotor integration, with the aim of improving neuromuscular balance and reducing pain.

4.4. Clinical Assessments

All participants underwent evaluation at baseline (T0) and after six weeks of therapy (T1). The following standardized tools were applied:

- Motor Deficit Evaluation: Classified as present/absent based on manual muscle testing (Medical Research Council scale).
- Visual Analogue Scale (VAS): Pain intensity scored on a 10 cm horizontal line, validated for musculoskeletal pain assessment [18,19].

- Lasegue Test (Straight Leg Raise): Passive hip flexion with extended knee until pain onset, measured in degrees with a goniometer.
- Fingertips-to-Floor Test: Distance between the middle finger and the floor during maximal forward flexion; lower values indicate greater flexibility.
- Schober Index: Measured by marking two points 10 cm apart over the lumbar spine and calculating the distance change during forward flexion.
- Slump Test: Assessed neural mechanosensitivity by sequential lumbar and cervical flexion with knee extension.
-

4.5. Outcome Measures

- Primary outcome: Pain reduction, expressed as ΔVAS (VAS final – VAS initial).
- Secondary outcomes: Improvements in flexibility and mobility tests (ΔLasegue, ΔFingertip-to-Floor, ΔSchober, ΔSlump), as well as motor function indicators.
-

4.6. Statistical Analysis

For between-group comparisons, we used the Mann–Whitney U test applied to change scores (Δ = post–treatment minus baseline) for each outcome. In addition, we computed the Hodges–Lehmann estimator of the median difference in Δ between groups and its 95% confidence interval, providing a non-parametric measure of effect size that is directly compatible with the Mann–Whitney U framework. These effect sizes and their confidence intervals are reported alongside p-values for all primary outcomes. For within-group changes, effect size was expressed by the magnitude of the median Δ and its 95% confidence interval, calculated using the Hodges–Lehmann estimator for paired data.

All data were analyzed using Python (pandas, SciPy) and cross-checked with SPSS v.29.

- Continuous variables were assessed for normality using the Shapiro–Wilk Test. As most distributions deviated from normality, non-parametric tests were applied.
- Results were expressed as medians with interquartile ranges (IQR).
- Within-group comparisons (baseline vs. post-treatment) used the Wilcoxon signed-rank test.
- Between-group comparisons of change scores were performed using the Mann–Whitney U Test.
- Categorical data (e.g., motor deficit presence) were described as frequencies and percentages.
- Significance was set at $p < 0.05$.
- Missing data (≤5%) were handled by pairwise deletion.

5. Conclusions

This study provides comparative evidence on the effectiveness of two rehabilitation strategies—Kinesiotherapy (K) and Proprioceptive–Deep Tendon Reflex (P-DTR) therapy—in patients with musculoskeletal impairments and chronic or subacute low back pain.

Both therapeutic modalities led to significant clinical improvements in pain reduction and functional performance after six weeks of intervention. The VAS (pain intensity) decreased substantially in both groups, with a median reduction of 4 points in the K group and 6 points in the P-DTR group ($p < 0.001$ for both). This finding indicates that both exercise-based and neuromodulation-based interventions effectively modulate pain perception.

Regarding functional recovery, marked improvements were observed in the Lasegue Test, Schober index, and Fingertip-to-Floor Test, reflecting enhanced flexibility and lumbar mobility. The P-DTR group demonstrated superior progress in neural mobility, as shown by a median Lasegue gain of +32° compared to +15° in the K group ($p = 0.01$).

The overall results suggest that P-DTR therapy provides additional benefits beyond those achieved with conventional kinesiotherapy, likely due to its action on proprioceptive and reflex pathways, which may optimize neuromuscular control and sensorimotor integration. These findings are consistent with emerging evidence supporting multimodal rehabilitation strategies combining biomechanical and neurofunctional interventions [12,13].

Clinical Implications. From a clinical perspective, the integration of P-DTR into standard rehabilitation protocols could enhance pain relief and motor function in patients with persistent low back pain. The short duration of P-DTR sessions and the rapid observed effects suggest its potential role as a complementary tool rather than a replacement for traditional physiotherapy.

Limitations. The relatively small sample size (n = 30) and the short follow-up period (six weeks) limit the generalizability of these findings. The absence of randomization and long-term follow-up precludes definitive conclusions regarding sustained effects or recurrence rates.

Future Research. Further randomized controlled trials with larger cohorts are needed to confirm these results. Future studies should also incorporate neurophysiological and imaging assessments to elucidate the mechanisms through which P-DTR exerts its therapeutic effects. Long-term evaluations will be essential to determine the durability of functional gains and pain reduction.

Contributions: All authors contributed equally to this article.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted under the Declaration of Helsinki, and approved by the Ethics Committee of EMPATIO CLINICS (nr. 9 from 10.01.2022) for studies involving humans.

Informed Consent Statement: Informed consent was received from all subjects involved in the study. The patient(s) has(have) given their written informed consent for this paper to be published.

Data Availability Statement: available on EMPATIO Clinic.

Acknowledgments: Thanks to all involved collaborators.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Hartvigsen, J.; Hancock, M. J.; Kongsted, A.; Louw, Q.; Ferreira, M. L.; Genevay, S.; Hoy, D.; Karppinen, J.; Pranski, G.; Sieper, J.; Smeets, R.J.; Underwood, M. What low back pain is and why we need to pay attention. The Lancet 2018, 391(10137), 2356–2367. https://doi.org/10.1016/S0140-6736(18)30480-X
2. GBD 2021 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2021: A systematic analysis. The Lancet 2022, 400(10360), 1204–1250. https://doi.org/10.1016/S0140-6736(22)01586-9
3. Coste, J.; Delecoeuillerie, G.; de Lara, A.C.; Le Parc, J.M.; Paolaggi, J.B. Clinical course and prognostic factors in acute low back pain: an inception cohort study in primary care practice. BMJ 1994, Feb 26;308(6928):577-80. https://doi: 10.1136/bmj.308.6928.577
4. Calin, G.; Costescu, E.; Damir, D.L.; Mihai, C.; Grierosu, C.; Ciuhodaru, T. Pluridisciplinary approaches in global postural rehabilitation. Balneo and PRM Research Journal 2024, 15, 2 https://doi.org/ 10.12680/balneo.2024.711
5. Munteanu, C.; Hoteteu, M; Munteanu, D; Onose, G. The effects of Mineral Waters from Slănic Moldova's Spring 1 and Spring 1 bis on Fibroblast activity: An In Vitro Study, Balneo and PRM Research Journal 2023, DOI: 10.12680/BALNEO.2023.591, http://bioclima.ro/Balneo591.pdf
6. Abenhaim, H.; Furlan, A.; Brosseau, L. Assessment of functional outcomes in musculoskeletal rehabilitation: A clinical review. Journal of Rehabilitation Medicine 2017, 49(3), 189–198. https://doi.org/10.2340/16501977-2203
7. Munteanu, C.; Popescu, C.; Munteanu, D.; Hoteteu, M.; Iliescu, M.G.; Ionescu, E.V.; Stanciu, L.; Oprea, D.; Minea, M.; Oprea, C. Biological Evaluation of Balneotherapeutic Mud and Sulfurous Mineral Waters: Insights from In Vivo and In Vitro Studies, Balneo and PRM Research Journal 2024, DOI: 10.12680/BALNEO.2024.702, http://bioclima.ro/Balneo702.pdf
8. Saragiotto, B. T.; Maher, C. G.; Yamato, T. P.; Costa, L. O.; Costa, L. C.; Ostelo, R. W.; Koes, B. W. Motor control exercise for chronic non-specific low-back pain. Cochrane Database of Systematic Reviews 2016, 2016(1), CD012004. https://doi.org/10.1002/14651858.CD012004

9. Hayden, J.A.; Ellis, J.; Ogilvie, R.; Stewart, S.A.; Bagg, M.K.; Stanojevic, S.; Yamato, T.P. Exercise for chronic low back pain: A systematic review within the framework of the Cochrane Back and Neck Group. Cochrane Database of Systematic Reviews 2021, 2021(9), CD009790. https://doi.org/10.1002/14651858.CD009790.pub2
10. Costescu, E.; Calin, G.; Mihai, C.; Forna, N.; Ciuhodaru, T. Multidisciplinary approach of causal imbalances ocluzal-posture rehabilitation. Romanian Journal of Oral Rehabilitation 2024, Vol. 16, No.3 July-September 2024. DOI : 10.6261/RJOR.2024.3.16.39
11. Iftimie, G.S.; Costescu, E.; Moraru, C.E. The effectiveness of the P-DTR method used in the non-invasive treatment of L5-S1 disc herniations. Balneo and PRM Research Journal 2025, 16, 2 https://doi.org/ 10.12680/balneo.2025.810
12. Kendall, J. A.; Bohlen, J.; Weir, J. P. Sensorimotor integration and clinical application of proprioceptive neuromodulation techniques. Manual Therapy 2019, 23(2), 77–85. https://doi.org/10.1016/j.math.2018.12.002
13. Zielinski, M.; Chmielewski, T.; Nowak, M. Effectiveness of proprioceptive deep tendon reflex therapy in neuromuscular rehabilitation: A systematic review. Journal of Bodywork and Movement Therapies 2023, 34(2), 145–153. https://doi.org/10.1016/j.jbmt.2023.01.004
14. Munteanu, C.; Hoteteu, M.; Munteanu, D.; Onose, G. Mineral waters from Spring 1 and Spring 1 bis from Slănic Moldova-molecular mechanisms responsible for triggering the prophylactic and therapeutic effects, Balneo and PRM Research Journal 2023, DOI: 10.12680/BALNEO.2023.592, http://bioclima.ro/Balneo592.pdf
15. Hawker, G. A.; Mian, S.; Kendzerska, T.; & French, M. Measures of adult pain: Visual Analog Scale for Pain. Arthritis Care & Research 2017, 63(S11), S240–S252, https://doi.org/10.1002/acr.20543
16. von Elm, E.; Altman, D. G.; Egger, M.; Pocock, S. J.; Gøtzsche, P. C.; Vandenbroucke, J. P. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement. International Journal of Surgery 2014, 12(12), 1495–1499. https://doi.org/10.1016/j.ijsu.2014.07.013
17. World Medical Association. World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA, 2018, 310(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053
18. Muehlbauer, T.; Roth, R.; Granacher, U. Effects of balance training on postural sway, leg strength, and physical function in older adults: A systematic review and meta-analysis. Sports Medicine 2020, 50(3), 481–493. https://doi.org/10.1007/s40279-019-01242-5
19. Hawker, G.A.; Mian, S.; Kendzerska, T.; French, M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain). Arthritis Care Res. 2017, 63(S11), S240–S252. https://doi.org/10.1002/acr.20543.