

**Supplemental Table 1. Interventions for Hand, Wrist, and Forearm**

Author/Year	Study Objectives	Level/Design/Participants	Intervention and Outcome Measures	Results	Study Limitations
Bakhtiar & Rashid-Pour (2004)	To compare the efficacy of ultrasound and LLLT treatments in mild to moderate CTS	Level I RCT  <i>Participants</i> N = 50 participants (90 hands)	<i>Intervention</i> 2 experimental groups were randomly selected to receive either ultrasound (1 MHz, 1.0 w/cm <sup>2</sup> , pulse 1:4, 15 min/session) or LLLT (9 joules, 830 nm infrared laser at 5 points). Treatments were provided 5 times/wk for a total of 15 sessions.	Improvement was significantly more pronounced in the ultrasound group than in the LLLT group for motor latency, motor action potential amplitude, finger pinch strength, and pain relief. Effects were sustained in follow-up assessment.	No placebo or sham group was used.
			<i>Outcome Measures</i> Assessment included visual analogue scale for pain, electroneurographic measurements (motor and sensory latency and motor and sensory action potential amplitude), pinch and grip strength testing.		
Baur et al. (2009)	To examine the effects of handwriting training and auditory grip-force feedback in people with writer's cramp	Level III Pre-post assessment, single group  <i>Participants</i> N = 7 people with diagnosed writer's cramp	<i>Intervention</i> Handwriting training was conducted following principles created by Mai with focus on reducing inappropriate writing strategies.  Treatment was conducted over seven 1-hr sessions spread over a 2- to 7-wk period (variation among participants).  Each session involved exercises with use of conventional pen, sensor pen, and auditory force feedback.	Improvements were noted in decreased writing pressure and grip force. Subjective writing performance and pain also improved after handwriting training and auditory grip-force feedback.	<ul style="list-style-type: none"> <li>• Small sample size</li> <li>• Heterogeneous group</li> </ul>
			<i>Outcome Measures</i> Participants were assessed before and after intervention using the Fahn Dystonia Scale; writing performance test (digitized tablet using pen wrapped with force sensor		

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Bleakley et al. (2004)	To assess the evidence base for use of cryotherapy in treatment of acute soft tissue injuries	Level I Systematic review <i>Participants</i> N = 1,469 participants (22 trials) recovering from a soft tissue injury or orthopedic surgical intervention and receiving inpatient, outpatient, or home-based cryotherapy	matrix) measuring grip force, pressure, writing frequency, and number of inversions in velocity (NIV); and visual analog scales for subject report of pain and writing performance.  <i>Intervention</i> Inpatient, outpatient, or home-based cryotherapy used in isolation or in combination with other treatments  <i>Outcome Measures</i> Objective or subjective reports of pain, swelling, function, or ROM	Marginal evidence supported that ice plus exercise is most effective in reducing pain after ankle sprain and after surgery. Little evidence indicated that ice added to compression had any effect in hospital inpatient settings. No evidence supported an optimal mode or duration of ice application.	The included RCTs scored an average PEDro score of only 3 and 4; differences in treatment protocols described made it nearly impossible to make comparisons in and among studies. In addition, methodological problems with many studies limited generalizability of the evidence suggested.
Breger-Stanton et al. (2009)	To examine the evidence regarding the use of contrast baths	Level I Systematic review 10 of 28 clinical articles published since 1938 met inclusion criteria.	<i>Intervention</i> Studies included contrast bath protocols that differed in immersion time from 6 min. immersion in warm water followed by 4 min in cool water to a fixed ratio method of 4:1 warm to cold. Water temperatures varied from 106° to 113° for warm water and 47° to 60° for cool water.	Contrast baths may increase superficial skin temperature and blood flow, but evidence of the effect on edema is conflicting. No relationship between the physiological effects and function has been determined.	Low-quality studies; no RCTs were found for review.
Brosseau et al. (2002)	To assess the efficacy of DTFM for treating tendinitis	Level I Systematic review <i>Participants</i> N = 2 trials for those with clinical diagnosis of tendinitis at knee or elbow	<i>Intervention</i> DTFM was compared with groups receiving placebo treatment; no therapy or other active treatments were provided.  <i>Outcome Measures</i> Pain, ROM, muscle strength, endurance, and functional status	No evidence was found of clinically important benefit of DTFM for treating tendinitis.	Only 2 studies used as part of review
Brosseau et al. (2003)	To evaluate the effectiveness of different exercise intensities on people with osteoarthritis	Level I Systematic review of comparative controlled studies, such as RCTs.	<i>Intervention</i> Therapeutic exercises and high-intensity aerobic and low-intensity aerobic intensity aerobic exercises	No significant difference was found between high-intensity and low-intensity aerobic exercise in treatment of OA of	Only 1 study included in review

Brosseau et al. (2004)	To assess the effectiveness of LLLT in the treatment of OA	<p>controlled clinical trials, cohort studies, or case-control studies</p> <p><i>Participants</i> N = 39 participants (1 study)</p>	<p>were compared with control or active interventions in people with OA.</p> <p><i>Outcome Measures</i> Included functional status, gait, pain, aerobic capacity</p>	<p>the knee for measures of functional status.</p> <ul style="list-style-type: none"> <li>• Both types of exercise resulted in improvements for the knee OA participants' functional status.</li> <li>• A better result was realized for low-intensity exercise vs. control group than for high-intensity exercise vs. control group. (Result was in pain and function.)</li> </ul>
Brosseau et al. (2004)	To assess the effectiveness of LLLT in the treatment of OA	<p>Level I</p> <p>Systematic review</p> <p><i>Participants</i> N = 345 participants (7 trials) with OA, 184 randomized to LLLT, and 161 randomized to placebo laser</p>	<p>Controlled clinical trials of LLLT for participants with a diagnosis of OA were selected for study.</p> <p><i>Outcome Measures</i> Pain reduction, ROM</p>	<p>The results of the review were inconclusive. 3 trials showed no effect on pain, 2 demonstrated beneficial effects with laser, and 1 found increased knee ROM (lower and higher doses yielded same result). Outcomes of joint tenderness and strength were not significant.</p> <ul style="list-style-type: none"> <li>• Heterogeneity of clinical application of LLLT, including different dosage, wave lengths, and types of LLLT</li> <li>• Publication bias in articles chosen</li> </ul>
Case-Smith (2003)	To measure functional outcomes after outpatient occupational therapy for clients who had upper-extremity injury, surgery, or both and to determine the correlation of the Canadian Occupational Performance Measure with other outcome measures	<p>Level III</p> <p>Descriptive study; pretest and posttest after typical hand therapy treatment</p> <p><i>Participants</i> 37 participants were selected according to predetermined criteria, including diagnosis of hand injury within 30 days without burn, major nerve involvement or central nervous system involvement, and physician order for hand therapy. 8 therapists provided treatment and had an average of 7 yr of experience.</p>	<p><i>Intervention</i> Treatment was generally described as including physical agent modalities, manual techniques, and therapeutic activities. Clients received a mean of 13 hr of outpatient occupational therapy services; they received no other services at that time.</p> <p><i>Outcome Measures</i> The COPM, DASH, and SF-36 were administered at time of initial visit and on discharge from therapy after 6-8 wk. The CIQ was administered 2-3 mo after discharge. 33 clients completed the study.</p>	<p>Functional performance gains after 6-8 wk of services were significant according to the COPM, DASH, and SF-36. The CIQ, initially created for the brain-injured population, was not found to be as sensitive to changes in client function 2-3 mo after discharge. Use of the CIQ was not beneficial in this setting.</p> <ul style="list-style-type: none"> <li>• Relatively small sample size with a combination of diagnoses creates difficulty in generalizing results.</li> <li>• Participants completed questionnaires, which can introduce error.</li> <li>• Evaluating therapist was not blinded to participant.</li> <li>• Treatments varied among participants on the basis of diagnosis. Treatments were not described beyond the general descriptive categories.</li> <li>• No control group</li> </ul>

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**Supplemental Table 1. Interventions for Hand, Wrist, and Forearm (cont.)**

Author/Year	Study Objectives	Level/Design/Participants	Intervention and Outcome Measures	Results	Study Limitations
Egan & Brosseau (2007)	To review the evidence regarding the effectiveness of splinting for carpalometacarpal OA of the thumb	Level I Systematic review; 7 articles of the following designs were included in review: Level I RCT, 1 pretest–posttest study, 1 retrospective cohort study, 1 posttest-only study, 3 RCTs that compared various splints <i>Participants</i> <i>N</i> = 258	<i>Intervention</i> Use of prefabricated short neoprene splint; custom-made short opponens thermoplastic splint; short opponens, volar long opponens, semirigid orthosis that did not cross wrist; firm elastic splint with semirigid strip along dorsal side of thumb; supple elastic wrist gauntlet; custom-made leather splint; semistable textile splint; and no splint. Wear time of splints varied.	On average, participants who received a splint obtained some relief from it. No splint was found to be more effective than another for reducing pain and enhancing function.  None of the studies used a design that resulted in strong evidence of effectiveness. The overall effectiveness of splinting in providing pain relief remains unanswered by this review.	Internal validity challenged by placebo effect and fact that other forms of treatment (NSAIDs) were initiated at same time as splint.
Ekim et al. (2007)	To evaluate the efficacy of LLLT in patients with rheumatoid arthritis with CTS	Level I RCT <i>Participants</i> <i>N</i> = 19	<i>Intervention</i> 1 group received LLLT once per day on weekdays for a total of 10 days using a gallium–aluminum–arsenide diode laser device (power output = 50mW, wave length = 780 nm). 1.5 J/ per point were applied. Placebo group did not receive actual laser light.  <i>Outcome Measures</i> • Pain • Function • Wearing comfort • Pinch strength • Desire for surgery	Improvements were greater in treatment group than in the placebo group in pain and functional status score at end of treatment and at 3 mo. Other parameters were not significantly different between placebo and treatment group. Both groups improved in pain and Functional Status Scale scores.	Small sample size and combined diagnosis limit generalizability of results.
Feehan & Bassett (2004)	To determine whether scientifically valid evidence exists for the effect of early motion (<21 days) on joints surrounding an extra-articular hand fracture on fracture	Level I Systematic review of Q–RCT studies <i>Participants</i> <i>N</i> = 459 participants (6 trials) with simple, closed	<i>Intervention</i> Studies compared complex postfracture immobilization of both joints proximal and distal to the fracture with motion of 1 or both joints adjacent to the fracture. Joint motion had to	Early motion resulted in earlier recovery of mobility and strength and earlier return to work and did not affect fracture alignment.	<ul style="list-style-type: none"> <li>• All studies included in review were rated as poor quality.</li> <li>• All were reported as RCTs but were recategorized by review as Q–RCTs.</li> </ul>

<p>healing or functional outcomes</p>	<p>metacarpal fractures occurring in 2nd through 5th digits</p>	<p>be initiated in the first 21 days after fracture or reduction.</p> <p><i>Outcome Measures</i> Standardized hand function or health-related quality of life, functional strength, mobility, pain, satisfaction, activities of daily living, instrumental activities of daily living</p>	<ul style="list-style-type: none"> <li>No study reported use of a standardized measure of time to clinical or bony union or a score on a standardized hand function test or quality-of-life test instrument.</li> </ul>
<p>Field et al. (2000)</p> <p>To evaluate the effects of massage therapy on reduction of postburn itching and pain and on reduction of anxiety and depressed mood</p>	<p>Level I RCT <i>Participants</i> N = 20 participants (mean age = 38.2 yr) randomly assigned to massage therapy (treatment group) or standard care (control group)</p>	<p><i>Intervention</i> Control group received standard medical care (physician visits, medication, physical therapy or occupational therapy, cocoa butter to closed wounds without massage). Treatment group received massage therapy for 30 min, 2 times/wk for 5 wk. Massage therapists applied mild to moderate pressure with cocoa butter as a lubricant in a stroking manner; pressured movements from perimeter of wound to center using pads of fingers; circular, transverse, and vertical strokes for 10 min; skin rolling; and long strokes.</p> <p><i>Outcome Measures</i> Participants rated their itching severity, pain, anxiety and depressed moods using a visual analog scale, McGill Pain Questionnaire, STAI, and the Profile of Mood States.</p>	<ul style="list-style-type: none"> <li>Participants were all from a low socioeconomic status group; unclear whether results are generalizable.</li> <li>Standard medical care that was continued by physical or occupational therapist is not fully described.</li> <li>Unclear whether this standard treatment included methods that may have contributed to outcomes.</li> </ul>
<p>Guzelkucuk et al. (2007)</p> <p>To compare the efficacy of therapeutic activities that simulate ADLs with that of traditionally used therapeutic exercises in the management of injured hands in young adult patients</p>	<p>Level I RCT <i>Participants</i> N = 36 participants with functional hand loss resulting from injury; 20 allocated to</p>	<p><i>Intervention</i> Control group was provided with an appropriate twice-daily treatment program including passive, active assisted, and AROM and strengthening activities. In</p>	<ul style="list-style-type: none"> <li>Study was not blind, compliance with home program was not assessed, chronic and acute conditions were included in both groups, and efficacy of activities with specific</li> </ul>
<p>Although both groups improved at 2-mo follow-up, there were statistically significant differences (including functional outcomes) between the groups in favor of the</p>			<p>of activities with specific</p>

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Author/Year	Study Objectives	Level/Design/Participants	Intervention and Outcome Measures	Results	Study Limitations
Haythornthwaite et al. (2001)	To test the efficacy of 2 brief cognitive interventions in supplementing regular medical treatment of pain during dressing change	Level I RCT <i>Participants</i> <i>N</i> = 42 adult burn patients requiring hospitalization. Participants had 2nd- and 3rd-degree burns that encompassed 3%–65% of total body surface area. Participants were randomly assigned to 1 of 3 groups: control, sensory focusing, or distraction.	<p>the treatment group, 16 to the control group</p> <p>addition, physical agent modalities were applied.</p> <p>Treatment group received the same intervention as the control group for 1 session per day, with a 2nd session consisting of 25 activities that simulated ADLs. Treatment continued for 3 wk, 5 days/wk. Patients were discharged to a home program.</p> <p><i>Outcome Measures</i></p> <p>Grip strength, pinch strength, finger pulp–distal palmar crease distance, total active movement, range of opposition, range of abduction, Jebsen hand function test, and DASH</p> <p><i>Intervention</i></p> <p>Before dressing change:</p> <ul style="list-style-type: none"> <li>Sensory-focusing group participants were instructed to focus on present moment, not to anticipate pain.</li> <li>Distraction group participants listened to and focused on music of their choice.</li> <li>Control group participants received no intervention.</li> </ul> <p>Participants in sensory-focusing and distraction groups listened to 20-min audiotapes that taught them how to use the coping strategy. They were repeatedly prompted to practice the technique during 4-stage dressing change.</p>	<p>treatment group, except for total ROM and abduction.</p> <p>Sensory focusing resulted in higher ratings of relief, whereas distraction, which included self-selected music and music appreciation training, did not show any beneficial effects. Sensory focusing also changed the memory of painful procedures, which supports its utility for multiple painful procedures.</p>	<p>types of injuries was not determined.</p> <ul style="list-style-type: none"> <li>Small sample size</li> </ul> <ul style="list-style-type: none"> <li>Methodology that required participant to record pain at 10-min intervals may have interfered with intervention.</li> <li>Relatively small sample size</li> <li>Variations in nursing procedures, timing, and duration of dressing changes</li> </ul>

<p><i>Outcome Measures</i> Pain, degree of relief, satisfaction, depression, amount of analgesic medications</p>	<p><i>Intervention</i> <i>Group 1:</i> Contrast bath protocol ending with cool water (70°) included fisting exercises in water <i>Group 2:</i> Second contrast bath protocol ending in cool water (70°) did not include exercise. <i>Group 3:</i> Control group; exercise-only group</p> <p><i>Outcome Measure</i> Volumeter</p>	<p>Convenience sample of patients with CTS—a condition not typically associated with significant edema—may have skewed generalizability of findings.</p>
<p><i>Outcome Measures</i> Pain intensity (visual analog scale, ordinal scale), global status (overall improvement), disorder-specific functional status (UEFS, NULI), generic functional status or quality of life (DASH, WHMPI), ability to work, health care consumption and cost, satisfaction with treatment</p>	<p><i>Intervention</i> Studies are described on the basis of categorization of the intervention type. 9 articles dealt with splinting and casting, 6 with joint mobilization, 2 with</p>	<p>Consistent evidence suggested positive effectiveness of splints to increase joint ROM. Moderate support exists for joint mobilization techniques with ROM loss result-</p>
<p><i>Outcome Measures</i> Pain, degree of relief, satisfaction, depression, amount of analgesic medications</p>	<p><i>Intervention</i> <i>Group 1:</i> Contrast bath protocol ending with cool water (70°) included fisting exercises in water <i>Group 2:</i> Second contrast bath protocol ending in cool water (70°) did not include exercise. <i>Group 3:</i> Control group; exercise-only group</p> <p><i>Outcome Measure</i> Volumeter</p>	<p>Convenience sample of patients with CTS—a condition not typically associated with significant edema—may have skewed generalizability of findings.</p>
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Author/Year	Study Objectives	Level/Design/Participants	Intervention and Outcome Measures	Results	Study Limitations
	dislocation, joint injury, and other soft tissue injuries	inclusion criteria. 2 reviewers determined abstract selection, and 2 reviewers performed critical appraisal of 26 articles. Level of evidence and quality was determined by a critical appraisal. Overall quality was considered moderate to low.	continuous passive motion, 2 with injection vs. other therapy, 4 with exercise, and 3 with in-clinic vs. home exercise. No articles described heat modalities.  Inclusion criteria included outcome of ROM. Other outcomes include pain, functional status, ADLs, length of treatment, return to activity, and patient satisfaction.	ing from joint stiffness. Some studies indicated that continuous passive motion may be a viable alternative to ROM exercise in selected post-operative cases, but very little literature exists on this expensive and time-consuming method. 4 studies supported passive ROM as an intervention to increase motion in stiff joints. Both home- and clinic-based treatment approaches were viable. Faster gains in shoulder ROM were realized after a steroid injection.	<ul style="list-style-type: none"> <li>Impact of ROM on disability not described.</li> </ul>
Michlovitz, Hun, Erasaia, Hengehold, & Weingand (2004)	To evaluate the efficacy of CLLHW therapy for the treatment of various sources of wrist pain including strain and sprain, tendinosis, OA, and CTS  To evaluate the efficacy of CLLHW compared with oral placebo treatment	Level I Prospective, randomized, parallel, single-blind, placebo-controlled, multicenter trial  <i>Participants</i> N = 94 participants (1 lost to follow-up) in general good health with wrist pain after surgical intervention <6 mo previously	<i>Intervention</i> Participants with moderate or greater wrist pain were randomized and stratified to 1 of the following treatments: efficacy evaluation (heat wrap, oral placebo) or blinding (oral acetaminophen, unheated wrap).  <i>Outcome Measures</i> Pain relief scale (0–5), joint stiffness (101-point numerical rating scale), dynamometer, Patient Rated Wrist Evaluation and Symptom Severity Scale and Functional Status Scale for participants with CTS	CLLHW therapy was efficacious in the treatment of common conditions causing wrist pain and impairment.  Pain relief and joint stiffness reduction was greater than placebo.  Heat wrap group demonstrated significant gain in strength over placebo group in short term but not at follow-up.  CTS group demonstrated improved grip strength through study and follow-up.  Differences in pain and disability were not significant between participants with OA, tendinosis, and strain or sprain. For those with CTS, change was significant for the heat wrap group.	Study is of good quality.
Muller et al. (2004)	To determine the effectiveness of hand therapy interventions for CTS	Level I Systematic review	<i>Intervention</i> Systematic review examined several treatment interventions	Splinting was supported by 5 studies; various types of splint angles were found to be	Magnetic treatment that used splints may have been limited by effect of splint use to hold

Participants  
N = 24 trials

for CTS, including splinting, ultrasound, nerve-gliding exercises, yoga, LLLT, magnetic therapy, manual therapy, acupuncture, and combined therapies. Studies explored effects of these therapies on areas such as general symptomatology, severity of pain, sleep, nerve conduction studies, numbness and tingling, morning stiffness, paresthesias, tactile sensation, and pinch-and-grip strength.

effective. Twenty 15-min treatments of deep, pulsed ultrasound decreased symptoms, reduced sensory loss, and improved median nerve conduction and strength. 10 treatments of superficial, continuous ultrasound for 5 min were not effective.

Manual therapy results depended on particular techniques being used.

magnets in place; splints alone have been found to be effective.

Nerve-gliding exercises reduced pain and increased ROM compared with no treatment. 1 session of brief magnetic therapy did not decrease pain more than sham treatment; both decreased pain. Prolonged therapy in wrist support wraps improved symptoms of numbness and tingling and improved nerve conduction studies more than sham treatment. Laser therapy was supported by 1 study.

Biweekly Hatha yoga sessions improved symptoms but not grip strength or pain more than splinting alone did. Manual therapy effectively relieved pain, but stretches of Digits 3 and 4 did not change nerve conduction in CTS.

Nash, Mickan, Del Mar, & Glasziou (2004)

To determine whether benefit or harm comes from mobilizing or immobilizing an acute limb injury in adults

Systematic review

Participants  
N = 3,366 participants  
49 trials of immobilization for soft tissue injuries and fractures of both upper and lower limbs were identified.  
2 reviewers selected articles.

Studies were divided into 4 groups: lower-limb fractures, other lower-limb injury, upper-limb fractures and other upper-limb injuries. Groups were further divided into trials using limb support vs. no support.

Outcome Measures

- Patient-centered outcomes
- Measures of global function, including subjective and objective criteria: pain, stiffness, swelling; use of

All studies reported either no difference between rest and early mobilization protocols or benefits from early mobilization. Benefits of mobilization included earlier return to work; decreased pain, swelling, and stiffness; and a greater preserved ROM. Early mobilization caused no increase in deformity, complications, or residual symptoms.

Reviewers did not contact authors for clarification or updated research. Many studies were of poor quality; review focused on studies of higher quality only.

Reviewers did not list all diagnoses included in all studies; it is not known whether acute tendon repairs, nerve injuries, or joint replacements (as examples) were considered

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O'Brien & Pandit (2006)	To determine the effect of silicone gel sheeting for prevention or correction of hypertrophic or keloid scarring in people with newly healed wounds and people with established scars	Level I Cochrane Systematic Review  <i>Participants</i> 13 trials with 559 participants ages 2–81 yr were included in review	supports, stair climbing, work, sport play and ADLs ROM • Deformity and other complications • Patient preference  <i>Outcome Measures</i> • Prevention studies: number of people who developed these scars, as determined by blood flow, hyperpigmentation, erythema, scar thickness and regularity of scar • Treatment studies: change in scar size (area, length, volume, height, or width) measured with ruler, impression or ultrasound	Prevention trials, when compared with no treatment, indicated reduced incidence of hypertrophic scarring.  Gel sheeting increased scar elasticity in established scar.	Both prevention and correction studies were highly susceptible to bias and considered poor-quality studies by reviewers. Reviewers suggest caution when using the results of these studies.
O'Connor et al. (2003)	To evaluate the effectiveness of nonsurgical treatment (other than steroid injection) for CTS vs. a placebo or other nonsurgical, control interventions in improving clinical outcomes	Level I Systematic review of randomized and QRCT studies  <i>Participants</i> N = 884 participants	<i>Intervention</i> Trials compared adhesive silicone gel sheeting with control, nonsilicon gel sheeting, silicone gel plates with added vitamin E, laser therapy, triamcinolone acetonide injection, and nonadhesive silicone gel sheeting.  <i>Intervention</i> Treatment methods included splinting, ultrasound, yoga, carpal tunnel mobilization, ergonomic keyboards, magnet therapy, laser acupuncture, exercise, chiropractic care. Only steroid injection was excluded.  <i>Outcome Measures</i>	Moderate indication of short-term benefit from oral steroids; limited evidence has suggested that splinting, ultrasound, yoga, and carpal bone mobilization can be effective. Equivocal results have been shown for the use of ergonomic keyboards to reduce pain and improve function. Other nonsurgical techniques (magnet therapy,	Several studies had high levels of bias.

<p>Improvement in clinical symptoms (pain and parathesias) <math>\geq 3</math> mo post-treatment was shown. Secondary outcome measures included improvement in function, quality of life, or both.</p>	<p>nerve gliding, and chiro-practic) were not found to be effective.</p>	<p>After the 12-mo study period, no significant differences in impairment ratings were detected between the treatment groups and the control group or in the treatment groups themselves. Longstanding symptoms may have already reached a natural plateau.</p>	<ul style="list-style-type: none"> <li>• Subjective experience of patients not taken into account; impairment rating does not measure actual functional disability.</li> <li>• Patients were able to switch groups on request.</li> <li>• Standard treatment protocols used by physical and occupational therapists in the Netherlands may not match treatment approaches used by U.S. therapists.</li> </ul>
<p>Improvement in clinical symptoms (pain and parathesias) <math>\geq 3</math> mo post-treatment was shown. Secondary outcome measures included improvement in function, quality of life, or both.</p>	<p>Studies included locally injected steroids, vitamin B6 regimen, steroid vs. NSAIDs</p>	<p>Review found strong evidence in favor of the use of local and oral steroids and moderate</p>	<ul style="list-style-type: none"> <li>• Several studies had small sample sizes.</li> </ul>
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<p>Improvement in clinical symptoms (pain and parathesias) <math>\geq 3</math> mo post-treatment was shown. Secondary outcome measures included improvement in function, quality of life, or both.</p>	<p>Review found strong evidence in favor of the use of local and oral steroids and moderate</p>	<p>Review found strong evidence in favor of the use of local and oral steroids and moderate</p>	<ul style="list-style-type: none"> <li>• Several studies had small sample sizes.</li> </ul>

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Richard et al. (1987)	To investigate 2 common interventions for increasing finger-flexion ROM, passive exercise, and static wrapping	Level I 33 RCTs dating from 1985–2006 were reviewed.  RCT; counterbalanced repeated <i>Participants</i> <i>N</i> = 6 patients	and diuretics, ultrasound vs. laser therapy, exercise therapy, and splints.  <i>Intervention</i> Passive ROM exercise was administered to involved finger joints (except distal interphalangeal joint) by the therapist for 10 min.  Affected joints were wrapped in full mitten configuration by therapist using 3-in. elastic bandage; wrap was left in place for 10 min.  13 trials of each technique were conducted. Timeframe was not reported.  <i>Outcome Measures</i> Tool not explicitly stated; however, authors do include AROM measurements taken immediately before and after treatment.	evidence that vitamin B6 is not effective and that full-time use of splints is effective. Limited or conflicting evidence that NSAIDs, diuretics, yoga, laser, and ultrasound are effective, and evidence that exercise and botulinum toxin B are ineffective.  Passive exercise was more effective in increasing metacarpophalangeal joint flexion.  Static wrapping was better at increasing proximal interphalangeal joint flexion.	<ul style="list-style-type: none"> <li>Review may have overlooked studies that could have added important insight to conclusions.</li> <li>Small sample size</li> <li>Brief period of intervention</li> </ul>
Rogers & Wilder (2007)	To determine the effects of 2 yr of whole-body strength training and gripper exercise on hand strength, pain, and function in adults with radiographic evidence of hand OA	Level III Pre- and posttest design with single group <i>Participants</i> <i>N</i> = 55; median age = 71.5 ± 6.5 yr, 80% female	<i>Intervention</i> Participants completed a structured strength-training routine that addressed muscular strength, endurance, and joint mobility. The 25- to 30-min routine included warm-up, strength training, and cool down.  <i>Outcome Measures</i> Jamar dynamometer for isometric grip strength; isotonic grip strength measured using 15-repetition weight achieved	Older adults with radiographic evidence of hand OA and minimal dysfunction demonstrated increase in static and dynamic grip strength by completing whole-body strength training that includes gripper exercise. Those adults with symptomatic OA were able to reduce pain while increasing strength.	<ul style="list-style-type: none"> <li>Unclear when pain assessment was completed.</li> <li>Isotonic hand gripper cannot be evaluated independent of whole-body strength-training routine.</li> <li>Assessment and training did not include pinch strength.</li> </ul>

<p>during training with a gripper machine</p> <p>Pain of hands and 7 other body areas were measured using numerical rating scale (0–10) at baseline and weekly. Self-reported hand and finger function was measured using the Arthritis Impact Measurement Scale.</p>	<p>Level I RCT</p> <p><i>Participants</i> N = 46 adults &gt; age 50 with diagnosis of hand OA</p>	<p>To investigate the effects of a daily 16-wk home exercise regimen on hands with OA</p>	<p>Rogers &amp; Wilder (2009)</p>	<p>Home-based daily exercise program modestly increased grip-and-pinch strength, but this benefit was not enough to be seen in self-reported hand function or pain. No change noted in Perdue pegboard test.</p>	<p><i>Intervention</i> Both investigational protocol and sham protocol were included. The procedure was 16 wk of activity and a wash-out period of 16 wk with no intervention. Following wash-out period, the groups were switched.</p> <p>Investigational group was given 9 hand exercises that involved ROM and strengthening.</p> <p>Placebo group was instructed in a hand massage program using a nonvigorous and gentle technique.</p> <p><i>Outcome Measures</i> Australian Canadian Osteoarthritis Hand Index physical function subscale (includes self-reports), Jamar grip and pinch dynamometers, and Perdue pegboard</p>	<p>• Daily progressive protocol may have been too aggressive for older population.</p> <p>• Investigator was not blind to treatment vs. sham group.</p>	
<p>The ISS, but not the modified Greentest or the SIP, showed a difference between physical therapy vs. occupational therapy and computed tomography. Physical therapy and occupational therapy were more costly than computed tomography, but none showed higher medical costs.</p>	<p>Level I RCTs</p> <p><i>Participants</i> N = 135 participants with diagnosis of RSD in 1 upper extremity who experienced symptoms for &lt;1 yr</p>	<p>To study the cost-effectiveness of adjunctive treatment of patients with RSD of 1 extremity</p>	<p>Severens et al. (1999)</p>	<p>Functional abilities and disability were not measured.</p> <p>• Monetary values and cost of medical care in the Netherlands may not be generalizable to the United States.</p> <p>• Protocols used or frequencies and durations of treatments were not provided.</p>	<p>The ISS, but not the modified Greentest or the SIP, showed a difference between physical therapy vs. occupational therapy and computed tomography. Physical therapy and occupational therapy were more costly than computed tomography, but none showed higher medical costs.</p>		

(Continued)

**Supplemental Table 1. Interventions for Hand, Wrist, and Forearm (cont.)**

Author/Year	Study Objectives	Level/Design/Participants	Intervention and Outcome Measures	Results	Study Limitations
van der Windt et al. (1999)	To evaluate the effectiveness of ultrasound therapy in the treatment of musculoskeletal disorders	Level I Systematic review N = 38 trials	kept track of time missed from work.  <i>Outcome Measures</i> ISS, modified Greentest, SIP	Physical therapy was found to result in clinically relevant improvement in RSD.  Incremental cost-effective ratios indicated that physical therapy is more cost-effective and less costly than occupational therapy and computed tomography.	<ul style="list-style-type: none"> <li>Standard treatment protocols used may not be representative of treatment approaches in United States.</li> <li>Patients were able to switch groups.</li> </ul>
Verhagen et al. (2006)	To determine whether conservative interventions have a significant impact on short- and long-term outcomes for upper-extremity, work-related musculoskeletal disorders	Level I Systematic review of RCTs and controlled clinical trials  <i>Participants</i> N = 925 participants	<i>Intervention</i> 1 group received active ultrasound and the other received either no treatment or placebo control.  <i>Outcome Measures</i> Patient report of general improvement, improvement of pain (visual analog scale, ordinal scale, pain questionnaire), improvement of functional disability, improvement in ROM, or both.	Evidence was not found to support the use of ultrasound therapy in the treatment of musculoskeletal disorders. Statistical pooling for placebo-controlled trials on lateral epicondylitis yielded results that warrant further investigation.	<ul style="list-style-type: none"> <li>Possible selection bias indicated</li> <li>Overall poor quality of studies</li> <li>Wide range of interventions examined</li> <li><i>Work-relatedness</i> not defined</li> </ul>
Wajon & Ada (2005)	To compare the effects of 2 6-wk splint and exercise	Level I RCT	<i>Intervention</i> The experimental group was issued an abduction exercise	Limited evidence for the effectiveness of keyboards with alternative-force key displacement or alternate geometry  Limited evidence for the effectiveness of individual exercise.  The benefit of ergonomic modifications in the workplace was not demonstrated.	<ul style="list-style-type: none"> <li>Factors other than the interventions could have accounted for the significant</li> </ul>

<p>regimens for patients with trapeziometacarpal OA</p>	<p><i>Participants</i> N = 40; participants complained of pain at the base of the thumb and had been diagnosed with Stages I–III trapeziometacarpal OA</p>	<p>routine and a thumb splint known as the thumb strap splint, designed to prevent flexion and adduction of the metacarpal, dorsoradial subluxation of the base of the first metacarpal and metacarpophalangeal hyperextension. The control group was instructed to wear a short opponens splint. Both groups were instructed to wear the splints full time for a period of 2 wk. For Wk 2–6, splinting continued with the addition of the exercise regiment. For the experimental group, the exercises consisted of pain-free abduction exercise only; the control group received a typical treatment program that included pain-free pinching exercises with a soft foam block.</p>	<p>differences in pain, strength, or hand function noted after 4-wk exercise and splint program (Wk 2–6). Overall, both groups did improve statistically in all 3 areas.</p>	<p>improvements such as the Hawthorne effect, the placebo effect, and the method of statistical regression.</p>
<p>Weinstock-Zlotnick et al. (2004)</p>	<p>To compare the effects of PGWGs with sueded palm and SPGGs on functional hand use in people with hand burns</p>	<p>Level III Quasi-experimental, nonrandomized, repeated-measures design PGWG served as the experimental condition, and SPGG served as control condition; each participating hand was its own control. <i>Participants</i> 2 individuals (a total of 3 burned hands) participated in the study.</p>	<p>In general, the 3 participating hands scored better in the PGWG condition than in the SPGG condition in functional hand tasks. The work glove was unanimously preferred and described as the ideal choice if only 1 glove was to be allocated. Changes in functional hand use were significant.</p>	<ul style="list-style-type: none"> <li>• Small sample size; convenience sample may not be appropriately generalized to larger populations.</li> <li>• Likert scale used for rating ADL abilities relied on memory of task difficulty, not on actual task performance. Likert scale may not have been a sensitive instrument.</li> </ul>
<p><i>Outcome Measures</i> Pain, strength, and hand function</p>				

(Continued)

**Supplemental Table 1. Interventions for Hand, Wrist, and Forearm (cont.)**

Author/Year	Study Objectives	Level/Design/Participants	Intervention and Outcome Measures	Results	Study Limitations
Werner et al. (2005)	To determine whether night splinting of workers identified with CTS would improve symptoms and median nerve function and affect medical care	Level I RCT  <i>Participants</i> N = 112 auto workers reporting symptoms of CTS	<i>Outcome Measures</i> Jamar dynamometer, pinch meter, Moberg pick-up test, Jebson-Taylor hand function test, participant verbal scores on ease of performance of several ADL skills, and participant identification of glove preference  <i>Intervention</i> Both groups (treatment n = 63; control n = 49) were given instructions in how to reduce ergonomic stressors in both work and home environments via a 20-min video.  Treatment group was fitted with a custom hand-wrist orthosis that placed the wrist in neutral. The most symptomatic hand was chosen for study in those participants with bilateral hand involvement. Splints were to be worn at night for 6 wk.  <i>Outcome Measures</i> Included a validated CTS symptom severity scale and a 30-day worst-discomfort rating on a 10-point visual analog scale  Participants underwent nerve conduction testing before the study and again at the 12-month interval.	6-wk trial of splinting reduced discomfort scores; no difference was reported in the symptom severity scale scores; improvements persisted for 12 mo. Both groups improved over time, but improvements were greater in the treatment group. No difference in nerve conduction studies was shown between the 2 groups between pre- and poststudy measurements.	<ul style="list-style-type: none"> <li>• Participants were not blinded to their treatment and the primary outcome measure was a self-reported questionnaire.</li> <li>• Participants were not fully evaluated at 3- and 6-month intervals.</li> <li>• Statistical methodology and loss of participants may have confounded the analysis in the logistic model.</li> <li>• Symptoms in the control group were found to be more severe than those in the treatment group, despite randomization.</li> </ul>
Wessel (2004)	To evaluate the efficacy of hand exercises for people with rheumatoid arthritis	Level I  Systematic review of comparative trials and case studies	<i>Intervention</i> Interventions included any form of hand exercise such as ROM, strengthening, endurance exercises, or motor control	Value of hand exercise in the treatment of RA is not conclusive, although weak evidence exists that appropriate exercises might lead to long-term strength	<ul style="list-style-type: none"> <li>• Lower quality studies were used in review.</li> <li>• Studies used did not mention expected change that would be considered clinically important.</li> </ul>

<p>or relearning. Interventions could include a combination of exercise and modalities.</p> <p><i>Outcome Measures</i> Included strength, ROM, dexterity, pain, stiffness, and self-report of function as related to impairments or outcomes of the hand</p>	<p>changes and very short-term changes in stiffness. In general, meta-analysis was not possible because of the wide range of study designs and outcome measures.</p>	<p>• Studies lacked power calculations. • Little attempt was made to blind studies or introduce placebo to participants. • Studies did not highlight a specific form of intervention.</p>	<p>Participants N = 402 (9 trials)</p>
<p>Williams et al. (2004)</p>	<p>To evaluate the available evidence on workplace rehabilitation interventions for work-related upper-extremity disorders</p>	<p>Evidence is insufficient to identify effective workplace rehabilitation interventions for work-related upper-extremity disorders. Although several studies reported positive findings, some studies identified for inclusion in review and flaws in the studies limited the ability of this review to make generalized recommendations.</p>	<p>Level I Systematic review <i>Participants</i> N = 751 (8 trials) for those receiving workplace-based interventions for upper-extremity disorders</p>
<p><i>Intervention</i> Workplace interventions included ergonomic modifications to the workplace to decrease repetitiveness, force, and awkward positioning, job accommodations included modified work, light-duty work trials, and graded return to work.</p> <p><i>Outcome Measures</i> Pain ratings via visual analog scale, pre- and post-EMG testing, program evaluation, demographics questionnaire, Modified Functional Status Scale, 12 wk of keyboard use, 24 wk of keyboard use, self-reports, and workplace accommodations</p>	<p>Studies were limited by small sample size, lack of standardized outcome measures, and inadequate reporting of interventions and results.</p>		

*Note.* ADLs = activities of daily living; AROM = active range of motion; CIQ = Community Integration Questionnaire; CLLHW = continuous low-level heat wrap; COPM = Canadian Occupational Performance Measure; CTS = carpal tunnel syndrome; DASH = Disabilities of the Arm, Shoulder, and Hand questionnaire; DTFM = deep transverse friction massage; EMG = electromyography; ISS = Impairment-level Sum Score; LLLT = low-level laser therapy; NSAIDs = nonsteroidal anti-inflammatory drugs; NULL = Neck and Upper Limb Index; OA = osteoarthritis; PEDro = Physiotherapy Evidence Database; PGWGs = pressure garment work gloves; QRCT = quasi-randomized trial; RA = rheumatoid arthritis; RCT = randomized controlled study; ROM = range of motion; RSD = reflex sympathetic dystrophy; SIP = Sickness Impact Profile; SPGGs = standard-pressure garment gloves; STAI = State Trait Anxiety Inventory; UEFS = Upper Extremity Function Scale; WHMPI = West Haven-Yale Multidimensional Pain Inventory.

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