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Linking hand therapy outcome measures used after carpal tunnel release to the International Classification of Functioning, Disability and Health: A systematic review



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ABSTRACT

Introduction: The goal of hand therapy after carpal tunnel release (CTR) is restoration of function. Outcome assessment tools that cover the concepts contained in the International Classification of Functioning, Disability and Health (ICF), a framework for describing functioning and disability, are appropriate for hand therapy treatment of this diagnosis.

Purpose of the Study: To identify and review outcome measures used in studies on rehabilitation after CTR and link these to the concepts contained in the ICF.

Methods: A comprehensive literature search was conducted. Outcome measures in the included studies were linked to the ICF. For data calculation purposes, outcome measures were linked to the specific ICF category, which matched the majority of assessment items if there were components that fit into more than 1 category. The quality of the studies was evaluated, and effect sizes for the treatment interventions were calculated for a comprehensive systematic review.

Results: Seven studies met the inclusion criteria. Eleven outcomes (68.75%) were linked to body function, 1 (6.25%) to body structure, 3 (18.75%) to activity and participation, and 1 (6.25%) to environmental factors. No outcomes were associated with environmental factors or personal factors. Structured Effectiveness for Quality Evaluation of Study scores of the included studies ranged from 23 to 43/48.

Discussion: The predominant outcome tools in the current research on rehabilitation after CTR are impairment measures and are linked to the category of body structures and body functions.

Conclusions: Functional measures, associated with the activity and participation category, are only modestly represented, and there is a lack of representation of environmental and personal factors for outcome measures used following CTR.

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Introduction

Since Phalen popularized the diagnosis and treatment of carpal tunnel syndrome (CTS) in the 1950s,^{1,2} there has been a debate over the optimal management of the condition in relation to conservative treatment, surgical approach, and postsurgical intervention. In general, the goal of postoperative rehabilitation is to support and

enhance symptom resolution and restore function following surgery. Research suggests that postsurgical treatment interventions can combine scar management, strategies for controlling edema, range of motion, strengthening, functional exercises, and the gradual progression of functional activities.^{3,4} No clinical practice guidelines exist regarding the optimal postsurgical approach, and a recent systematic review concluded that there is limited and generally low-quality evidence on the benefit of treatment interventions after operation for CTS.⁵ Therefore, it is suggested that rehabilitation following carpal tunnel release (CTR) consider the specifics of the circumstances such as patients' needs, preferences, and context in addition to current evidence and clinician expertise.⁵

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When assessing outcomes of hand therapy interventions, it is important to ensure that the outcome measures chosen by the clinician are comprehensive, valid, and reliable to adequately measure the effectiveness of the intervention. For instance, it is valuable to understand the impact of postoperative rehabilitation on function (activity) and return to work (participation). In the last few decades, there has been an increased emphasis in the hand therapy literature on the use of appropriate functional outcomes measures to better understand treatments and improve patients' functional results. It is not always appropriate to solely focus on physical impairments (body structures and body functions) when evaluating health outcomes after therapy interventions.⁶

The application of the International Classification of Functioning, Disability and Health (ICF) allows more comprehensive and systematic documentation of the lived experience of health in order to guide clinical practice. The ICF provides a standard language and conceptual basis for the definition and measurement of disability and puts every person in a context.⁷ The ICF is a framework for comprehensively examining functioning and disability through the organized and defined categories of body functions, body structures, and activity and participation. The ICF also covers contextual factors including environmental factors and the yet to be defined personal factors.⁷ Linking outcome measures to the ICF allows hand therapists and other health care providers to better understand what specifically is being assessed.

In 2006, a systematic review⁸ analyzed the outcome measures used to assess treatment following CTR in 28 studies and linked these tools to the ICF categories. Their study found that the majority of outcome measures used were linked to body structure and body function (ie, self-reported symptom resolution and grip or pinch strength), and only a small number of studies used measures that linked to the activity and participation category.⁸ Based on the increased emphasis and understanding of the ICF since 2006, it may be assumed that current studies on post-operative CTR rehabilitation more comprehensively link to all the categories of the ICF. The primary purpose of this systematic review is to identify the outcome measures assessed in recent randomized controlled clinical trials on rehabilitation after CTR and link these to the concepts contained in the ICF in order to better understand current hand therapy outcome assessment following CTR.

Methods

A systematic review was performed to identify the outcome measures used in clinical trials after CTR and to link these concepts to the ICF as a reference tool. The study was developed based on the framework outlined in the guidelines provided by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement). The registration of this systematic review was properly accomplished in PROSPERO. The registration identifier of the protocol is CRD42017058066.

Identification and selection of studies

Inclusion and exclusion criteria for the articles were identified. Inclusion criteria were randomized controlled trials (RCTs) published after 2006 that assessed outcomes for postoperative rehabilitation after CTR. All outcome measures from the studies that met inclusion criteria were extracted as long as data calculations were performed in the original study. All trials were published in English. We excluded studies that solely addressed presurgical interventions or conservative therapy, studies that compared surgery with rehabilitation interventions, studies that also addressed other diagnoses such as DeQuervain's tendinosis or associated distal radius fractures, and studies that assessed interventions that are

not performed by physical or occupational therapists such as postoperative analgesia.

Search strategy

A computer search was conducted using the following databases: PubMed, CINAHL, ProQuest Central, MEDLINE, and PEDro. Search terms included CTR, carpal tunnel surgery, rehabilitation, outcomes, patient-reported outcome (PRO), hand therapy, and postsurgical treatment. All authors completed separate searches of the databases but worked together to determine which articles met the inclusion criteria. The authors also reviewed bibliographies of relevant articles and performed hand searches as needed to identify all appropriate studies. There was agreement among the authors as to which articles would be included for analysis in this systematic review.

Subjects

Descriptive information was gathered and recorded on the included studies including information on the number of subjects in the study, the age range of the subjects, the surgical intervention the subjects received, the length of time of the follow-up period, and the percentage of subjects lost to follow-up.

Outcomes

The outcome measures used in each study were extracted and then defined (Table 1). The outcome measures used in the studies were linked to the ICF categories (body structures, body functions, activity and participation, environmental factors, and personal factors) following the procedure described by Cieza et al¹⁰ All authors studied the linking rules before initiating the study and came to consensus during the categorization process. For an assessment to be considered an outcome measure for the purpose of this review, there had to be data calculations completed on that particular assessment in the original study. A few of the outcome measures have components that fit into more than one of the categories, that is, the Disability of the Arm, Shoulder and Hand (DASH) and the Michigan Hand Questionnaire (MHQ). For the data calculations in this systematic review, the outcome measure was linked to the specific ICF category which matched the majority of the assessment's items. In analyzing the specific breakdown of the questions for the PROs as components of the ICF, the work of Dixon et al,¹¹ Forget and Higgins,¹² and Farzad et al¹³ was used as a reference.

Study quality assessment

The quality of the studies was evaluated using the Structured Effectiveness for Quality Evaluation of Study (SEQES).¹⁴ The SEQES is a 24-item critical appraisal tool developed by MacDermid and used to evaluate the methodological characteristics of a study.¹⁴ The SEQES score is calculated by totaling the scores of each of the 24 items on the tool. A score of 2 is the highest possible score, a score of 1 indicates a fair rating, and a score of 0 indicates incomplete fulfillment of the criterion. Two of the authors (N.N., L.A.) completed the scoring for each study. Each of the reviewer's SEQES scores was blinded to the other reviewer until scores were compared. Any discrepancies in the score were discussed until a consensus was reached.

Data analysis

Statistical significance of the primary outcomes of the studies intervention was withdrawn from the studies. The standardized

Table 1
Short description of outcome measures used in the included studies

Outcome measure	Short description
Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)	A self-report validated questionnaire designed to evaluate the outcome specifically in CTS
Disabilities of Arm, Shoulder and Hand (DASH)	30-item self-report questionnaire for musculoskeletal disorder of the upper limb
Distal motor and sensory latency	Electrophysiological test to determine nerve conduction distance and sensory conduction velocity of the median nerve
Grip strength	Hydraulic measurement of grip strength in kgs or lbs.
Locognosia test	A standardized test for the median and ulnar nerves which divides the fingertips into quadrants and with vision occluded patients are asked to identify the exact quadrant using a heavy graded monofilament.
Michigan Hand Questionnaire (MHQ)	37-item self-report outcome instrument that measures conditions/injuries related to the hand/wrist graded on a 5-point Likert scale and divided into 6 modules.
Moberg Pick Up Test	A standardized timed test for the assessment of hand dexterity. Twelve objects are picked up and placed in a container. The test is then repeated with vision occluded.
Pain (Alves et.al. ⁹)	Monitored by surgeon according to “complaints of symptoms”
• Palmar	
• Pillar	
• Nighttime	
• Scar	
• Numbness	
Pinch strength (key, lateral, or tip)	Hydraulic measurement of key/lateral, tip to tip pinch strength in kgs or lbs.
Shape texture identification (STI)	A quantitative test for the assessment of tactile gnosis by identifying shapes and textures of decreasing size with fingertips without visual cues.
Touch threshold (WEST)	A sensory assessment for measuring cutaneous sensibility utilizing a series of monofilaments of progressive strength to establish the pressure needed to detect touch.
Two-point discrimination test (static)	A somatosensory evaluation that measures the individual’s ability to perceive 2 points of stimuli present simultaneously, typically using a caliper or 2 sharp points.
Visual Analog Scale for pain	Pain is rated along a continuum, ie, from 0 to 10 where 0 is no pain and 10 is the worst pain

CTS = carpal tunnel syndrome.

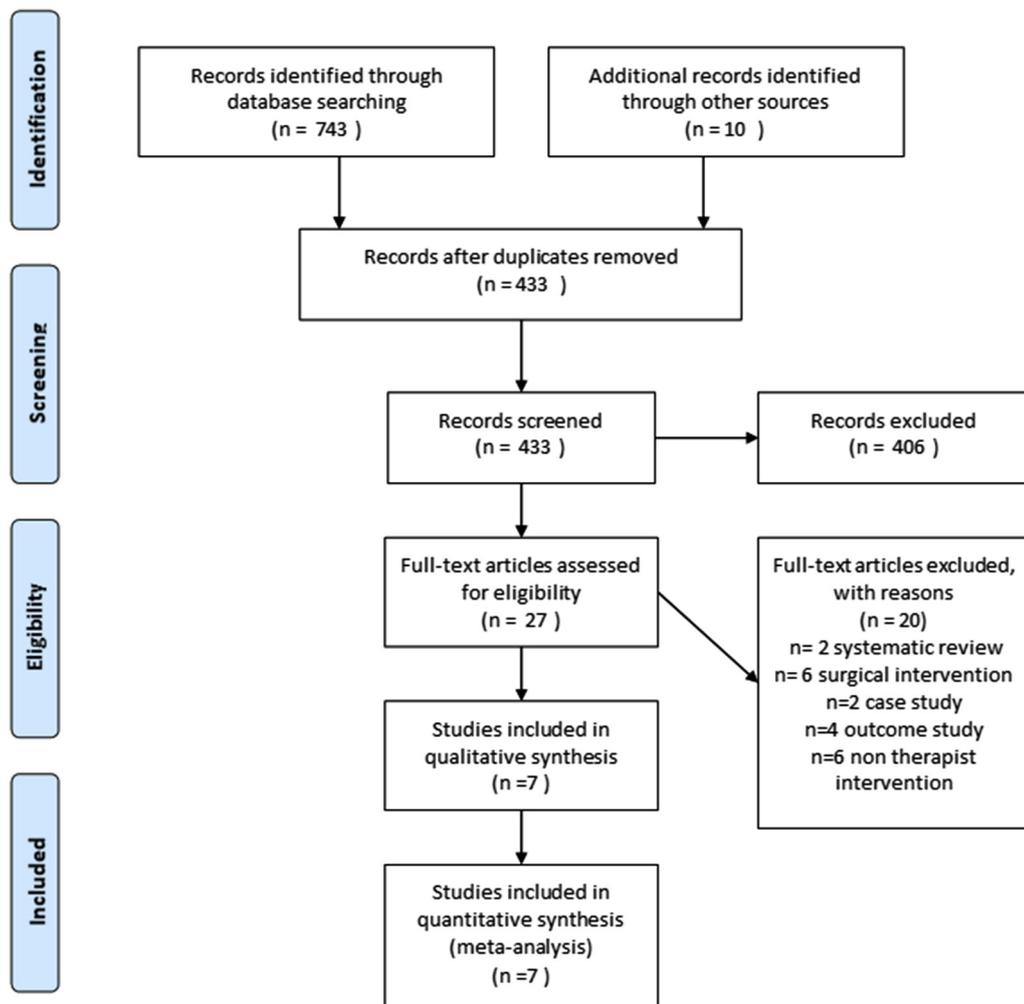


Fig. 1. Flow diagram of the search results. Moher D, Liberati A, Tetziaff J, Altman DG. The PRISMA Group (2009). Preferred reporting item for systematic reviews and meta-analyses: The PRISMA statement. PLoS Med 6(7): e1000097. <https://doi.org/10.1371/journal.pmed1000097>. For more information, visit www.prisma-statement.org.

mean difference effect size (*d*) contrasting the difference between means before and after intervention was calculated when the standard deviations of the means were provided by the authors or when enough information was provided to calculate the standard deviations. Effect size was calculated according to Cohen's *d* index. Data were unable to be pooled for meta-analysis due to the lack of homogeneity of the outcome measures used in the included studies. This data analysis was completed as a component of the systematic review to reflect comprehensiveness but was not a purpose for this particular study.

Results

Search results

A total of 743 records were identified in the database search, and 10 records were identified in the hand search after review of bibliographies in relevant research. There were 433 records after removal of duplicates. From the 433 records, a total 27 full-text articles were assessed for eligibility. Of these, 7 studies met the inclusion criteria and were included in this review.^{9,15-20} (Fig. 1)

Subjects

A total of 486 participants are included in this systematic review. The ages of the participants ranged from 36 to 71.9 years old. Three of the studies described the surgical procedure as a standard CTR,^{9,15,18} 1 described it as a contemporary short incision,¹⁹ 1 described it as a transverse carpal ligament release,²⁰ and 2 studies did not provide specifics on the type of surgical procedure.^{16,17} Follow-up in the included studies ranged from 1 to 6 months. Four of the studies^{9,18-20} lost 0% of participants to follow-up, one¹⁶ lost 9.68%, another study¹⁷ lost 10.58%, and the final study¹⁵ lost 13.04% (Table 2).

Outcomes

The outcome measures were identified and linked to the most appropriate ICF category (Table 3). Four of the 7 included studies^{15-17,19} incorporated a validated self-report outcome measure (Boston Carpal Tunnel Questionnaire [BCTQ], MHQ, and DASH), which were linked to activity and participation (d) due to the majority of the questions covering concepts in this category. Eleven (68.75%) outcomes of interest were linked to the category of body function (b) which included grip and pinch strength, pain (measured in a variety of ways), and sensory function (Touch Threshold Test WEST, Static 2 point discrimination test, locognosia test, Shape Texture Identification, and Moberg Pickup Test). There was one (6.25%) outcome of electromyography results that was linked to body structure (s). Three (18.75%) outcome measures (the DASH, MHQ, and the Functional Severity Scale of the BCTQ) were linked to the activity and participation and difficulty with a bulky dressing, or one (6.25%) outcome was linked to environmental factors (e). No outcomes were linked to personal factors.

The interventions in the included studies involved low-level laser therapy versus placebo,⁹ a 2- to 3-week period of orthosis use postoperatively,^{15,18} sensory relearning,^{16,17} home exercises versus clinic-based therapy,¹⁹ and ultrasound versus laser versus cold and warm water soaks.²⁰ Effect sizes were able to be calculated for 5 of the studies^{15-18,20} based on the information presented by the authors. When using Cohen's interpretations of 0.2 small, 0.5 medium, and 0.8 large²¹ guidelines to determine the effectiveness of the interventions in the included studies, the effect sizes varied between small and large. When calculating between group differences, the 3 largest effect sizes found were in favor of the sensory retraining program group¹⁶ ($D = 1.187$) for the Shape Texture Identification and in favor of the ultrasound group²⁰ ($D = 2.57$ and $D = 1.660$) for pain reduction and gains in pinch strength respectively (Table 4).

Table 2
Study methodologies

Study	Number of subjects	Mean age of subjects (in y)	Surgical procedure	Impairment measures	Functional measures	Follow-up	Percent lost to follow-up (%)
Alves et al ⁹	58	44.3 and 51.9 (reported as mean in each group)	Standard open procedure	Neurofunctional evaluation, presence of painful scar, pillar pain, numbness, nighttime pain, palmar pain, and clinical signs	None	1, 2, 3, and 6 mo postop	0
Cebestoy et al ¹⁵	46	36 and 37 (reported as mean in each group)	Standard open procedure	Reported difficulties with bulky dressing or splintage	BCTQ	Preoperatively and at 1 and 3 mo postop	13.04
Jerosch-Herold et al ¹⁶	31	65.8 and 71.9 (reported as mean in each group)	Unspecified	Touch Threshold Test (WEST) Static 2 Point Discrimination Test Locognosia Test Shape Texture Identification Moberg Pick-Up Test	DASH	4 and 8 wk after study began	9.68
Jerosch-Herold et al ¹⁷	104	71.8 and 70.8 (reported as mean in each group)	Unspecified	Touch Threshold Test (WEST) Locognosia Test Shape Texture Identification Moberg Pick-Up Test	MHQ	6 and 12 wk after study began	10.6
Martins et al ¹⁸	52	49.8	Standard open procedure	BCTQ; Symptom severity and intensity scale Static two-point discrimination	BCTQ	Preop and 2 wk postop	0
Pomerance and Fine ¹⁹	150	46	Contemporary short incision	Grip Pinch VAS DASH	DASH	6 mo	0
Sawan et al ²⁰	45	40.2	Transverse carpal ligament release	VAS Pinch strength EMG	None	Postop and at 10 wk (4 wk after last treatment)	0

DASH = Disability of the Arm, Shoulder and Hand; MHQ = Michigan Hand Questionnaire; BCTQ = Boston Carpal Tunnel Questionnaire; VAS = Visual Analog Scale; EMG = electromyography.

Table 3
Linking outcome measures to the ICF categories

Study	Body functions	Body structure	Activity and participation	Environmental factors	Personal factors
Number of outcomes	11	1	3	1	0
Alves et al ⁹	Pain (b280) <ul style="list-style-type: none"> • Palmar • Nighttime • Paresthesia Pain (b280) <ul style="list-style-type: none"> • Pillar • Scar 	Electromyographic studies (s198)			
Cebesoy et al ¹⁵	Questionnaire of Levine for Clinical Assessment of Carpal Tunnel Syndrome: symptom severity scale (b730), (b270), (b280), (b134)		Questionnaire of Levine for Clinical Assessment of Carpal Tunnel Syndrome: functional Severity Scale	Difficulty with bulky dressing/orthosis	
Jerosch-Herold et al ¹⁶	Touch Threshold Test (WEST) (b265) Static two point discrimination test (b265) Locognosia test (b265) Shape Texture Identification (d265) Moberg Pick-up Test (d440, d265)		Disabilities of the Arm Shoulder and Hand (DASH)		
Jerosch-Herold et al ¹⁷	Touch Threshold Test (WEST) (b265) Locognosia test (b265) Shape Texture Identification (d265) Moberg Pick-up Test (d440, d265)		Michigan Hand Questionnaire (MHQ)		
Martins et al ¹⁸	BCTQ: Symptom Severity Scale (b730), (b270), (b134) BCTQ: Symptom Intensity Scale (b280) Static two-point discrimination test (b265)				
Pomerance and Fine ¹⁹	Grip strength (b730) Pinch strength (b730) Visual Analog Scale (VAS) for pain (b280)		Disabilities of the Arm Shoulder and Hand (DASH)		
Sawan et al ²⁰	Visual Analog Scale (VAS) for pain (b280) Pinch dynamometer (b730)	Electromyography machine (EMG) (s198)			

BCTQ = Boston Carpal Tunnel Questionnaire; FSS = Functional Status Score; ADL= activity daily life.

Study quality assessment

The SEQES scores of the included studies ranged from 23/48¹⁸ to 43/48.²⁰ The studies had an average score of 35/48. The included RCTs were not without methodological flaws. Some of the limitations included the lack of priori power calculation before undertaking the study,^{9,20} lack of blinded treatment providers^{9,18,19} and assessors,^{9,15,18} and lack of effect size calculations of the outcomes.^{9,15,17-20} (Table 5)

Discussion

The primary purpose of this systematic review was to identify and review the outcome measures assessed in recent randomized controlled clinical trials on rehabilitation after CTR and to compare these to the concepts contained in the ICF in order to better understand current hand therapy outcome assessment following CTR. Although 10 years have passed since the link between outcome measures used after carpal tunnel surgery to the ICF by Jerosch-Herold et al,⁸ our findings were similar. The majority of outcomes measures used by researchers assessed impairments of body function and body structure and a small number of outcomes linked to activity and participation. Jerosch-Herold et al⁸ reported that 5 out of 28 (18%) of the studies included in their systematic review assessed activity and participation and our review found that 4 out of 7 (58%) studies included in our review included an outcome measure to assess activity and participation.

We agree with Jerosch-Herold et al¹⁶ regarding the importance of developing an alternate PRO measure that is more specific to sensory impairments of the hand and recommend that the use of

several outcome measures is justified. Gardner et al²² reported the high sensitivity of the modified DASH-Work measure to identify work limitations. They also recommend the Functional Severity Scale from the BCTQ as a condition-specific measure with high sensitivity for CTS versus other upper extremity cases.²² They further recommend an overall measure of physical health, the 8-item Short-Form Health Survey, could be used to cover the broad outcomes that are appropriate for this population.²²

Surgical decompression of CTS may relieve symptoms of paresthesia, pain, and nocturnal waking, which link to the ICF categories of body structures and body functions. The current studies included in this systematic review do not assess long-term loss of functional sensibility, another body function because none of the studies included a follow-up period beyond 6 months. Postsurgical allodynia rates (involving body structure and function) have been reported to be as high as 6%–41% 1 month to 1 year after open surgical decompression of carpal tunnel.²³ Other complications related to body functions including scar tenderness (7%) and pillar pain (12%) have also been reported following surgery.²⁴ Jerosch-Herold et al¹⁶ reported that there may be as high as a 26% incidence of self-reported numbness 1 year or later after decompression of the carpal tunnel and these patients may have ongoing sensory and hand function impairments. Peters et al⁵ found that there is limited low-quality evidence for the benefit of the rehabilitation interventions following CTR, but the study by Jerosch-Herold et al¹⁶ was not included in their review. Neuroplastic changes or reorganization in cortical topography can be induced by increased neural activity (pain and paresthesia) or, in severe cases of CTS, reduced activity from denervation.²⁵ Sensory relearning is an intervention

Table 4
Effect sizes of study outcomes

Study	Intervention	Description of findings and statistical significance if reported	Effect size of group differences Cohen's D
Alves et al. ⁹	Low-level laser therapy (LLLT) for 10 consecutive days (not weekends) postop at 3 points of the carpal tunnel vs placebo	No standardized functional outcome measure used. Authors reported better function of LLLT group	Unable to calculate
Cebesoy et al. ¹⁵	Bulky surgical dressing with immediate exercise post op versus orthosis wrist immobilization for 10 d and exercise at 3 wk post op	FSS score Orthosis Preoperative 26.6 Postoperative 10.65* Bandaged Preoperative 26.11 Postoperative 10.26* No statistical significance between groups reported for the FSS score Symptom Severity Scales Orthosis Preoperative 37.74 Postoperative 13.50 Bandaged Preoperative 36.32 Postoperative 11.9 Scores in the 3rd postoperative month, scores were found to be lower in favor of the bandage group ($P = .023$)	Unable to calculate
Jerosch-Herold et al. ¹⁶	Sensory retraining program versus no treatment	DASH Experimental Baseline 38.94 8 wk: 32.28 Control Baseline 47 8 wk 45.14 Shape Texture Identification Test (STI) Experimental Baseline 3.38 8 wk: 5.09 Control Baseline 2.67 8 wk: 3.15 Statistical significance not reported by authors	DASH Experimental D = 0.29 Control D = 0.09 Between groups D = 0.55 in favor of sensory reeducation group STI Experimental D = 1.11 Control D = 0.25 Between groups D = 1.187 in favor of the sensory reeducation group
Jerosch-Herold et al. ¹⁷	Sensory relearning versus no treatment	MHQ-Overall Function Experimental Baseline: 55.7 12 wk: 63.3 Control Baseline: 55.2 12 wk: 55.3 MHQ-ADL affected hand Experimental Baseline: 61.7 12 wk: 73.1 Control Baseline: 64.8 12 wk: 63.0 MHQ-ADL both hands Experimental Baseline: 62.3 12 wk: 73.8 Control Baseline: 60.1 12 wk: 65.1 MHQ-Work Experimental Baseline: 64.2 12 wk: 75.1 Control Baseline: 60.6 12 wk: 67.0 There was a statistically significant difference between groups for overall function and ADL at 12 wk favoring the sensory reeducation group.	MHQ-overall function Experimental D = -0.49 Control D = -0.006 Between groups D = 0.50 favoring the sensory reeducation group MHQ-ADL-affected hand Experimental: D = -0.48 Control D = 0.03 MHQ-ADL both hands Experimental D = -0.52 Control D = -0.22 MHQ-Work Experimental D = -0.54 Control D = -0.3 STI Experimental D = -0.33 Control D = -0.37 Between group D = 0.100

(continued on next page)

Table 4 (continued)

Study	Intervention	Description of findings and statistical significance if reported	Effect size of group differences Cohen's D
		Shape Texture Identification Test (STI) Experimental Baseline: 3.6 12 wk: 4.19 Control Baseline: 3.4 12 wk: 4.02 No statistical significance between groups reported for the STI.	
Martins et al. ¹⁸	Two week immobilization in a neutral wrist orthosis versus no immobilization following a CTR.	Symptom Severity Score (SSS) Immobilization Preoperative 33.38 Postoperative 11.38 Non immobilization Preoperative 31.77 Postoperative 12.33 No statistical significance between groups reported for the SSS, Symptom Intensity index, or 2 point discrimination.	Symptom Severity Score (SSS) Immobilization D = 3.60 Nonimmobilization D = 3.08 Between groups D = 0.20 Favoring immobilization group
Pomerance and Fine ¹⁹	Home program instruction versus home program instruction along with clinic based therapy for 2 wk (6 sessions)	Grip Strength Therapy Preop 25.5 Postop 26.2 Control Preop: 25.5 Postop: 26.6 Pinch Strength Therapy Preop 7.4 Postop 7.6 Control Preop: 7.4 Postop 7.8 Pain Therapy Preoperative:6 Postoperative: 1 Control Preoperative: 6 Postoperative: 1 No statistical significance between groups for DASH, grip, pinch strength, or pain at any time point between groups	Grip strength Therapy D = 0.06 Control D = 0.11 Between groups D = 0.04 favoring the control group Pinch strength Therapy D = 0.08 Control D = 0.17 Between groups D = 0.41 favoring the control group Unable to calculate for pain or DASH.
Sawan et al. ²⁰	3 groups: Group1: continuous ultrasound for 5 min during differential tendon gliding; Group 2 low-level laser therapy for 15 min during differential tendon gliding; Group 3: Hand placed in warm water (4 min) followed by cold water (1 min) followed by nerve & tendon gliding exercises	Pain US Baseline: 7.4 Six wk 2.4* Laser Baseline: 8.2 Six wk 3.0* Exercise Baseline: 7.0 Six wk: 4.2* Statistical significance reported between the US and exercise groups $P < .05$ Pinch US Baseline 7 lbs. Six wk: 12.6* lbs. Laser Baseline 7 lbs. Six wk: 11.2* lbs. Exercise Baseline 6.4 lbs. Six wk: 8.6 lbs. Statistical significant reported between the US and exercise groups $P < .05$	US D = 5.61 Laser D = 4.98 Exercise D = 3.04 Between groups D = 2.57 favoring US group US D = 4.06 Laser D = 2.77 Exercise D = 1.93 Between groups D = 3.32 favoring US group

CTR = carpal tunnel release; ICF = International Classification of Functioning, Disability and Health; DASH = Disability of the Arm, Shoulder and Hand; MHQ = Michigan Hand Questionnaire.

*Equals a statistically significant difference between the baseline and final outcome.

Table 5
SEQES: Structured effectiveness for quality evaluation of study scores

Author	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	
Alves et al. ⁹	2	2	2	2	2	2	0	0	1	2	0	2	2	1	1	1	1	2	1	0	0	1	1	1	1	29
Cebesoy et al. ¹⁵	1	2	2	2	2	1	1	0	1	2	0	2	2	1	2	2	1	2	2	1	1	0	2	2	2	34
Jerosch-Herold et al. ¹⁶	2	2	2	2	2	0	2	2	2	2	1	2	1	1	1	2	2	2	2	2	2	2	1	2	2	41
Jerosch-Herold et al. ¹⁷	2	2	2	2	2	0	0	1	2	2	2	2	1	1	2	2	2	2	2	2	2	2	1	2	2	40
Martins et al. ¹⁸	0	2	0	2	0	0	0	0	0	2	1	1	2	1	2	2	1	0	2	1	1	0	2	1	1	23
Pomerance & Fine ¹⁹	0	2	2	2	2	0	0	2	1	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	36
Sawan et al. ²⁰	2	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2	2	1	1	2	2	2	43

performed following CTR based on the principle that through attention, memory, and the use of other senses, the cortical representation of the hand in the brain can be remodeled.¹⁶ Perhaps, there is limited evidence for rehabilitation interventions that focus on the improvement of outcomes of the body functions of strength and pain, and activities and participation, but there is not enough research to quantify the effect of sensory retraining on the body structure and function of cortical plasticity. Jerosch-Herold et al.¹⁶ had a large effect ($D = 1.187$) for sensory relearning in their pilot study. However, in contrast, a follow-up RCT performed by Jerosch-Herold et al.¹⁷ determined that sensory relearning was not clinically effective.

Limitations

We attempted to minimize bias in the selection of studies for the systematic review, but our searches were limited to electronic databases and hand searches and the results of unpublished studies may have been missed. Although data calculations were performed in each study, some of the outcomes of interest were not performed via a validated assessment tool, calling into question the findings as an accurate representation of what the outcome measure is supposed to be measuring.⁹

Conclusion

This systematic review on rehabilitation following CTR indicates that the predominant outcome tools found in the current research are impairment measures and are inextricably linked to the ICF category of body functions. Functional measures are modestly represented and most precisely associated with the ICF category of activity and participation with a lack of representation for the ICF category of environmental factors. Similarly, the concept of personal factors is not addressed or given mindful consideration. The ICF will continue to provide a framework for establishing suitable and appropriate outcome measures relevant and meaningful to patients following CTR surgery.

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Quiz: # 611

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- #1. The study design is
- RCTs
 - a systematic review
 - a case series
 - qualitative
- #2. The following has been validated as a self-report measure in evaluating outcomes with carpal tunnel
- DASH
 - BCTQ
 - MHQ
 - all of the above
- #3. CTS was first named by
- Madden
 - Lundborg
 - Phalen
 - Hunter
- #4. The concept of personal factors, in this analysis of the data, is
- a central focus
 - not addressed
 - addressed on an individual case-by-case basis
 - is given a strict definition by the ICF and the AOTA
- #5. The investigators found that the predominate outcome tools are essentially impairment measures which are linked with ICF categories of body functions
- true
 - false

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