Effectiveness of Nerve Gliding Exercises on Carpal Tunnel Syndrome: A Systematic Review

Ruth Ballestero-Pérez, PhD,[a] Gustavo Plaza-Manzano, PhD,[b] Alicia Urraca-Gesto, PT,[c] Flor Romo-Romo, PT,[c] María de los Ángeles Atín-Arratibel, MD,[a] Daniel Pecos-Martín, PhD,[d] Tomás Gallego-Izquierdo, PhD,[d] and Natalia Romero-Franco, PhD[e]

Abstract

Objective: The objective of this study was to review the literature regarding the effectiveness of neural gliding exercises for the management of carpal tunnel syndrome (CTS).

Methods: A computer-based search was completed through May 2014 in PubMed, Physiotherapy Evidence Database (PEDro), Web of Knowledge, Cochrane Plus, and CINAHL. The following key words were included: *nerve tissue*, *gliding, exercises*, *carpal tunnel syndrome*, *neural mobilization,* and *neurodynamic mobilization*. Thirteen clinical trials met the inclusion/exclusion criteria, which were: nerve gliding exercise management of participants aged 18 years or older; clinical or electrophysiological diagnostics of CTS; no prior surgical treatment; and absence of systemic diseases, degenerative joint diseases, musculoskeletal affectations in upper limbs or spine, or pregnancy. All studies were independently appraised using the PEDro scale.

Results: The majority of studies reported improvements in pain, pressure pain threshold, and function of CTS patients after nerve gliding, combined or not with additional therapies. When comparing nerve gliding with other therapies, 2 studies reported better results from standard care and 1 from use of a wrist splint, whereas 3 studies reported greater and earlier pain relief and function after nerve gliding in comparison with conservative techniques, such as ultrasound and wrist splint. However, 6 of the 13 studies had a quality of 5 of 11 or less according to the PEDro scale.

Conclusion: Limited evidence is available on the effectiveness of neural gliding. Standard conservative care seems to be the most appropriate option for pain relief, although neural gliding might be a complementary option to accelerate recovery of function. More high-quality research is still necessary to determine its effectiveness and the subgroups of patients who may respond better to this treatment. (J Manipulative Physiol Ther 2017;40:50-59)

Key Indexing Terms: *Carpal Tunnel Syndrome; Nerve Tissue; Stress, Mechanical; Exercise Therapy; Movement*

Introduction

Carpal tunnel syndrome (CTS) is the result of an irritation, compression, or stretching of the median nerve as it passes through the carpal tunnel in the wrist. Symptoms range from pain (mainly nightly)[1] and paresthesia to thenar eminence muscle atrophy[2-6] This syndrome represents the most prevalent neural injury in the general population (1-4%)[7-9] and workers at risk (15-20%)[10-12] (those requiring repetitive movements of the wrist and fingers such as typing, nursing, and cleaning), whose tendency to become chronic patients has an economic impact because of work absences and surgical treatments required to improve the condition.[7]

The initial phases of the conservative treatment methods require corrective splints in the wrist while neutral or in an extension position, electrotherapy with ultrasound or laser, or manual therapy and exercises.[13-16] At severe stages,

[a] Departamento de Medicina Física y Rehabilitación, Universidad Complutense de Madrid, Madrid, Spain.
[b] Departamento de Medicina Física y Rehabilitación, Facultad de Medicina, Universidad Complutense de Madrid; Instituto de Investigación Sanitaria del Hospital Clínico San Carlos (IdISSC), Madrid, Spain.
[c] Departamento de Rehabilitación y Fisioterapia, Hospital Universitario Fundación Alcorcón, Madrid, Spain.
[d] Departamento de Enfermería y Fisioterapia, Universidad de Alcalá, Madrid, Spain.
[e] Department of Nursing and Physiotherapy, University of the Balearic Islands, Palma, Spain.
Corresponding Author: Natalia Romero-Franco, PhD, Nursing and Physiotherapy Department, University of the Balearic Islands, University Campus—Beatriu de Pinos, Road Valldemossa, Km 7.5, E-07122, Palma, Spain. Tel.: +34 971172916.
(e-mail: *narf52@gmail.com*).

Paper submitted May 8, 2014; in revised form September 14, 2016; accepted September 27, 2016.
0161-4754

http://dx.doi.org/10.1016/j.jmpt.2016.10.004

Table 1. *Methodological Quality of Studies Included According to PEDro Scale*

Publication	1	2	3	4	5	6	7	8	9	10	11	Total
De-la-Llave-Rincón et al., 2012[25]	✓	✗	✗	✗	✓	✗	✗	✓	✓	✗	✓	5/11
Horng et al., 2011[30]	✓	✓	✓	✓	✗	✗	✗	✓	✗	✓	✓	7/11
Fernández-de-las-Peñas et al, 2010[26]	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓	4/11
Bardak et al, 2009[32]	✓	✓	✓	✓	✗	✗	✓	✓	✗	✓	✓	8/11
Bialosky et al, 2009[27]	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓	✓	9/11
Heebner and Roddey, 2008[22]	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓	8/11
Brininger et al, 2007[3]	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	6/11
Baysal et al, 2006[28]	✓	✓	✓	✓	✗	✗	✓	✗	✗	✓	✓	7/11
Pinar et al, 2005[19]	✓	✓	✗	✓	✗	✗	✗	✗	✗	✓	✓	5/11
Akalin et al, 2002[31]	✓	✓	✗	✓	✗	✗	✗	✗	✓	✓	✓	6/11
Seradge et al, 2002[12]	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓	4/11
Tal-Akabi and Rushton, 2000[29]	✓	✓	✗	✓	✗	✗	✗	✓	✗	✓	✗	5/11
Rozmaryn et al, 1998[13]	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	4/11

✓, no; ✗, yes; *1*, eligibility criteria were specified; *2,* subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated in order in which treatments were received); *3,* allocation was concealed; *4,* groups were similar at baseline with respect to most important prognostic indicators; *5,* there was blinding of all subjects; *6,* there was blinding of all therapists who administered the therapy; *7,* there was blinding of all assessors who measured at least one key outcome; *8,* measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; *9,* all subjects for whom outcome measures were available received the treatment or control condition as allocated, or, where this was not the case, data for at least one key outcome were analyzed by "intention to treat"; *10,* results of between-group statistical comparisons are reported for at least one key outcome; *11,* study provides both point measures and measures of variability for at least one key outcome.

authors recommend surgical procedures.[14] However, the unclear etiology and the frequent chronicity of CTS make its clinical approach controversial.

Recently, several studies reported optimum results with the use of neurodynamic mobilization as a conservative treatment, with neural slipping helping nerve mobilization in relation to musculoskeletal tissues.[2,17] The biomechanical effect of the treatment would restore neural mobilization by decreasing the edema and adhesion in the carpal tunnel.[7,18,19] Because of the chronicity of CTS, studies also described neuromodulator effects from neural mobilization techniques such as the decrease in nociception of the median nerve; reduction in algogenic and pro-inflammatory substances[20]; and reversibility in the pain pathways previously modified. Consequently, peripheral and central sensitization may decrease and descending pain modulation might occur.[21,22] To our knowledge, however, the clinical effectiveness of the neurodynamic approach remains unclear because very few studies to date have analyzed this approach to the treatment of CTS.[18] The aim of the present study was to review clinical trials regarding the effectiveness of neurodynamic mobilization of the median nerve in patients with CTS.

Methods

Our systematic review was guided by the PRISMA (preferred reporting items for systematic reviews and meta-analyses) statement.[23] The research strategy included all clinical trials regarding the neurodynamic treatment of CTS. The following criteria were included: articles on participants aged ≥18 years with a clinical or electrophysiological diagnosis of CTS; and articles on neurodynamic mobilization as a conservative method for CTS treatment. Excluded from this review were articles on participants with systematic diseases, degenerative joint diseases, musculoskeletal affectations of the upper limbs or spine, or pregnancy; and articles on surgery as a treatment method for CTS.

In the computer-based search, authors considered MEDLINE, Physiotherapy Evidence Database (PEDro), Web of Knowledge, Cochrane Plus and CINAHL, up to May 2014. The following key words were employed: *nerve tissue* [MeSH], *gliding, exercises*, *carpal tunnel syndrome* [MeSH], *neural mobilization,* and *neurodynamic mobilization*. These terms were combined with the Boolean operator AND. We limited the search strategy to studies in English, Spanish, French, and Portuguese. We did not consider any limit in the publication date.

The PEDro scale was employed to measure the methodologic quality of the articles (Table 1). The validity of this scale was reported in previous studies.[24] A score of 5 points represents high quality; a score between 4 and 5 points, moderate quality; and scores lower than 4 points, low quality.[24]

Results

The research strategy initially produced 118 articles. After analysis, 13 clinical trials were considered according to the inclusion criteria (Fig 1). The characteristics of all the studies selected are summarized in Table 2.

According to the evaluation of the quality of the studies selected, the PEDro scale indicated that all of the articles had study limitations. Almost half of the studies scored a 4 or 5 out of 11, and only 2 studies had a 9 of 11. No studies satisfied 100% of the questions of PEDro scale (Table 1).

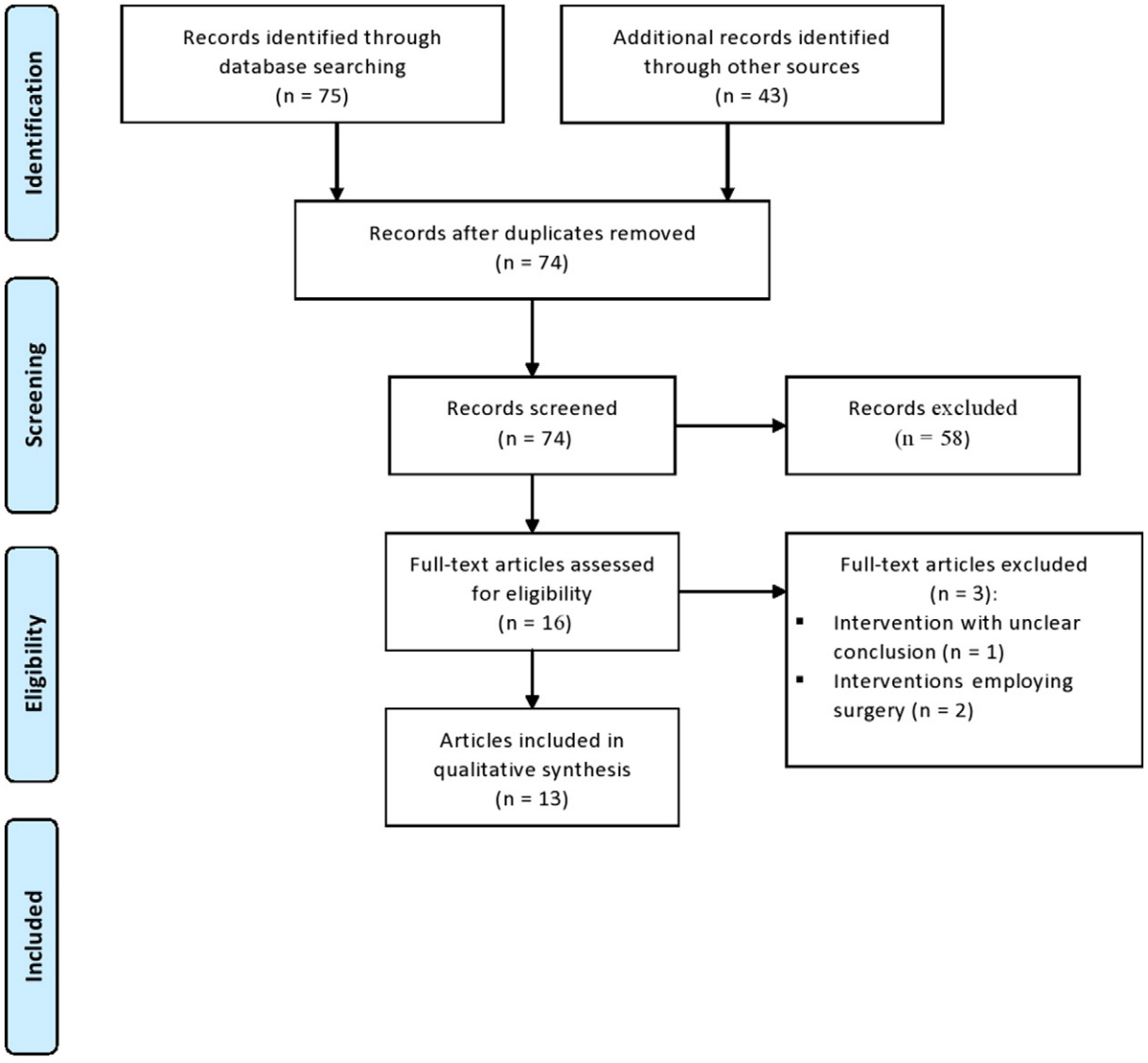

Fig 1. *PRISMA flow diagram.*

Participants

The number of participants varied from 18 to 197. Among the articles that provided the gender of the participants, 4 involved only women[25-28] and 3 involved women and men[22,29,30]; the remaining studies did not specify gender. Five articles assessed middle-aged adults (30-59),[22,25,26,28,30] 2 articles involved mixed-age groups of participants (aged 18–80),[27,29] and 6 articles did not specify the age range.

Study Procedure

Almost all of the studies applied neural mobilization by nerve gliding, and 1 study compared neural mobilization with increasing stress on the nerve to neural mobilization with decreasing stress on the nerve.[27] Eight articles compared nerve gliding with standard care consisting of volar wrist splint and medication[3,13,19,22,28,30-32]; 2 articles compared nerve gliding with carpal or tendon mobilization[29,30]; 1 article compared nerve gliding with ultrasound therapy[28]; and 3 articles did not compare the nerve gliding method with any additional intervention.[12,25,26]

With respect to methods assessing pain and function, the studies exhibited high variability. Two studies assessed the level of pain with the numerical pain rating scale[25,26]; 4 studies used a visual analog scale[19,27-29]; and 1 study used the pain relief scale.[31] For function, 3 studies used the Disabilities of the Arm, Shoulder, and Hand Questionnaire[22,27,30]; 6 studies employed the Functional Status scale[3,12,26,28,31,32]; and 1 study used the Functional Status box.[29] Four articles also considered pinch and grip strength as a functional parameter.[19,27,28,30] Other studies assessed pain and function at the same time with the Symptom Severity Scale,[3,12,26,28,31] 24-hour symptom diary,[29] Carpal Tunnel Specific Questionnaire,[22,26,30] or Symptom Total Point Score.[32]

Pain and Pressure Pain Threshold

All articles that compared nerve gliding with standard care, such as splint or tendon/carpal mobilization, reported that all participants improved independently of nerve gliding application; in fact, 2 studies reported better results from standard care without nerve gliding,[22,32] and only 1 reported earlier pain relief in the nerve gliding group.[19] All studies that analyzed nerve gliding as a unique treatment reported significant pain relief in all patients.[12,25,26]

Function

From investigations that compared nerve gliding with standard care, 4 studies reported better scores of function after standard care without nerve gliding exercises[22,30,32] or the same results independently of the nerve gliding application,[3] and 3 studies reported better function status in those participants receiving nerve gliding.[19,28,31] Studies that analyzed the nerve gliding exercises as an isolated treatment reported that between 71% and 93% of patients improved function.[12,25,26]

Additional Outcomes

Two articles analyzed the percentage of CTS patients who underwent surgery as a main outcome of effectiveness of the nerve gliding exercises.[13,29] Both studies reported that almost all the participants receiving nerve gliding avoided the surgical intervention.

Discussion

The main findings in this systematic review refer to positive effects from median nerve mobilization. However, some studies reported similar effects of this neural technique compared with other conservative methods for treatment of CTS, and even better results from standard care. However, the low-quality methodology of some studies might have influenced the results.

Studies including neural mobilization as a clinical approach to CTS treatment reported greater and faster pain relief, decreased sensitive distal latency, time summation, and improvement of functions such as pinch grip, which avoided surgical intervention in the majority of cases.[7,13,19,26,27] Fernandez-de-las-Peñas et al.[26] and Ortega-Santiago et al.[7] reported greater pain relief in patients undergoing neural mobilization. However, the lack of a control group and the study of only one case, respectively, weakened the scientific evidence of these results. Other authors reported pain improvement only for patients performing neural mobilization[29] and decreased numbers of patients undergoing surgical treatments in all patients receiving any mobilization (neural and carpal).[29] The reduced sample may explain the lack of differences among the remaining variables.[29]

Pinar et al.,[19] Akalin et al.,[31] and Baysal et al.[28] reported improved grip and pinch strength after tendon and nerve gliding. Because of the functional tasks the tests involve, these authors obtained higher Functional Status scores, although the treatment was combined with splinting.[31]

Also, Baysal et al. assessed the group electroneurographically, finding improved sensitive distal latency that remained 4 to 8 weeks after treatment in patients performing nerve and tendon gliding exercises.[28] This finding represents the most objective measure supporting the beneficial effects of the neurodynamic approach. Supporting this finding, Park et al. reported a terminal latency index difference between median and ulnar nerves as a factor assessing the severity of CTS.[33] Thus, the improvement of this variable may directly decrease the severity status of CTS patients. However, the small sample size of the Baysal et al. study and the lack of methodologic quality in other similar studies make a solid conclusion difficult.[28] Therefore, although neural mobilization may represent a good option as an additional conservative method in CTS patients, it should be considered with caution.

With respect to patients that undergo surgical treatments, studies found a significant decrease in symptoms after tendon and nerve gliding exercises.[13] However, the lack of randomization and of a control group prevents this study from strongly concluding this as a clinical approach.[13]

In contrast, some studies comparing nerve gliding exercises with other conservative methods reported similar results without any differences with the neural approach. Brininger et al.[3] found similar function status and pain levels in all patients wearing a specific wrist splint with and without nerve gliding exercises.[3] However, the main limitation concerned the severity of symptoms in patients, which might make for a more difficult resolution of CTS: several authors consider severe symptomatology a factor limiting the benefit from conservative methods in CTS.[14] Bardak et al. also obtained similar results for those patients undergoing standard conservative treatments with and without nerve gliding, and these results were superior to those obtained after treatments in which nerve gliding exercises were isolated.[32] Other studies support this finding because they report better results for patients without nerve gliding, with which most of the studies today disagree.[22,30] Although Bialosky et al. obtained similar results when comparing sham and nerve gliding, they reported improvement in time summation only after nerve gliding exercises.[27] Because time summation is mediated by type C fibers, which involve chronic pain progression and maintenance, this finding could lead to an effective intervention to decrease the excitability of dorsal horn cells.[27]

The controversy over neural mobilization as a conservative method in the treatment of CTS responds to different parameters added during the neural techniques: most studies used neural mobilization exercises that progressively stretch

Table 2. *Main Aspects of Studies Considered*

Authors	Design	Intervention	Characteristic of Sample	Variables	Results	Quality (PEDro)
De-la-Llave-Rincón et al, 2012[25]	RCT Prospective	1 session (30 min) of soft tissue mobilization and nerve slider neurodynamic exercises	*N* = 18 (34 hands) Gender: women Age: 44 ± 10 y Patients grouped according to severity of symptoms in CTSQ: mild, moderate, and severe	Pain (NPRS) PPT over median, radial, and ulnar nerves; C5-6 zygapophyseal joint; carpal tunnel; and tibialis anterior muscle Baseline, after treatment and 1-wk follow-up	Patients had less hand pain and higher PPT over C6 Zygapophyseal joint after 1 wk ($P < .01$ and $P < .001$, respectively) Any other difference on PPT was found ($P > .05$)	5/11
Horng et al, 2011[30]	RCT Single blind	8 wk of paraffin, splinting, and tendon and nerve gliding exercises	*N* = 53 Gender: 3 men; 50 women Age: 51.1 ± 9.1 y Group 1: splint, paraffin, and tendon gliding exercises Group 2: splint, paraffin, and nerve gliding exercises Group 3: splint and paraffin	Pain (BCTSQ) Function (DASHQ) Life quality (WHOQOL-BREF) Nerve conduction (NCS) Semmes-Weinstein monofilament test Grasp power test Pinch power test	All patients improved symptom severity and pain, but group 1 improved more in DASHQ and WHOQOL-BREF	7/11
Fernández-de-las-Peñas et al, 2010[26]	RCT Prospective Single blind	1 session (30 min) of soft tissue mobilization and nerve slider neurodynamic exercises	N=72 Gender: women Age: 44.7 ± 8.7 y Patients grouped according to severity of symptoms in CTSQ: mild, moderate, and severe	Thermal detection and pain threshold (NPRS) PPT over median, radial, and ulnar nerves; C5-6 Pain (NPRS) Function (BCTQ: Functional Status and Symptom Severity scales) Quality life (SF36) Baseline, after treatment	48% of patients improved PPT and function over C6 zygapophyseal joint, heat pain threshold, and quality life 93.3% improved taking into account only two of these three parameters	4/11
Bardak et al, 2009[32]	RCT Prospective Single blind	6 wk of SCT vs. tendon and nerve gliding exercises	*N* = 111 Gender nonspecified Age: not specified Intervention group 1 (*n* = 41): CTS Intervention group 2 (*n* = 35): CTS + tendon and nerve gliding exercises Intervention group 3 (*n* = 35): tendon and nerve gliding exercises	Symptoms total point score Functional status Tinel test Phalen test Reverse Phalen test Compression test Patients satisfaction 11 months later	All patients improved symptoms and functionality, but groups 1 and 2 had greater results than group 3 ($P < .001$) Percentage of asymptomatic patients from groups 1 and 2 were higher than group 3 ($P < .02$ and $P < .04$, respectively)	8/11
Bialosky et al, 2009[27]	RCT Single blind	3 wk of nerve gliding exercises, stressing nerve	*N* = 40 Gender: women Age: 18-70 Intervention group (*n* = 20): mobilization stressing median nerve Control group (*n* = 20): mobilization minimizing stress to the median nerve	Pain (MVAS) PPT Thermal pain: threshold and temporal summation Function (DASHQ) Grip strength Semmes-Weinstein monofilament test Nerve conduction (NCS)	All patients improved pain and function at 3 wk, but only intervention group improved temporal summation ($P < .01$)	9/11

Heebner and Roddey 2008[22]	RCT	Tendon and nerve gliding exercise	$N = 60$ (76 hands) Gender: 9 men, 51 women Age average: 52 y Group I ($n = 28$): standard care Group II ($n = 32$): standard care and tendon and nerve gliding	Function (DASHQ) CTSQ Nerve irritability (NIMN) Baseline and 1 and 6 mo	Group 1 had higher CTSQ score at 6 mo ($P = .016$) Any between-group difference was found in the rest of variables	8/11
Brininger et al, 2007[3]	RCT	4 wk of neutral wrist and metacarpo-phalangeal splint, wrist cocked up, and tendon and nerve gliding exercises	$N = 51$ Gender: not specified Age non-specified Intervention group 1 ($n = 14$): neutral wrist and metacarpophalangeal splint Intervention group 2 ($n = 13$): neutral wrist and metacarpophalangeal splint + tendon and nerve gliding exercises Intervention group 3 ($n = 11$): wrist cocked-up Intervention group 4 ($n = 13$) wrist cocked-up + tendon and nerve gliding exercises	Symptom Severity scale Functional Status scale Baseline, at 4 weeks and 8 weeks later	All patients improved symptoms and functional status, but those wearing neutral wrist and metacarpophalangeal splint had greater results (independently if they performed tendon and neural gliding) Improvements remained 8 weeks later	6/11
Baysal et al, 2006[28]	RCT Prospective Double blind	3 wk of ultrasound, splinting, and tendon and nerve gliding exercises	$N = 28$ (56 hands) Gender: women Age: 49.8 ± 6.0 y Group 1 ($n = 12$): splinting and tendon and nerve gliding exercises Group 2 ($n = 8$): splinting and ultrasound Group 3 ($n = 8$): splinting, tendon and nerve gliding, and ultrasound Most of patients were homemakers	Pain (VAS) Static 2-point discrimination Grip strength Pinch strength Phalen test Tinel test Symptom Severity scale Functional Status scale Electroneurography: MDL, SDL Patients satisfaction 11 months later Baseline and 4 and 8 wk later	All patients improved physical examination at 4 and 8 wk and Symptom Severity scale ($P < .05$), but 2-point discrimination ($P > .05$) Group III had better results on functional status Group I decreased SDL at 4 and 8 wk No group improved MDL at 8 wk	7/11
Pinar et al, 2005[19]	RCT	6 wk of volar wrist splint, conservative method, and an additional 4 wk of nerve gliding exercises	$N = 26$ (35 hands) Gender: not specified Age: not specified Control group (n =13): wrist splint and conservative method Intervention group ($n = 13$): wrist splint, conservative method, and nerve gliding exercises	Pain (VAS) Muscle strength Grip strength (Tinel test) Pinch strength (Phalen test) Electrophysiological measurements	All patients improved pain, although intervention group had more rapid pain reduction and greater functional improvements, especially grip strength ($P < .05$)	5/11
Akalin et al, 2002[31]	RCT prospective Pre-post treatment	4 weeks of volar neutral wrist splint and neural and tendon gliding exercises	$N = 28$ (36 hands) Gender: not specified Age: not specified Control group ($n = 14$): neutral wrist splint during night and	Clinical parameters Functional status scale Fischer test Symptoms severity scale Patient satisfaction after 8 wk	All patients improved, but intervention group had higher lateral pinch strength value ($P = .026$) 72% of patients from control	6/11

(continued on next page)

Table 2. (*continued*)

Authors	Design	Intervention	Characteristic of Sample	Variables	Results	Quality (PEDro)
			functional task Intervention group (n = 14): neutral wrist splint during night and functional task + neural and tendon gliding exercises		group and 93% from intervention group had excellent results	
Seradge et al, 2002[12]	CT Prospective	SCT and carpal tunnel decompression exercises	N = 28 (33 hands) Gender: not specified Age: not specified Patients grouped according to severity of symptoms in CTSQ: mild, moderate, and severe	Functional Status scale Symptoms Severity scale At 1 wk, 2 wk, and 1 mo from beginning of treatment	80% and 71% of patients with mild and moderate symptoms, respectively, improved All patients with severe symptoms underwent surgery	4/11
Tal-Akabi and Rushton, 2000[29]	RCT	Neurodynamic mobilization vs carpal bone mobilization	N = 21 (30 hands) Gender: 14 women, 7 men Age: 29-85 Intervention group 1 (n = 7): neurodynamic mobilization Intervention group 2 (n = 7): carpal bone mobilization Control group (n = 7): no treatment	24-h symptom diary Pain (VAS) Functional box scale Pain relief scale Active ROM (wrist flexion and extension) Median nerve biased test Patients to surgery	Both treatment groups improved pain ($P < .02$ and $P < .01$) Any difference was found on functional box scale, pain relief scale, and median nerve test Patients to surgery: 2 from intervention 1; 1 from intervention 2; 6 from control group	5/11
Rozmaryn et al, 1998[13]	CT Retrospective	Standard conservative methods and nerve and tendon gliding exercises	N = 197 (240 hands) Gender: not specified Age: not specified Control group (n = 124): standard conservative method Intervention group (n = 116): standard conservative method + neural and tendon gliding exercises Groups incomparable in baseline: more manual jobs (control), more administrative jobs (intervention)	Undergo surgery Interview about symptoms to intervention group who did not undergo surgery after 23 mo	Patients underwent surgery: 71.2% of control group; 43.0% of intervention group Of patients responding to detailed interview after 23 mo, 70.2% had excellent results; 19.2% remained symptomatic; 10.6% were noncompliant	4/11

BCTSQ, Boston Carpal Tunnel Specific Questionnaire (the same as CTSQ); *CT*, clinical trial; *CTS*, carpal tunnel syndrome; *CTSQ*, Carpal Tunnel Specific Questionnaire; *DASHQ*, Disabilities of the Arm, Shoulder, and Hand Questionnaire; *MDL*, motor distance latency; *MVAS*, mechanical visual analog scale; *NCS*, nerve conduction study; *NIMN*, neurodynamic irritability of median nerve; *NPRS*, Numerical Pain Rating Scale; *PCOQ*, Patient-Centered Outcome Questionnaire; *PPT*, pressure pain threshold; *RCT*, randomized clinical trial; *ROM*, range of motion; *SCT*, standard conservative treatment (splinting and local steroid injections); *SDL*, sensitive distance latency; Standard care, patient education, splinting, and tendon gliding; *WHOQOL-BREF*, The World Health Organization Quality of Life Questionnaire Brief; *VAS*, visual analog scale.

the nerve context,[34] without considering that the previous position of closer joints and the nervous system continuity may add tension to the technique. Authors related the increased tension because of a wrist extension with negative effects after neural mobilization[35]: the increased neural stress caused by stretching of its context along with a high mechanosensitivity may produce ectopic discharges.[36] Thus, authors using neural mobilization should avoid stretching the median nerve excessively when extending fingers in wrist extension. Some authors recommend alternate extension and flexion for the wrist with flexion and extension of the fingers, respectively, to minimize median nerve tension during exercising.[4] Several studies forgot to control the nerve gliding, including stress to the median nerve when it is advised against.[12,26] As no studies to date have considered this difference as a possible mechanism producing different effects, we found motley results from neural mobilization in CTS symptoms.[27]

Also, the participants in studies regarding CTS had heterogeneous anthropometric and social characteristics, such as female gender only, that make the comparison and extrapolation of results difficult.[25,27,28,30]

Despite the controversy, Totten et al. identified factors limiting the conservative method as a beneficial clinical approach: age ≥50 years, symptom duration >10 months, positive Phalen test <30 seconds, continuous paresthesia, and tenosynovitis in flexor muscles.[34] In fact, Vysata et al. reported that as CTS patients age, a longer time for recovery of distal motor latency is required, even after surgery.[37] Fernandez-de-las-Peñas et al. also considered factors determining earlier clinical improvement: pain pressure threshold over the C5–6 zygapophyseal <137 K Pa, heat pressure pain over the carpal tunnel <39.6°, and general health <66 points on the 36-item Short Form Health Survey (SF-36).[26] This finding could relate the peripheral sensitization to beneficial effects of treatments in CTS patients, instead of central sensitization.[26]

In future research, authors should distinguish neural mobilization with the glissade or tension parameter to analyze the effects of both neural techniques separately, as well as include patients with homogeneous anthropometric and social characteristics.

Another important question arising from this systematic review is the low quality of the literature addressing the conservative management of CTS patients. According to the PEDro scale, 6 of the 13 studies selected in this review had 4 of 5 of the 11 items possible, and no studies satisfied the highest quality (11 items). The highest score among the studies was 9 of 11 possible. The main aspects missing referred to blinding during treatment, concealed allocation, and comparison with a control intervention. Future studies should consider these aspects to improve the quality of the studies and the subsequent results.

Despite the controversial results for nerve gliding exercises and the lack of high-quality studies, standard conservative methods had beneficial effects in CTS patients. Thus, nerve gliding exercises might be a therapy to consider as an addition to a standard conservative approach.

Limitations

This study had some limitations. Because of the strict inclusion criteria, some studies might have been excluded. However, we preferred to guarantee the existence of CTS pathology by including its electrophysiological diagnosis. Also, because we considered only those studies in English, Spanish, French, and Portuguese, studies in other languages were not included.

Conclusion

Neural mobilization effects remain unclear because of the glissade or tension parameter added during mobilization. Mechanical effects may differ because of the incomparability of the 2 types of mobilization. Standard conservative care seems to be the most appropriate option to improve the pain and function of individuals with CTS patients, but addition of nerve gliding exercises may improve this recovery by accelerating the rehabilitation process and avoiding the surgical intervention.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): A.U.G., R.B.P., M.A.A.A.
Design (planned the methods to generate the results): A.U.G., R.B.P., F.R.R.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): N.R.F., G.P.M., A.U.G.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): N.R.F., R.B.P., F.R.R.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): G.P.M., D.P.M., T.G.I.
Literature search (performed the literature search): N.R.F., R.B.P., F.R.R.
Writing (responsible for writing a substantive part of the manuscript): N.R.F., M.A.A.A.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): G.P.M., D.P.M., T.G.I.

Practical Applications

- Standard conservative methods such as corrective splinting showed beneficial effects in CTS patients.
- Neural mobilization may improve pain and function in CTS patients as therapy to add to the conservative approach.
- Age, symptom duration and intensity concern parameters that may limit the effectiveness of conservative methods in CTS patients.

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