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Review

Efficacy of tendon and nerve gliding exercises for carpal tunnel syndrome: a systematic review of randomized controlled trials

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Abstract [Purpose] The purpose of this study was to assess the quality of evidence for the efficacy of tendon and nerve gliding exercises in the management of carpal tunnel syndrome. [Subjects and Methods] Four electronic databases were searched to identify randomized controlled trials on the efficacy of tendon and nerve gliding exercises for carpal tunnel syndrome. Quality assessment was conducted using the Cochrane risk of bias tool. [Results] Four trials were identified and included in the review. The results of critical appraisal of quality ranged between low and moderate risk of bias. The available data could only be included as a narrative description. Symptom severity decreased and functional status improved with combined treatment, involving a tendon or nerve gliding exercise group plus conventional treatments, compared with the use of conventional treatments alone. [Conclusion] Evidence from 4 randomized controlled trials suggests that tendon and nerve gliding exercises, when combined with conventional treatments, may have a favorable effect in patients with carpal tunnel syndrome. However, further randomized controlled trials designed to assess the effect of tendon and nerve gliding exercises alone are required to investigate the hypothesis that such exercises alleviate carpal tunnel syndrome, and to confirm and further elucidate the efficacy of standardized physical exercise programs in patients with carpal tunnel syndrome.
Key words: Tendon and nerve gliding exercises, Carpal tunnel syndrome

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INTRODUCTION

Our hands have a variety of functions, including activities of daily living and job performance[1)]; these functions can be restricted by carpal tunnel syndrome (CTS), a compressive neuropathy of the median nerve that occurs within the carpal tunnel at the wrist[2–5)]. The incidence of CTS is reported to be between 2.7% and 5.8%[6)]. The most common symptoms are pain and paresthesia of the fingers, which occur secondary to impairment of median nerve functions; CTS can have a negative effect on a client's quality of life[7)]. Conservative treatment options include splinting, specific exercises, paraffin therapy, medications, and therapeutic ultrasound. Of these conservative treatments, tendon and nerve gliding exercises are popular, and have been used since 1990 in the management of CTS[5–14)]. However, while evidence for the efficacy of tendon and nerve gliding exercises for CTS is emerging, the use of these exercises for the treatment of CTS remains controversial[7, 10, 15)]. It has been stated previously that support for the use of tendon and nerve gliding exercises in the treatment of CTS will require high-quality studies with rigorous methodological approaches[7–9, 12, 16)]. Therefore, the aim of this review was to assess the quality of evidence for the efficacy of tendon and nerve gliding exercises in the management of CTS.

SUBJECTS AND METHODS

This review was planned and conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[16)] and Consolidated Standards of Reporting Trials (CONSORT) guidelines for reporting parallel group randomized trials[17)]. Four electronic databases (Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Cochrane Library, Embase, and PubMed) were searched to identify randomized controlled trials (RCTs) published in the period between 1963 and January 2015. The search terms were carpal tunnel syndrome AND tendon and nerve gliding exercises OR tendon gliding exercises OR nerve gliding exercises. All potentially eligible studies were retrieved, and the full-text articles were reviewed to determine whether they met the following selection criteria.

To be eligible for inclusion, studies had to meet the following conditions: 1) Participants in the trials had to be diagnosed with CTS. 2) The studies had to be RCTs that used tendon and nerve gliding exercises as an intervention to reduce symptoms associated with CTS compared with

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no tendon and nerve gliding exercises. 3) The outcome measures had to be symptom severity and functional status. Quality assessment of included articles was conducted using a critical appraisal tool (the Cochrane Collaboration's risk of bias tool), as recommended in the Cochrane Handbook for Systematic Reviews of Interventions[18]. The Cochrane risk of bias tool is a 6-item list designed to assess sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other potential sources of bias. Each item was rated as "yes", "no", or "unclear". According to the Cochrane Handbook, there are 3 levels of evidence: A, B, and C. The level assigned to a study gives an indication of the quality of the trial[19]. If the study design fully met all of the preceding 6 criteria, its level was considered to be A (low risk of bias). A study was assigned to be the B level when one or more criteria were partly met. If one or more criteria were not met, the study was assigned to be the C level, implying a high risk of bias[19]. Any study assigned to the C level was eliminated from this review.

RESULTS

A total of 164 articles related to the search terms were screened. Among them, potentially relevant trials were identified in the CHINAL (n=7), Cochrane library (n=14), Embase (n=25), and PubMed (n=21) databases. After the titles of the articles were retrieved, a total of 48 studies were excluded due to retrieval of duplicate articles, study designs other than RCTs (case studies, commentaries, or review articles), or a lack of target concepts in the article (i.e., no CTS). The abstracts of the remaining 19 articles were retrieved. After assessing the abstracts, 4 studies were excluded on the basis of an absence of tendon and nerve gliding exercises; thus, a total of 15 potentially relevant trials were identified in the search; all 15 articles were retrieved for evaluation of their full texts. After assessment of the full articles, 11 studies were excluded; 8 studies did not involve a randomized trial, and 3 studies did not contain the full texts of the RCTs. The literature retrieval process is depicted in Fig. 1. Characteristics of the included studies are presented in Table 1.

With regards to country of origin, 2 RCTs were conducted in Turkey[6, 11], 1 was conducted in the USA[8], and 1 was conducted in Taiwan[7]. Studies were conducted at the following centers: the University of Pittsburgh Medical Center's Orthopedic Outpatient Hand Clinic, the department of physical medicine and rehabilitation of a community hospital, the Outpatient Clinic at the Istanbul Physical Medicine and Rehabilitation Training and Research Hospital, and the Department of Physical Medicine and Rehabilitation and the Department of Neurology of Dokuz Eylül University. Sample sizes in the 4 studies ranged from 36 to 111 participants and totaled 261 participants overall, with 243 being female and 18 being male. The mean age of participants reported in the different studies ranged from 49.1–51.9 years. The overall median age of participants was 50.3 years.

The 4 RCTs identified in this review were analyzed. Types of intervention were heterogeneous among the studies: 1 RCT used paraffin therapy plus splints plus tendon gliding exercises in group 1, paraffin therapy plus splints plus nerve gliding exercises in group 2, and paraffin therapy plus splints

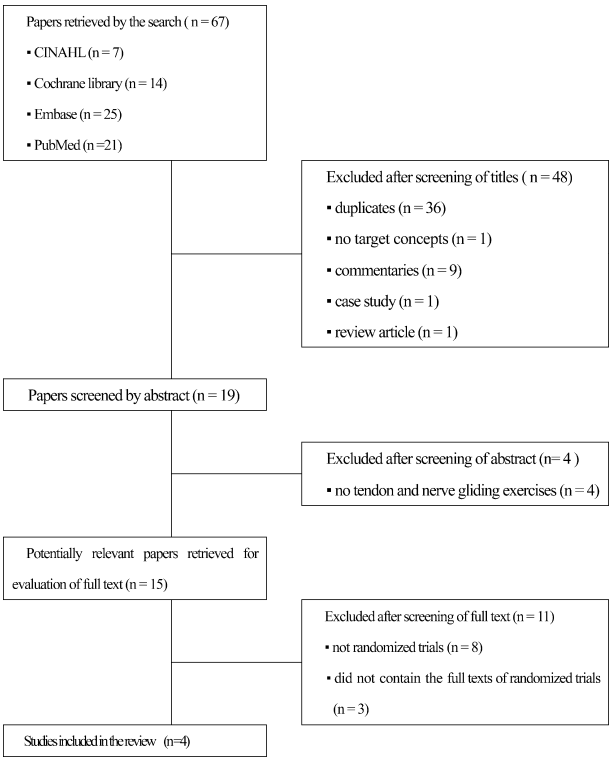

Fig. 1. Flowchart for the included studies from the literature searches

in group 3; another RCT used standard conservative treatment (SCT) in group 1, SCT plus tendon and nerve gliding exercises in group 2, and tendon and nerve gliding exercises in group 3; another RCT used neutral wrist/metacarpophalangeal (NW/MCP) splints in group 1, NW/MCP splints plus tendon and nerve gliding exercises in group 2, wrist cock-up (WCU) splints in group 3, and WCU splints plus tendon and nerve gliding exercises in group 4; and the remaining RCT used neutral volar wrist splints in group 1 and neutral volar wrist splints plus tendon gliding exercises in group 2.

The Intervention lengths of the 4 trials ranged from 4 weeks to 11 months. Interventions were performed under the guidance of physiotherapists, and a brochure describing the tendon and nerve exercises was provided to all patients.

All 4 trials reported an effect on CTS. The available data could only be included as a narrative description. Symptom severity and functional statuses were improved in groups that received combined treatment with tendon and nerve gliding exercises and conventional treatments compared with the groups that received conventional treatments alone. No study reports included data relating to adverse effects of treatment (Table 1).

The risks of bias in the 4 studies were low or moderate.

DISCUSSION

The purpose of this review was to assess the evidence for the efficacy of tendon and nerve gliding exercises for CTS when compared with other treatments. A meta-analysis combining the results from all the trials was not feasible

Table 1. Characteristics of the included randomized controlled trials

Author (years), country	Participants Sample size (n) Gender (M/F) Mean age (range) Drop out n (%)	Interventions	Outcome measures	Main results	Adverse effects	limitations	Risk of bias
Horng et al. (2011), Taiwan	53 (18/19/16) 3/50 50.5 (-) 7 (13.2)	Group 1 paraffin therapy, splint, tendon gliding exercise (2 months) Group 2 paraffin therapy, splint, nerve gliding exercise (2 months) Group 3 paraffin therapy, splint (2 months)	1) SSS 2) FSS 3) Pain intensity 4) DASH 5) WHOQOL-BREF	1) Improved in all groups 2) Improved in group 1 3) Improved in all groups 4) Improved in group 1 5) Improved physical area in group 1	None	- Lack of generality; no severity participants - Confounding factor - Drop out - Many different clinical test	Low
Bardak et al. (2009), Turkey	111 (41/35/35) 10/101 49.1 (22–74)	Group 1 SCT (11 months) Group 2 SCT, tendon and nerve gliding exercises (11 months) Group 3 tendon and nerve gliding exercises (11 months)	1) SSS 2) FSS 3) Physical examination (1) Phalen's test (2) Tinel's test (3) Reverse Tinel's test (4) Compression test	1) Improved in all groups 2) Improved in all groups 3) Percentages of asymptomatic patients in group 1 and 2 were higher than in group s	None	- Lack of electrophysiological assessment during the posttreatment period	Low
Brininger et al. (2007), USA	61 (13/14/13/11) 3/58 50.0 (21–86) 10 (16.3)	Group 1 NW/MCP splints (8 weeks) Group 2 NW/MCP splints, tendon and nerve gliding exercises (8 weeks) Group 3 WCU splints (4 weeks) Group 4 WCU splints, tendon and nerve gliding exercises (4 weeks)	1) SSS 2) FSS	1) Splint and time on the SSS ($p<0.001$) 2) Splint and time on the FSS ($p<0.001$)	None	- Halo effect - Subjective outcome measures - Short-term follow-up	Moderate
Akalin et al. (2002), Turkey	36 (18/18) 2/34 51.9 (38–64)	Group 1 neutral volar wrist splint (4 weeks) Group 2 neutral volar wrist splint, tendon and nerve gliding exercises (4 weeks)	1) SSS 2) FSS	The differences between the 2 groups were not statistically significant.	None	- Small number of subjects - Did not evaluate efficacy of the treatment	Low

M: male; F: female; N: number; SCT: standard conservative treatment; NW: neutral wrist; WCU: wrist cock-up; MCP: metacarpophalangeal; SSS: symptom severity scale; FSS: functional status scale; DASH: Disability of the Arm, Shoulder, and Hand questionnaire; WHOQOL-BREF: World Health Organization Quality of Life questionnaire

due to the heterogeneity of the identified studies. A total of 4 RCTs were identified and included in this review. The interventions in all studies included tendon and nerve gliding exercises to manage CTS.

All 4 trials reported a significant improvement in CTS-related symptom severity and functional status in all groups. However, the efficacy of the tendon and nerve gliding exercises alone could not be identified because the 4 trials involved different combinations of tendon and nerve gliding exercises with standard conservative treatments that included splints, paraffin therapy, and other exercises. Additional RCTs are required to provide evidence for the efficacy of tendon and nerve gliding exercises alone as a management option for CTS.

The quality ratings of the trials included in this review indicated low or moderate risks of bias. Two trials did not mention blinding, which may have led to biased results. Overall, no strong conclusions can be made due to the small number of included trials and other methodological considerations.

The use of rigorous methodological criteria is a strength of this systematic review. Among the included studies major strengths included the use of randomization, and the quality of the measurement tools utilized. There are no reported adverse effects associated with the use of tendon and nerve gliding exercises in the treatment of CTS.

Limitations of the included studies were also identified. Firstly, the generalizability of results is limited because most of the participants had mild or moderate symptoms. Therefore, caution should be exercised when attempting to apply these findings to patients with more severe symptoms. Secondly, there were issues with blinding; the persons who administered the treatment and evaluated outcomes were not blinded to the subjects' group assignments. For strict and rigorous methodological research, blinding is necessary because it may reduce the risk of ascertainment bias. Of the 4 RCTs included in this review, two articles involved single blinding, and none of the RCTs included in this review involved double blinding. However, blinding is not easy to implement with interventions such as physical exercises; therefore post hoc research should be processed with strict blinding. Finally, none of the RCTs used tendon and nerve gliding exercises alone as a treatment for CTS. This may have led to difficulties in interpretation and identification of the efficacy of the tendon and nerve gliding exercises in the management of CTS. All 4 RCTs combined tendon and nerve gliding exercises with standard conservative treatments.

In conclusion, although this review included only a limited number of small trials, it had several strengths, such as the inclusion of only RCTs and the use of outcome measures that are reliable, valid, and commonly used in clinics. However further rigorous methodological and high-quality RCTs are needed to confirm and further understand the efficacy of standardized tendon and nerve gliding exercises as an intervention to control symptom severity and improve functional status in CTS. Future studies need to take into consideration the value of larger sample sizes and ensure a more strenuous and rigorous adherence to the exercise protocols.

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