JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

https://doi.org/10.61919/z3wza416

Original Article

Comparison of Manual Therapy and Neurodynamic Techniques in Patients with Carpal Tunnel Syndrome: A Quasi-Experimental Study

Madiha Ahmad[1], Nabeel Ahmed[2], Hammad Sabir[3], Naveed Anwar[4]

[1] Department of Anatomy and Histology, University of Veterinary and Animal Sciences (UVAS), Lahore, Pakistan
[2] University Institute of Physical Therapy (UIPT), University of Lahore (UOL), Lahore, Pakistan
[3] Xinjiang Medical University, China
[4] NHS North PCN, Harlow, England

***Corresponding author: Madiha Ahmad, madihaahmad1994@gmail.com**

"Cite this Article" Received: 07 April 2026; **Accepted**: 09 June 2026; **Published**: 19 June 2026

Author Contributions: Concept: MA; Design: NAh; Data Collection: NAh; Analysis: MA; Drafting: HS and NAn. **Ethical Approval**: Imperial University, Lahore, Pakistan . **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Carpal tunnel syndrome is a common median nerve entrapment neuropathy that affects hand sensation, functional activity, and quality of life. Manual therapy and neurodynamic mobilization are commonly used conservative interventions, but direct comparative evidence remains limited. Objective: To compare the short-term effects of manual therapy plus electrotherapy and median nerve neurodynamic mobilization plus electrotherapy on symptom severity and functional status in patients with carpal tunnel syndrome. Methods: This quasi-experimental study included 16 participants with carpal tunnel syndrome who were allocated equally into two groups. Group A received manual therapy with TENS and EMS, while Group B received median nerve neurodynamic mobilization with TENS and EMS. Treatment was provided three to four times per week for two weeks. Outcomes were assessed using the Boston Carpal Tunnel Questionnaire at baseline, Week 1, and Week 2. Data were analyzed using SPSS version 21, with $p < 0.05$ considered statistically significant. Results: Both groups showed significant within-group improvement in symptom severity and functional status over two weeks. Symptom severity decreased from 1.78 ± 0.69 to 0.52 ± 0.47 in the neurodynamic group and from 1.92 ± 0.61 to 0.57 ± 0.50 in the manual therapy group. Functional status decreased from 2.02 ± 0.85 to 0.47 ± 0.64 and from 2.19 ± 0.94 to 0.55 ± 0.80, respectively. Week-2 between-group differences were not statistically significant for symptom severity ($p = 0.854$) or functional status ($p = 0.833$). Conclusion: Both combined rehabilitation approaches were associated with short-term improvement, with no statistically detectable difference between groups. Larger randomized trials are needed to confirm comparative effectiveness. Keywords: Carpal Tunnel Syndrome; Manual Therapy; Neurodynamic Techniques; Median Nerve; Boston Carpal Tunnel Questionnaire; Electrotherapy.

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most frequent entrapment neuropathy of the upper limb and occurs due to compression or mechanical irritation of the median nerve as it passes through the carpal tunnel beneath the transverse carpal ligament (1). The condition commonly presents with numbness, tingling, pain, and sensory disturbance involving the thumb, index finger, middle finger, and radial half of the ring finger, and symptoms may be aggravated by repetitive hand movements, sustained wrist postures, or occupational tasks requiring prolonged gripping and fine motor activity (2). Because CTS can impair hand dexterity, functional independence, work performance, and quality of life, timely conservative management is clinically important, particularly in patients with mild to moderate symptoms who may benefit from non-surgical rehabilitation strategies (2, 3).

Several conservative interventions have been used for CTS, including splinting, electrotherapy, exercise-based rehabilitation, manual therapy, and neurodynamic mobilization. Manual therapy is commonly applied to address restrictions in carpal bone mobility, soft tissue stiffness, and local mechanical factors that may contribute to median nerve compression within the carpal tunnel. Previous evidence suggests that manual therapy techniques may reduce pain, improve hand function, enhance local tissue mobility, and support improved nerve excursion during wrist and finger movements (4–6). These effects may be clinically meaningful because restricted carpal mobility and altered soft tissue mechanics can increase mechanical stress around the median nerve and contribute to persistent symptoms.

Neurodynamic mobilization is another conservative rehabilitation approach that aims to restore the mechanical and physiological mobility of peripheral nerves by using controlled sliding or gliding movements. In CTS, median nerve neurodynamic techniques are intended to improve nerve excursion, reduce mechanosensitivity, and facilitate symptom reduction during functional upper-limb movement (7, 8). Systematic review evidence indicates that neurodynamic techniques may provide short-term improvement in pain and function among patients with CTS, although the magnitude and consistency of benefit may vary across outcomes such as symptom severity, grip strength, and electrophysiological parameters (9, 10). Therefore, neurodynamic mobilization remains a clinically relevant intervention, but its comparative value against other rehabilitation approaches requires further investigation.

Although both manual therapy and neurodynamic mobilization have plausible biomechanical and neurophysiological mechanisms for improving CTS-related symptoms, direct comparative evidence remains limited. Existing studies often evaluate these techniques as part of combined treatment packages, compare them with usual care or electrotherapy, or include heterogeneous intervention protocols, making it difficult to determine whether one approach provides superior short-term functional benefit over the other. This gap is clinically important because rehabilitation professionals frequently select between manual therapy and neurodynamic techniques in routine practice, yet treatment choice is often guided by therapist preference rather than direct comparative evidence. In addition, when both interventions are delivered alongside electrotherapeutic modalities, it is necessary to interpret findings as comparative effects of combined treatment packages rather than as isolated effects of a single technique.

The present study was therefore designed to compare the short-term effects of manual therapy plus TENS and EMS with median nerve neurodynamic technique plus TENS and EMS in patients with CTS. The primary focus was improvement in symptom severity and functional status measured using the Boston Carpal Tunnel Questionnaire over a two-week treatment period. The study objective was to determine whether either combined rehabilitation approach produced greater improvement in BCTQ symptom severity and functional status scores among patients with CTS.

MATERIALS AND METHODS

This two-arm quasi-experimental study was conducted in the Department of Physiotherapy, Fatima Memorial Hospital, Shadman, Lahore, to compare the short-term effects of two conservative rehabilitation approaches in patients with carpal tunnel syndrome. The study included sixteen participants diagnosed with CTS, who were selected through purposive sampling and allocated equally into two treatment groups, with eight participants in each group. The intervention period lasted two weeks, and outcomes were assessed using the Boston Carpal Tunnel Questionnaire at baseline, after the first week, and after completion of the second week of treatment.

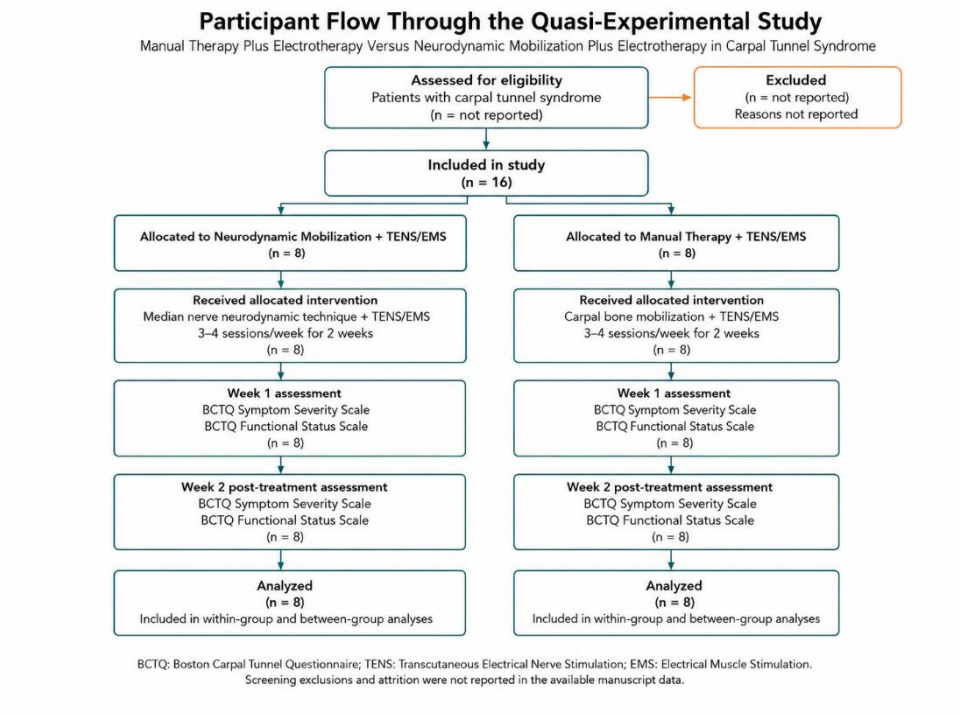
Participants aged 25 to 45 years with a clinical diagnosis of CTS were eligible for inclusion. Both male and female participants were included if they were not taking analgesic medication during the study period. Patients were excluded if they had severe cervical muscle spasm, a history of systemic disease including hypertension, diabetes mellitus, rheumatoid arthritis, or systemic lupus erythematosus, or a history of trauma. These eligibility criteria were applied to reduce the likelihood that symptoms were

attributable to systemic, cervical, traumatic, or inflammatory conditions rather than CTS. After screening for eligibility, informed consent was obtained from all participants before baseline assessment and treatment allocation.

The primary outcome measures were symptom severity and functional status assessed through the Boston Carpal Tunnel Questionnaire. The questionnaire includes the Symptom Severity Scale and Functional Status Scale and was administered before treatment, after one week of intervention, and after completion of the two-week intervention period. Lower post-treatment scores were interpreted as improvement in symptom severity and functional limitation. Baseline demographic and clinical variables included age, sex, baseline symptom severity score, and baseline functional status score. The principal comparative outcomes were change in BCTQ symptom severity and functional status scores over time within each group and post-treatment differences between the two groups.

Participants in Group A received manual therapy in addition to Transcutaneous Electrical Nerve Stimulation and Electrical Muscle Stimulation. Manual therapy consisted of carpal bone mobilization techniques applied to hypomobile wrist joints. The mobilization was performed with the participant in a sitting position, using a 5-second hold repeated 10 times during each treatment session. Participants in Group B received median nerve neurodynamic mobilization in addition to Transcutaneous Electrical Nerve Stimulation and Electrical Muscle Stimulation. The neurodynamic technique consisted of median nerve flossing performed with the participant in a supine position for 10 repetitions during each treatment session. Both groups received treatment three to four times per week for two weeks. Because TENS and EMS were provided to both groups, the study compared manual therapy plus electrotherapy with neurodynamic mobilization plus electrotherapy rather than evaluating either manual therapy or neurodynamic mobilization as an isolated intervention.

Procedural consistency was maintained by applying the same outcome measure and assessment schedule to both groups. Baseline assessment was completed before the start of treatment, and follow-up assessments were conducted at Week 1 and Week 2 using the same questionnaire format. The use of identical co-interventions in both groups was intended to reduce between-group performance differences related to electrotherapy exposure. Eligibility criteria excluding systemic disease, cervical involvement, trauma, and analgesic use were applied to reduce potential confounding from non-CTS pain sources and medication-related symptom modification. Participant responses were recorded systematically before statistical analysis to maintain data integrity.



Data were analyzed using SPSS version 21. Descriptive statistics were calculated for demographic and clinical variables. Continuous variables were reported as mean ± standard deviation, while categorical variables were summarized as frequencies. Baseline characteristics and post-intervention outcomes between the neurodynamic mobilization and manual therapy groups were compared using the independent samples t-test for continuous variables. Within-group changes in symptom severity and functional status across baseline, Week 1, and Week 2 were assessed using repeated-measures analysis, with post-hoc pairwise comparisons used to examine changes across assessment points. A p-value of less than 0.05 was considered statistically significant. The analysis focused on both within-group change over time and between-group post-treatment differences, while recognizing that the small sample size limits precision and does not allow formal equivalence or non-inferiority conclusions.

RESULTS

A total of 16 participants with carpal tunnel syndrome were included in the study, with 8 participants allocated to the neurodynamic mobilization plus electrotherapy group and 8 participants allocated to the manual therapy plus electrotherapy group. The mean age was comparable between the neurodynamic group and manual therapy group, and both groups had similar baseline BCTQ symptom severity and functional status scores before the start of treatment.

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	Neurodynamic Group (n = 8)	Manual Therapy Group (n = 8)	p-value
Age, years, Mean ± SD	36.50 ± 7.25	36.75 ± 5.50	0.939
Male, n (%)	3 (37.5)	4 (50.0)	—
Female, n (%)	5 (62.5)	4 (50.0)	—
Baseline Symptom Severity Score, Mean ± SD	1.78 ± 0.69	1.92 ± 0.61	0.681
Baseline Functional Status Score, Mean ± SD	2.02 ± 0.85	2.19 ± 0.94	0.707

SD: standard deviation. p-values were reported for continuous variables using independent samples t-test.

At baseline, the mean age differed by only 0.25 years between groups, with mean ages of 36.50 ± 7.25 years in the neurodynamic group and 36.75 ± 5.50 years in the manual therapy group. Baseline BCTQ symptom severity scores were 1.78 ± 0.69 in the neurodynamic group and 1.92 ± 0.61 in the manual therapy group, while baseline functional status scores were 2.02 ± 0.85 and 2.19 ± 0.94, respectively. The reported p-values for baseline symptom severity and functional status were 0.681 and 0.707, indicating no statistically detectable baseline difference between groups for these outcome measures.

Table 2. Within-Group Changes in BCTQ Outcomes Across the Two-Week Intervention Period

Outcome	Group	Baseline Mean ± SD	Week 1 Mean ± SD	Week 2 Mean ± SD	Baseline-to-Week 2 Mean Change	Baseline-to-Week 2 Change (%)	p-value
Symptom Severity Score	Neurodynamic	1.78 ± 0.69	1.15 ± 0.60	0.52 ± 0.47	-1.26	-70.8	<0.001
Symptom Severity Score	Manual Therapy	1.92 ± 0.61	1.22 ± 0.60	0.57 ± 0.50	-1.35	-70.3	<0.001
Functional Status Score	Neurodynamic	2.02 ± 0.85	1.23 ± 0.79	0.47 ± 0.64	-1.55	-76.7	<0.001
Functional Status Score	Manual Therapy	2.19 ± 0.94	1.31 ± 0.94	0.55 ± 0.80	-1.64	-74.9	<0.001

BCTQ: Boston Carpal Tunnel Questionnaire; SD: standard deviation. Negative change values indicate reduction in BCTQ scores from baseline to Week 2.

Both treatment groups showed progressive reductions in BCTQ symptom severity and functional status scores across baseline, Week 1, and Week 2. In the neurodynamic group, symptom severity decreased from 1.78 ± 0.69 at baseline to 0.52 ± 0.47 at Week 2, corresponding to a mean reduction of 1.26 points and a 70.8% reduction from baseline. In the manual therapy group, symptom severity decreased from 1.92 ± 0.61 to 0.57 ± 0.50, corresponding to a mean reduction of 1.35 points and a 70.3% reduction. Functional status showed a similar pattern, decreasing by 1.55 points in the neurodynamic group and 1.64 points in the manual therapy group from baseline to Week 2. The repeated-measures analysis

showed statistically significant within-group improvement for both outcomes in both treatment groups, with p-values less than 0.001.

Table 3. Post-Treatment Comparison of BCTQ Outcomes Between Groups at Week 2

Outcome	Neurodynamic Group Mean ± SD	Manual Therapy Group Mean ± SD	Mean Difference	95% CI	Cohen's d	p-value
Symptom Severity Score	0.52 ± 0.47	0.57 ± 0.50	-0.05	-0.57 to 0.47	-0.10	0.854
Functional Status Score	0.47 ± 0.64	0.55 ± 0.80	-0.08	-0.86 to 0.70	-0.11	0.833

SD: standard deviation; CI: confidence interval. Mean difference was calculated as neurodynamic group minus manual therapy group.

At Week 2, post-treatment symptom severity scores were 0.52 ± 0.47 in the neurodynamic group and 0.57 ± 0.50 in the manual therapy group, with a mean difference of -0.05 and a 95% confidence interval ranging from -0.57 to 0.47. Post-treatment functional status scores were 0.47 ± 0.64 and 0.55 ± 0.80, respectively, with a mean difference of -0.08 and a 95% confidence interval ranging from -0.86 to 0.70. The effect sizes for between-group post-treatment differences were small for both symptom severity and functional status, with Cohen's d values of -0.10 and -0.11, respectively. The reported p-values of 0.854 and 0.833 indicate that no statistically detectable post-treatment difference was observed between the two groups.

The overall pattern of results indicates that both combined rehabilitation approaches were associated with short-term improvement in BCTQ symptom severity and functional status over the two-week treatment period. However, the between-group differences at Week 2 were small, imprecise, and statistically non-significant. Therefore, the findings should be interpreted as showing similar observed short-term improvement in both groups rather than definitive equivalence between manual therapy and neurodynamic mobilization. Because the available aggregate data did not include standard deviations of paired change scores, within-participant correlations, F-statistics, or degrees of freedom, confidence intervals for within-group change and adjusted between-group change could not be validly calculated from the supplied information.

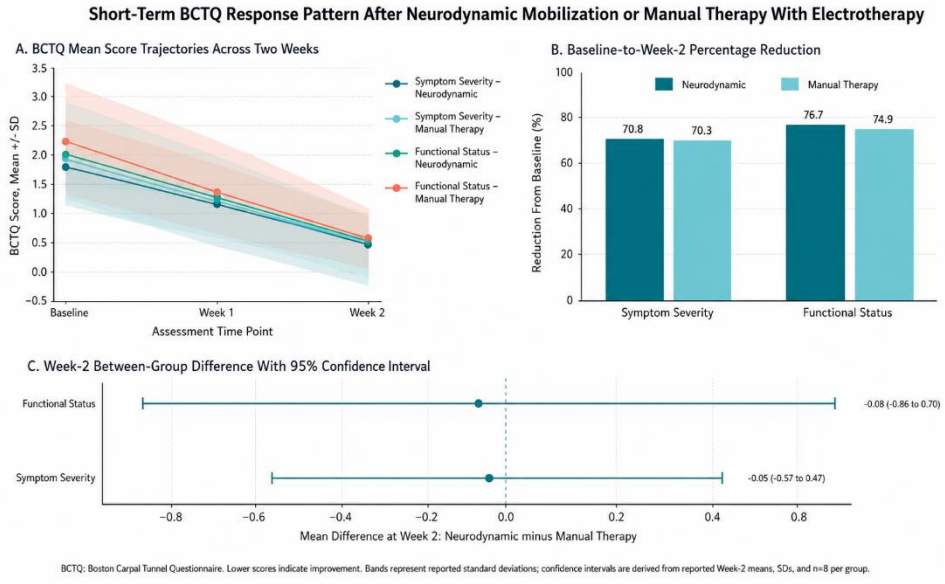


Figure 1 Short-Term BCTQ Response Pattern After Neurodynamic Mobilization or Manual Therapy with Electrotherapy

The panelled figure demonstrates parallel short-term improvement in both treatment groups across BCTQ symptom severity and functional status scores over the two-week intervention period. Symptom severity decreased from 1.78 to 0.52 in the neurodynamic group and from 1.92 to 0.57 in the manual therapy group, corresponding to baseline-to-Week-2 reductions of 70.8% and 70.3%, respectively. Functional status showed a slightly larger proportional reduction, decreasing from 2.02 to 0.47 in the neurodynamic group and from 2.19 to 0.55 in the manual therapy group, equivalent to reductions of 76.7% and 74.9%. Week-2 between-group differences were small and imprecise, with mean differences

of -0.05 for symptom severity and -0.08 for functional status, and both 95% confidence intervals crossed zero, indicating no statistically detectable post-treatment difference between groups. Overall, the visual pattern supports substantial within-group improvement in both combined rehabilitation approaches while reinforcing that the available aggregate data do not establish superiority or equivalence between interventions.

DISCUSSION

This quasi-experimental study compared the short-term effects of manual therapy plus electrotherapy and median nerve neurodynamic mobilization plus electrotherapy in patients with carpal tunnel syndrome. The findings showed that both treatment groups demonstrated progressive improvement in BCTQ symptom severity and functional status scores across the two-week intervention period. Symptom severity decreased from 1.78 ± 0.69 to 0.52 ± 0.47 in the neurodynamic group and from 1.92 ± 0.61 to 0.57 ± 0.50 in the manual therapy group, while functional status decreased from 2.02 ± 0.85 to 0.47 ± 0.64 and from 2.19 ± 0.94 to 0.55 ± 0.80, respectively. These changes indicate clinically relevant short-term improvement within both groups; however, the post-treatment between-group differences were small and statistically non-significant, with p-values of 0.854 for symptom severity and 0.833 for functional status. Therefore, the findings should be interpreted as showing similar observed improvement in both combined rehabilitation approaches rather than definitive equivalence or superiority of one intervention over the other.

The improvement observed in the manual therapy group is consistent with previous evidence suggesting that manual therapy may reduce CTS-related symptoms by improving carpal bone mobility, decreasing mechanical restriction around the carpal tunnel, and enhancing the mobility of soft tissues surrounding the median nerve. Manual approaches directed at the wrist and carpal region may influence local tissue mechanics and reduce compression-related irritability, which can contribute to improvements in pain, symptom severity, and functional performance. Previous studies have reported favorable outcomes with manual therapy in CTS, including improvement in symptom severity, grip-related function, pain intensity, and quality-of-life measures (11–13). These findings support the clinical plausibility of the present results, although the small sample size and short treatment duration limit the strength of inference.

The neurodynamic mobilization group also demonstrated substantial improvement in symptom severity and functional status over the two-week period. Neurodynamic techniques are intended to improve median nerve excursion, reduce mechanosensitivity, and restore the mechanical interface between the nerve and surrounding tissues. In CTS, restricted median nerve mobility and increased sensitivity during wrist and finger movements may contribute to symptom persistence, and controlled nerve-gliding or flossing maneuvers may help reduce mechanical stress during upper-limb movement. Previous evidence has shown that neurodynamic interventions can produce short-term improvements in pain and functional outcomes in patients with CTS, although effects on some outcomes such as symptom severity, grip strength, and electrophysiological parameters may be variable across studies (9, 10, 14). The present findings are broadly consistent with this literature, as neurodynamic mobilization was associated with marked improvement in BCTQ symptom severity and functional status.

The absence of a statistically significant post-treatment difference between groups may be explained by overlapping therapeutic mechanisms and by the use of common co-interventions. Manual therapy may improve local mechanical mobility at the wrist and carpal tunnel, whereas neurodynamic mobilization may improve median nerve sliding and mechanosensitivity; however, both approaches may ultimately reduce mechanical stress on the median nerve and improve tolerance to hand and wrist movement. In addition, both groups received TENS and EMS, which may have contributed to symptom reduction in both arms. As a result, the study compared two combined rehabilitation packages rather than isolated manual therapy and isolated neurodynamic mobilization. This distinction is important because the

observed improvement cannot be attributed solely to either manual therapy or neurodynamic technique. The common use of electrotherapy may have reduced between-group differences and contributed to the similar Week-2 outcomes.

From a statistical perspective, the non-significant between-group findings require cautious interpretation. The Week-2 mean differences were small, but the study was not designed or powered as an equivalence or non-inferiority trial. Therefore, the findings do not prove that both interventions are equivalent. Rather, they show that no statistically detectable difference was observed between groups in this small sample. The wide uncertainty expected with only eight participants per group limits precision and increases the possibility of type II error. Future studies should use larger samples, randomized allocation, concealed group assignment, assessor blinding, longer follow-up, and adjusted analysis of baseline-to-follow-up change scores to better determine whether one approach provides superior clinical benefit.

Several limitations should be considered when interpreting the findings. The sample size was small and participants were selected through purposive sampling, which reduces generalizability. The study duration was limited to two weeks, so the persistence of improvement beyond the immediate treatment period remains unknown. The diagnostic basis and clinical severity of CTS were not fully detailed, which limits reproducibility and subgroup interpretation. The allocation method was not clearly described as randomized, and blinding was not reported, increasing the risk of selection and assessment bias. Intervention reporting was also limited because detailed TENS, EMS, manual mobilization, and neurodynamic technique parameters were not fully specified. Finally, the absence of a no-treatment, placebo, sham, or electrotherapy-only control group prevents isolation of the specific treatment effect of each active intervention.

Despite these limitations, the study provides useful preliminary clinical evidence that both manual therapy plus electrotherapy and neurodynamic mobilization plus electrotherapy may be associated with short-term improvement in symptom severity and functional status among patients with CTS. The parallel improvement pattern across both groups suggests that either approach may be considered as part of conservative rehabilitation when appropriately selected for the patient's clinical presentation. However, stronger evidence from adequately powered randomized controlled trials is needed before firm conclusions can be drawn regarding comparative effectiveness, long-term benefit, or treatment superiority.

CONCLUSION

Manual therapy combined with TENS and EMS and median nerve neurodynamic mobilization combined with TENS and EMS were both associated with short-term improvement in BCTQ symptom severity and functional status scores among patients with carpal tunnel syndrome over a two-week intervention period. No statistically detectable post-treatment difference was observed between the two groups for symptom severity or functional status; however, the small sample size, short follow-up, and absence of formal equivalence testing mean that the findings should be interpreted as preliminary evidence of similar observed improvement rather than proof of equal effectiveness. Larger randomized controlled trials with standardized intervention protocols, longer follow-up, and adjusted analysis of change scores are required to confirm the comparative clinical value of these conservative rehabilitation approaches.

REFERENCES

1. Kablan N, Mete E, Karatekin BD, Tombul T. The effect of manual lymphatic drainage on intraneural edema of the median nerve in patients with carpal tunnel syndrome: a randomized controlled trial. J Hand Ther. 2025;38(1):80-90.

2. Rotaru-Zavaleanu AD, Lungulescu CV, Bunescu MG, Vasile RC, Gheorman V, Gresita A, et al. Occupational carpal tunnel syndrome: a scoping review of causes, mechanisms, diagnosis, and intervention strategies. Front Public Health. 2024;12:1407302.

3. Lin TY, Chang KV, Wu WT, Özçakar L. Ultrasonography for the diagnosis of carpal tunnel syndrome: an umbrella review. J Neurol. 2022;269(9):4663-75.

4. Jiménez del Barrio S, Estébanez de Miguel E, Bueno Gracia E, Haddad Garay M, Tricás Moreno JM, Hidalgo García C. Effects of diacutaneous fibrolysis in patients with mild to moderate symptomatic carpal tunnel syndrome: a randomized controlled trial. Clin Rehabil. 2018;32(12):1645-55.

5. Talebi GA, Saadat P, Javadian Y, Taghipour M. Comparison of two manual therapy techniques in patients with carpal tunnel syndrome: a randomized clinical trial. Caspian J Intern Med. 2020;11(2):163-70.

6. Wolny T, Saulicz E, Linek P, Shacklock M, Myśliwiec A. Efficacy of manual therapy including neurodynamic techniques for the treatment of carpal tunnel syndrome: a randomized controlled trial. J Manipulative Physiol Ther. 2017;40(4):263-72.

7. Duman İ, Davul S, Hallaçeli H, Doğramacı Y, Uruç V. Excursion of the median, ulnar and radial nerves during the nerve gliding exercises used in orthopedic physiotherapy: a cadaveric study. Med J Mustafa Kemal Univ. 2021;12(44):144-8.

8. Hamzeh H, Madi M, Alghwiri AA, Hawamdeh Z. The long-term effect of neurodynamics vs exercise therapy on pain and function in people with carpal tunnel syndrome: a randomized parallel-group clinical trial. J Hand Ther. 2021;34(4):521-30.

9. Núñez de Arenas-Arroyo S, Cavero-Redondo I, Torres-Costoso A, Reina-Gutiérrez S, Álvarez-Bueno C, Martínez-Vizcaíno V. Short-term effects of neurodynamic techniques for treating carpal tunnel syndrome: a systematic review with meta-analysis. J Orthop Sports Phys Ther. 2021;51(12):566-80.

10. Zaheer SA, Ahmed Z. Neurodynamic techniques in the treatment of mild-to-moderate carpal tunnel syndrome: a systematic review and meta-analysis. J Clin Med. 2023;12(15):4888.

11. Donati D, Boccolari P, Tedeschi R. Manual therapy vs. surgery: which is best for carpal tunnel syndrome relief? Life. 2024;14(10):1286.

12. Wielemborek P, Kapica-Topczewska K, Bielecki M, Kułakowski R, Mirowska-Guzel D, Kochanowicz J, et al. Manual therapy compared to surgery in the treatment of moderate carpal tunnel syndrome. Adv Psychiatry Neurol. 2024;33(4):248-56.

13. Ceylan İ, Büyükturan Ö, Aykanat Ö, Büyükturan B, Şaş S, Ceylan MF. The effectiveness of mobilization with movement on patients with mild and moderate carpal tunnel syndrome: a single-blinded, randomized controlled study. J Hand Ther. 2023;36(4):773-85.

14. Núñez de Arenas-Arroyo S, Martínez-Vizcaíno V, Cavero-Redondo I, Álvarez-Bueno C, Reina-Gutiérrez S, Torres-Costoso A. The effect of neurodynamic techniques on the dispersion of intraneural edema: a systematic review with meta-analysis. Int J Environ Res Public Health. 2022;19(21):14472.