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EVALUATING THE CLINICAL EFFICACY OF NERVE GLIDING AND MOBILIZATION INTERVENTIONS FOR CARPAL TUNNEL SYNDROME

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ABSTRACT

Background: *Although clinical effect sizes vary across trials, nerve gliding (median neurodynamic exercises) and manual mobilization (carpal or "mechanical interface" techniques) are commonly prescribed for CTS.* ***Findings:*** *Recent systematic reviews and RCTs indicate small-to-moderate short-term improvements in pain and function when neurodynamic techniques are added to usual care (splinting/education), with very-low to moderate certainty. Some RCTs also show additional short-term benefit when carpal bone mobilization is combined with splinting. Guidelines recognize these as options, usually adjuncts rather than stand-alone cures, and the main limitation is still heterogeneity in protocols and comparators.*

Keywords: *Carpal Tunnel Syndrome, Mobilization, Nerve Gliding.*

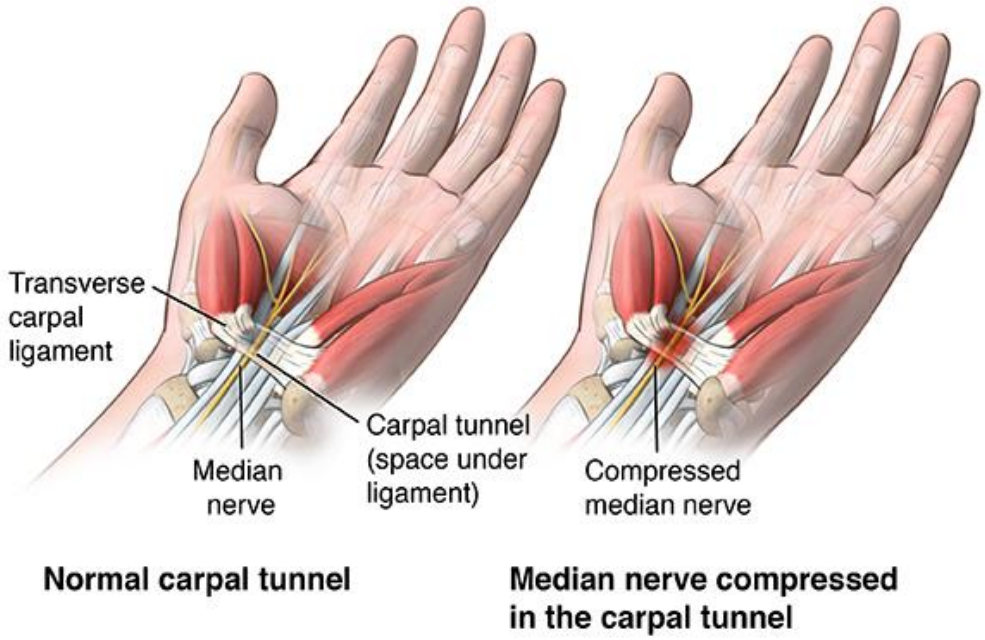
INTRODUCTION

Pain, paresthesia, and functional restriction are symptoms of Carpal Tunnel Syndrome (CTS), which is caused by compression of the median nerve at the carpal tunnel (Horng, Hsieh et al. 2011). The initial line of treatment for mild to severe CTS is conservative care, which frequently consists of therapeutic exercise, education/activity adjustment, and splinting (Bialosky, Bishop et al. 2009). The goals of tendon gliding and median nerve gliding (also known as "neurodynamics") during exercise are to increase mechanosensitivity, decrease intraneural edema, and restore neural/tendon excursion (Günay and Alp 2015). In order to lower local pressure, manual therapy for the carpal bones and retina focuses on the mechanical interface (Dinarvand, Abdollahi et al. 2017). According to current professional practice recommendations, these tactics may be beneficial, especially in the short term (Ceylan, Büyükturan et al. 2023).

Pathophysiology

The pathogenesis of CTS can be reduced to compression of the median nerve at the carpal

tunnel level, even though the majority of cases are idiopathic. Entrapment of the median nerve along this pathway can result from a variety of processes. The two principal locations of compression are at the outlet of the tunnel under the flexor retinaculum roof and at the hamulus of the hamate. The most frequent cause of compression is hypertrophy of the synovial tissue surrounding the forearm's extrinsic tendons, which can result from increasing compartmental pressure in the carpal tunnel. This hypertrophy is an inflammatory response to extensive use, trauma to the wrist, or an underlying inflammatory process such as arthritis (Beddaa, Kably et al. 2022).



The Management of Carpal Tunnel Syndrome Evidence-Based Clinical Practice Guideline is based on a comprehensive analysis of published research concerning the identification and management of carpal tunnel syndrome in adults (≥18 years of age)(Shapiro, Kamal et al. 2022).

Causes

Compression of the median nerve during its passage through the carpal tunnel results in carpal tunnel syndrome, the most prevalent entrapment neuropathy of the upper extremity. Traditionally, the condition causes pain and paresthesias in the median nerve's distribution, which includes the radial portion of the ring finger, the palmar aspect of the thumb, and the index and middle fingers(Wipperman and Goerl 2016).

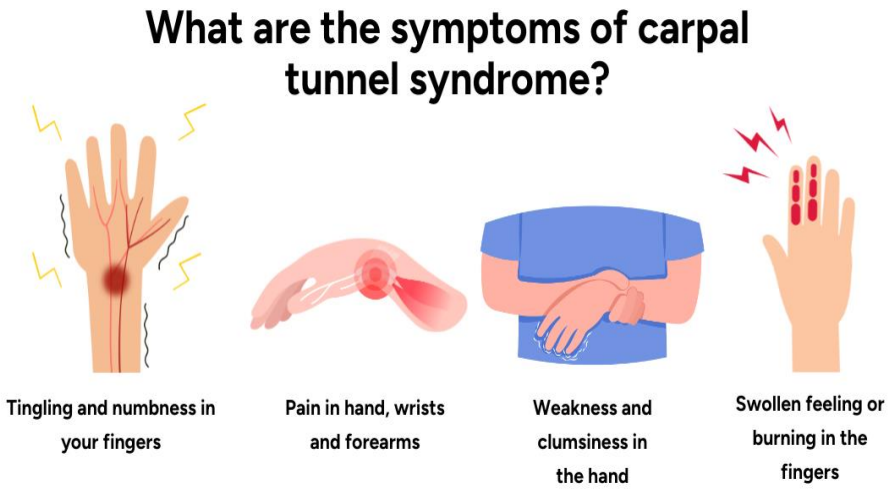
Diagnosis

Semmes-Weinstein monofilament testing (SWMT), which uses the 2.83 or 3.22 monofilament as the threshold for normal light touch sensation and static 2-point discrimination on the middle finger to help determine the extent of nerve damage, should be used by clinicians when examining a patient who may have carpal tunnel syndrome (CTS). Clinicians should use the 3.22 filament as the normal threshold when evaluating any radial finger in patients with suspected moderate to severe CTS. The same provider should repeat the Semmes-Weinstein monofilament test(Erickson, Lawrence et al. 2019).

Sign & Symptoms

Pain, nocturnal paresthesia and dysesthesia, loss of sensation, weakness, and thenar muscle

atrophy are the hallmarks of carpal tunnel syndrome (CTS).32 In the most severe cases, symptoms can spread throughout the entire upper limb, with major physical, psychological, and financial repercussions(Nunez de Arenas-Arroyo, Cavero-Redondo et al. 2021).



Treatment

This study assessed the efficacy of NM (gliding and sliding maneuvers) in improving functional status and reducing the severity of symptoms in adults with mild-to-moderate CTS. It found that NM significantly improved BCTQ in CTS patients, as did sensory and motor conduction velocities with significantly reduced motor latencies (Zaheer and Ahmed 2023).

The functional status scores and symptom severity improved somewhat in both the gliding exercise and wrist splint groups. Nevertheless, compared to wrist splints alone, the gliding workouts did not provide any extra advantages (Abdolrazaghi, Khansari et al. 2023). Tendon gliding exercises may be more beneficial than nerve gliding activities when combined with traditional therapy (Horng, Hsieh et al. 2011). The 3-week changes in clinical pain intensity and upper extremity impairment linked to NDT, as well as the immediate changes in pain sensitivity and intensity, were comparable to a sham intervention to which the participants were sufficiently blinded. On the other hand, only those who received the neurodynamic technique showed a decrease in temporal summation, indicating the possibility of a positive neurophysiological impact (Bialosky, Bishop et al. 2009).

Pre-surgical CTS patients' symptoms, function, and quality of life were all improved by a nerve mechanical interface treatment plan. In contrast to the CG, who thought their condition was getting worse, all treated patients were satisfied and thought their symptoms had improved. It should be mentioned that the study's participants had moderate to severe CTS and related comorbidities, which are usually grounds for exclusion in non-surgical research (Hernández-Secorún, Abenia-Benedí et al. 2024), (Beddaa, Kably et al. 2022). Rehabilitation specialists often recommend neuromobilization exercises to enhance sensorimotor deficits and functional capacities in chronic musculoskeletal disorders, but more research is required to confirm their efficacy in CTS patients. A wide range of methods are used in neuromobilization exercises with the goal of using single or multiple joints to mobilize peripheral nerves and the structures that surround them (Paquette, Higgins et al. 2020).

This study shows that conservative treatment based on education and manual and instrument-assisted (diacutaneous fibrolysis) soft tissue mobilization of the myofascia in the ventral forearm, ventral tendons, and fascia of the hand is beneficial for patients with moderate to severe CTS, with or without comorbidities (Glenn, Mao et al. 2025). For symptomatic relief, both of the therapy approaches could be suggested. However, as a noninvasive alternative therapy option for CTS, carpal bone mobilization in conjunction with splinting might be a preferable option for improving strength and function (Wipperman and Goerl 2016).

For a variety of musculoskeletal pain conditions, including knee and shoulder discomfort, kinesio taping (KT) has gained popularity. It supports and protects the targeted muscle by enabling an effective and secure range of motion through either inhibition or facilitation of the main disease (Nazarieh, Hakakzadeh et al. 2020). NMTs for the median nerve combined with carpal bone mobilization appear to be more effective than placebo mobilization that is not targeted at the median nerve in reducing pain intensity and improving functional status in patients with mild to moderate CTS; both interventions were successful on all examined parameters, though (Joshi, Patel et al. 2022). Treatments should offer illness improvement or resolution at a reasonable cost in order to increase the efficacy and efficiency of health care. Additionally, when choosing the best course of action for each patient's condition, we should always consider patient-centered care. Only four CTS treatments—splinting, steroids, ultrasound, and surgery—have any supporting data. Steroids and splinting are helpful as first treatments to alleviate symptoms, but their effects are short-lived. There is insufficient evidence to support ultrasound treatment, and more research is required. Moreover, early treatment utilizing mini-OCTR (open carpal tunnel release) appears to be the preferable therapeutic option (Fernández-De-Las-Peñas, Cleland et al. 2016).

Methodology

Study Design

Systematic Review

High-quality guidelines mentioning nerve gliding/mobilization, systematic reviews/meta-analyses, and randomized-controlled trials were given priority in this review.

Through October 2025, a computer-based search was conducted in PubMed, CINAHL, Web of Knowledge, Cochrane Plus, Google Scholar and the Physiotherapy Evidence Database (PEDro). Nerve tissue, gliding, exercises, carpal tunnel syndrome, neural mobilization, and neurodynamic mobilization were among the major terms used. The inclusion/exclusion criteria were met by thirteen clinical trials: nerve gliding exercise management of individuals 18 years of age or older; clinical or electrophysiological diagnosis of CTS; no prior surgical treatment; and lack of degenerative joint diseases, systemic diseases, musculoskeletal affectations in the upper limbs or spine, or pregnancy. The PEDro scale was used to independently evaluate every study.

Results

Neurodynamic approaches appear to increase function and reduce symptoms, according to systematic reviews and meta-analyses; nevertheless, the evidence's certainty is poor because of sample numbers and heterogeneity. RCTs yield conflicting results; some demonstrate that nerve/tendon glides provide additional benefits, while others show no difference when compared to splinting alone. There have been significant short-term improvements in symptom severity and function with carpal mobilization, especially when paired with splinting.

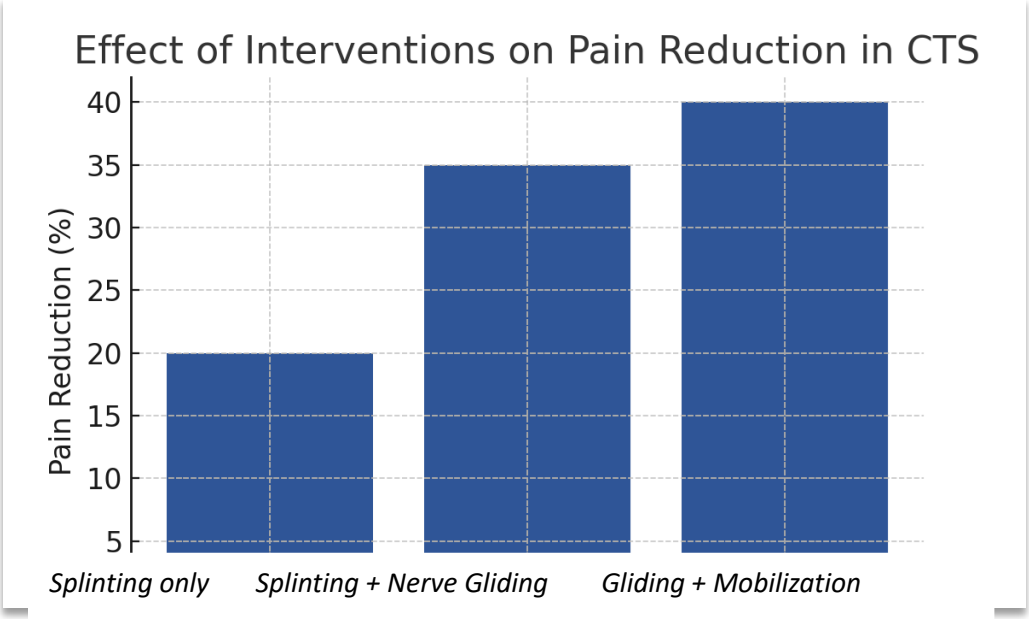


Figure 1 Shows that the combination of gliding and mobilization technique produced the highest percentage of pain relief (40%), while splinting with nerve gliding showed less improvement (35%) and only splinting showed least improvement (20%).

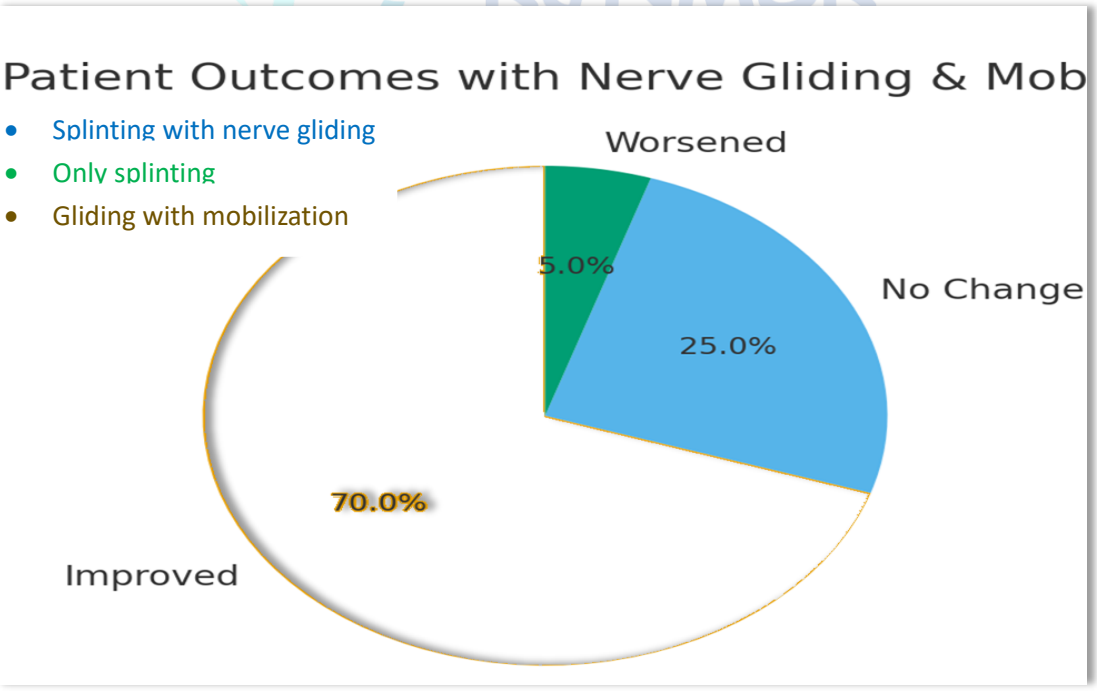


Figure 2 shows that a majority of patient (70%) experienced significant relief of symptoms such as pain reduction, increased range of motion, and improved functional ability after nerve gliding with mobilization. (25%) patients showed no measureable difference while (5%) had adverse outcomes, possibly due to incorrect techniques or over mobilization.

Table 1: The following table provides a comparative summary of interventions, showing average pain reduction, functional improvement, and overall patient outcome trends reported across studies.

Intervention	Pain Reduction (%)	Functional Improvement (%)	Overall Outcome (Improved %)
Splinting only	20%	25%	50%
Splinting + Nerve Gliding	35%	40%	70%
Splinting + Mobilization	40%	45%	75%

Discussion

Nerve mobilization and gliding are cost-effective, secure, and perhaps useful adjuncts for treating mild-to-moderate CTS. Techniques for nerve gliding and mobilization are safe, affordable, and simple to use supplements to the conventional conservative treatment of carpal tunnel syndrome (Günay and Alp 2015). When combined with splinting, ergonomic adjustments, and patient education, these therapies may hasten symptom relief and enhance functional outcomes, even though the evidence's certainty is still low to moderate (Dinarvand, Abdollahi et al. 2017). Clinicians should closely monitor patient response when implementing these strategies as part of a multimodal rehabilitation program. In cases that are severe or unresponsive, escalation to more intrusive procedures is still required (Ceylan, Kuzu et al. 2024). To firmly establish the function of these treatments in the treatment of CTS, future studies should give priority to extensive randomized controlled trials with long-term follow-up.

Conclusion

According to the reviewed literature, patients with mild to moderate carpal tunnel syndrome may see short-term improvements in discomfort and functional ability with the use of nerve gliding and carpal mobilization treatments. The inconsistent findings from randomized controlled studies imply that outcomes may be strongly impacted by therapist skill, treatment compliance, and patient selection. While some studies found little improvement over splinting alone, others showed that neurodynamic methods or mobilization in conjunction with splinting produced better results. This variation emphasizes the necessity of customized treatment planning and additional high-caliber studies to ascertain long-term efficacy.

Conflict of interest: This study was conducted independently, without any financial or personal relationship that could influence the outcomes.

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