

## Physiotherapy and Occupational Therapy Evidence-Based Intervention after Carpal Tunnel Release. Literature Review

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### Abstract

**Background:** Carpal tunnel syndrome is defined as median nerve compression at the level of the wrist and it's the most common nerve compression at this level. Also there is various rehabilitation treatments may be offered following carpal tunnel syndrome (CTS) surgery, the effectiveness of these interventions remains unclear.

**Objective:** Main objective of this study is to review the effectiveness and safety of rehabilitation interventions following CTS release compared with another intervention.

**Methods:** Potentially relevant literature was identified through computerized and manual searches from January 1996 until March 2016. Inclusion and exclusion criteria of the studies were well established and results were analyzed using a rating system with levels of evidence for each extracted outcome.

**Result:** Twelve articles with a total of 576 patients met all eligibility criteria and were included in the review.

**Conclusion:** There is insufficient evidence to support a suitable type of treatment after release of the median nerve because the limited and very low-quality evidence is available for rehabilitation treatments following carpal tunnel release (CTR).

**Keywords:** Carpal tunnel decompression; Splint; Median nerve; Median neuropathy; Carpal tunnel syndrome release; CTS post-surgical intervention

### Introduction

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy affecting the upper extremity. Defined as median nerve compression at the level of the wrist, CTS causes numbness and tingling in the hand and fingers and evidence-based guidelines for its treatment are lacking [1,2]. Symptoms include paresthesia involving the median nerve distribution along with a deep aching pain in the hand and wrist, and nocturnal pins which often causes the patient to wake at night [3,4].

The treatment of CTS is different based upon the severity of syndrome and it often is categorized as either conservative or surgical.

In the early stages of CTS, conservative treatment is recommended to improve quality of life. Some authors advocate the use of comprehensive multi-component therapy programmes to promote early return to function and work consists of rest, splinting, patient education, exercise prescription, mobilization techniques, B vitamins, job changes and ergonomic modification or anti inflammatory medication [5-8].

Surgical treatment is generally recommended for those with severe CTS [7,9,10]. The basic principle of carpal tunnel surgery is to increase the volume of the carpal tunnel temporarily by dividing transverse carpal ligament to release the pressure on the median nerve [4]. Complications following CT release are describe in the literature and *the persistence of symptoms* is the most common complication after CT release (CTR) [11-13].

The decision to provide rehabilitation following CTR should be based not only on the clinician's expertise, the patient's preferences and the context of the rehabilitation environment but also on the evidence. The goal of postoperative rehabilitation is to speed up and enhance symptom resolution and functional recovery following surgery [13].

Some studies suggest different postsurgical treatment intervention in order to allow patients to return to their normal activities with a minimal absence of nuisance pathology after CTR. Scar treatment, strategies for action against edema, passive, assisted and active mobilization, strengthening and development of functional exercises as well as gradual improvement activities are some of the recommendations described in the literature.

Although the evidence base for rehabilitation following CTR has grown, evidence and guidelines for the use of any of these interventions after CTR are limited.

Main objective of this study is to review the effectiveness and safety of rehabilitation interventions following CTR compared with another intervention in order to provide a complete, exhaustive summary of current literature relevant to treatment after CTR.

## Methods

### Search Methods

The following electronic databases were searched through January 1996 until March 2016 (20 last years): PubMed, EMBASE, Cochrane Central Register of Controlled Trials, CINAHL, Physiotherapy and Evidence Database (PEDro). The literature search was performed by selecting clinical trials and systematic reviews based on the post - surgical procedure used in patients with carpal tunnel.

**Keywords** Carpal tunnel syndrome, Median nerve, Median neuropathy, Entrapment neuropathy carpal tunnel, Carpal tunnel syndrome release and CTS post-surgical intervention. The titles and abstracts of identified articles were checked against pre-determined criteria for eligibility and relevance to form an inclusion set.

### Selection of the studies

Systematic reviews, meta-analyzes and Randomized or quasi-randomized Controlled Trials (RCTs) studies that compare postoperative rehabilitation treatment with another rehabilitation treatment.

Were included all studies with participants over 18, diagnosis of CTS (as defined by the authors of each study) who have been operated, endoscopically or via any open technique who have received postoperative rehabilitation treatments as: manual physical therapy, exercise, desensitization, orthosis, scar management, edema management, electrotherapy, passive physical modalities and ergonomic modification that used as outcome measurement the Boston Carpal Tunnel Questionnaire (BCTQ), Disabilities of the arm, shoulder and hand questionnaire (DASH), pain referred by the patient, return to work or occupation and grip and pinch force.

We excluded any intervention before surgery and studies that compared surgery with rehabilitation interventions or any interventions provided before surgery, and interventions that were not considered to be rehabilitation treatment, for example, postoperative analgesia.

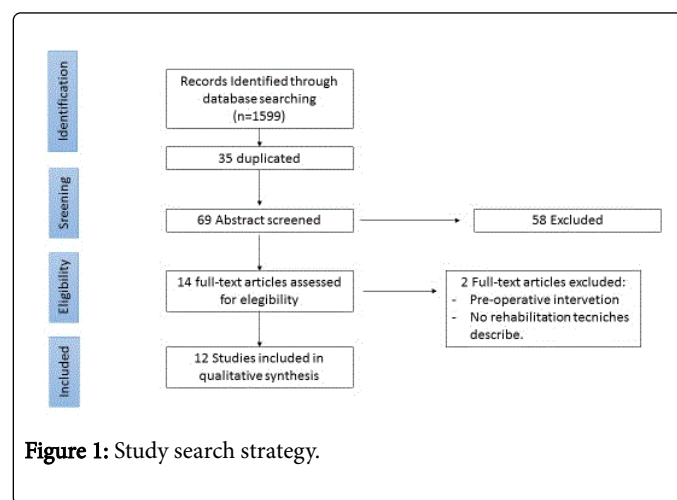
For selection of the study two researches independently examined the titles and abstracts of trials for possible inclusion. Each of these authors compiled a list of trials that met the inclusion criteria and studies that not meet the inclusion criteria were eliminated. Full text of all studies included and discrepancies were resolved through discussion whit a third review author.

Results were analyzed using a rating system with levels of evidence for each extracted outcome [14]. These levels are:

- Strong evidence: consistent findings among multiple high quality RCTs;
- Moderate evidence: consistent findings among multiple low quality RCTs and/or one high quality RCT;
- Limited evidence: one low quality RCT; Conflicting evidence: inconsistent findings among multiple trials;
- No evidence from trials.

## Result

Figure 1 reports the search strategy, number of studies retrieved and the number of studies excluded. Using as keyword carpal tunnel syndrome 1599 studies was identified. In a first analysis we identify 35 duplicated articles. After reading title and abstracts 127 studies were eliminated because they did not meet the inclusion criteria. Eleven-teen full text articles were assessed for eligibility. Two of them did not meet the inclusion criteria because did not address post - surgical recovery techniques. Twelve articles with a total of 576 patients met all eligibility criteria and were included in the review. The quality of eligible studies is report on table 1.



**Figure 1:** Study search strategy.

Study	Participants	Interventions	Outcomes	Results/Conclusion	Level of evidence
Bury et al. [16]	43	Study comparing 2 weeks of postoperative wrist splinting versus a bulky dressing only	Patient satisfaction, grip and lateral pinch strength, complication rates, and digital and wrist range of motion.	No beneficial effect from postoperative splinting after open carpal tunnel release when compared to a bulky dressing alone	II
Heuser A et al. [27]	5	No comparative group	Grip, Pinch and sensibility.	Three of the subjects (60%) increased their grip (up to 150%), and key pinch strengt. (up to 46%). Subjects 3 and 8 (40% of the subjects) had a substantial reduction in their hand grip strength (up to 31%) and key pinch (up to 39%) during the study All subjects improved in their tip pinch strength (between 20% and 267%).	IV

Cebesoy O et al. [21]	40	Group 1 used a splint (exercises given 3 wk postoperative) and group 2 was given a bulky bandage (exercises provided immediately) after open release.	Questionnaire of Levine for Clinical Assessment of Carpal Tunnel Syndrome	No statistical significance was found regarding symptom severity scale scores preoperatively and at the first postoperative month (P=.632 vs P=.353). At the third month, scores were lower in favor of group 2 (P=.023).	III
Martins RS et al. [19]	52	2 weeks immobilization and no immobilization after CTS release	Two-point discrimination test and pain	Wrist immobilization in the immediate post-operative period have no advantages when compared with no immobilization.	II
John Hochberg [22]	62	Evaluate and compare the effects of CCT and conventional ice therapy	pain, edema (wrist circumference), and narcotic use.	CCT is more effective than conventional ice therapy in providing efficient pain blockage and reduction of edema in postoperative management of carpal tunnel surgery.	I
Cook et al. [17]	50	Exercises versus splint at the first 2 weeks after surgery	Return to activities of daily living, dates of return to work at light duty and at full duty, pain level, grip strength, key pinch strength, and occurrence of complications	Splinted group had significant delays in return to ADL, return to work at light and full duty, and in recovery of grip and key pinch strength. Also increased pain and scar tenderness in the first month after surgery	I
Cebesoy O et al. [21]	40	Compare the clinical effectiveness and costs of postoperative splint and late rehabilitation with a bulky bandage dressing versus early rehabilitation	Clinical Assessment of Carpal Tunnel Syndrome	Postoperative immobilization with a splint has no detectable benefits in function. Used of splint is more expensive than a bulky dressing.	II
Fagan DJ et al. [28]	21	Two groups - one having high elevation at home and one being treated with a simple sling	Swelling	No significant difference between the two groups. In the trial group, the mean increase in volume of the operated hand was 11 ml (95% CI +4 to +17) or 2.7%.	II
Finsen et al. [18]	82	Postoperative immobilization or no immobilization after CTS release.	Pain, grip and key pinch.	Four weeks of postoperative immobilization confers no detectable benefit.	III
Alves et al. [24]	58	group 1 – low-level laser therapy (LLL); group 2 – placebo laser therapy (PLT).	Palmar pain, pillar pain, paresthesia, nighttime pain, pain or discomfort at the site of the scar and Tinels test, as well as time taken to return to activities of daily living or to work	The patients submitted to low-level laser therapy after surgical release of the flexor retinaculum in the wrist benefited from the treatment and obtained better functional results than those from the control group	
Bhatia et al. [15]	102	Used of a palmar plaster of Paris splint or a bulky wool and crepe bandage postoperatively	Pain	No statistically significant differences between the two groups	I
Gordon T et al. [25]	21	The control group underwent open carpal tunnel release surgery (CTRS) only. The stimulation group underwent CTRS followed by 1 h of electrical stimulation of the median nerve.	Axonal regeneration, Purdue Pegboard Test, Semmes Weinstein Monofilaments, and Levine's Self-Assessment Questionnaire.	1 h ES of the median nerve after surgical decompression accelerates axonal regeneration to promote complete muscle reinnervation	III
Total N=576					

Table 1: Quality of eligible studies.

## Discussion

The purpose of this review was to determine the effectiveness of various rehabilitation treatments to optimize outcomes following CTR compared with no treatment, placebo, or another non-surgical intervention. We included 12 articles investigating a total of 576 participants.

Regarding type of immobilization, some investigations compared two different types of immobilization after CTR [15,16]. Although measures of variability were limited in both studies, Bury et al in a no blind study, found no beneficial effect from postoperative splinting after open carpal tunnel release when compared to a bulky dressing alone. Instead, Bhatia et al performed a prospective randomized single

blind trial with 102 patients in order to see if plaster slab could reduce postoperative pain using it at the first 48h after surgery. No statistically significant differences between the two groups in postoperative pain scores or analgesic.

Others studies, compared the effect of immobilization of the wrist following CTR with early mobilization. Cook et al. (n=50), compared exercises versus splint at the first 2 weeks after surgery finding that splinted group had significant delays in return to ADL and in recovery of grip and key pinch strength. In splinting group, they also found increased pain and scar tenderness in the first month after surgery compared with early mobilization group [17]. Other studies that compared the effects of early mobilization after CTR concluded that there were no differences between groups [18]. But the lack of an appropriate randomization and the longtime of immobilization (four weeks) should make us take into consideration the results with caution. Martins et al. [19] conducted a prospective study in order to see the effects of wrist immobilization after open carpal tunnel release with 52 participants. They found no significant difference between the two groups for discrimination test, function or pain intensity. No measurements as grip or pinch force were taken in spite of the fact that some studies support a grip strength decreased by 19–25% when the wrist is splinted [20]. Other research conducted by Cebesoy et al. [21], disagree with the studies mentioned above and concluded that there are no benefits in the post-surgery immobilization and that used of splint is more expensive than a bulky dressing. In addition, report that 80% of participants in the splinted group experienced discomfort compared to none in the mobilization group, which was a statistically significant difference. However, non-specific data on the design of the splint or materials used are provided.

Regarding the use of ice therapy, we identified one randomized trial that compared effects of controlled cold therapy (CCT) versus ice therapy commenced immediately post-surgery and continued for three days. Hochberg et al. [22], evaluate and compare the effects of CCT and conventional ice therapy on pain, edema, and narcotic use. The results show that CCT is more effective than conventional ice therapy in providing efficient pain blockage and reduction of edema in postoperative management of carpal tunnel surgery. However either participants or researcher were blinded during the experiment, which could influence the results of the study.

Laser therapy and ultrasound were investigated by Sawan et al. at 2013 [23], they compared continuous ultrasound in conjunction with nerve and tendon gliding exercises versus laser therapy plus nerve and tendon gliding exercises versus nerve and tendon gliding exercises alone. They found significant differences between the ultrasound and exercise groups and between the laser therapy and exercise groups. But no participant blinding was provided and the use of different techniques in the same group, prevents us from knowing the effect of each of the techniques used as a unique treatment.

Low-level laser therapy after CTR were also investigated by Alves et al. [24] with a quasi-randomized trial. Outcomes measurement used in this study were: palmar pain, pillar pain, paresthesia, nighttime pain, pain or discomfort at the site of the scar and tinnels test, as well as time taken to return to activities of daily living or to work. In spite that authors of the study concluded that the patients submitted to low-level laser therapy after surgical release of the flexor retinaculum in the wrist benefited from the treatment and obtained better functional results than those from the control group, no statistically significant differences in CTS symptoms with low-level laser therapy versus

placebo and no differences between groups in the return to work outcome at three months post-surgery were found.

Others studies as Gordon et al. [25] and Li et al. [26] try to demonstrate the effectiveness of electrical stimulation versus control or versus decimeter wave therapy versus no treatment control group. Although both authors conclude that there are benefits in the use of electro stimulation in the post-surgery of carpal tunnel treatment, measuring instruments not provide suitable to be able to validate the results

## Conclusion

Despite the diminution of symptoms after carpal tunnel surgery, there is limited and very low-quality evidence available for rehabilitation treatments following CTR. The various techniques described and lack of studies that can test the effect of a single technique without influence from the other, makes it difficult to interpret the studies.

According our results, immobilization with a rigid brace for 2 weeks can cause pain and loss of strength as well as a delayed return to work.

Regarding the use of ice therapy, controlled cold therapy is more effective than conventional ice therapy in providing efficient pain blockage and reduction of edema in postoperative management of carpal tunnel surgery.

Other techniques that could help in recovery after CTR could be: ultrasound and laser therapy combine with exercise or electrical stimulation.

We have not found RCTs who evaluated the efficacy of different treatments used in rehabilitation such as mobilization techniques, strengthening, ultrasound, nerve gliding, massage...), so we can't draw conclusions about the overall efficacy of rehabilitation interventions after CTR. Studies with large samples and the power to detect statistically significant differences between groups are needed to determine the effects of interventions.

## Conflicts of interest and funding

No actual or potential conflict of interest exists and no external financial support was sought or received for the conduction of this review.

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