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A Systematic Review of Conservative Interventions for Osteoarthritis of the Hand

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ABSTRACT:
Study Design: Systematic Review.
Introduction: Hand therapy interventions for patients with hand osteoarthritis (OA) can include splinting, joint protection technique instruction, paraffin, exercises, and provision of a home exercise program.
Purpose: Examine the quality of the evidence regarding the hand therapy interventions for hand OA.
Methods: Twenty-one studies dated between 1986 and 2009 were included in the systematic review for analysis.
Results: The current evidence provides varied support for the interventions of orthotics, hand exercises, joint protection techniques, the utilization of adaptive devices, and paraffin. Findings for the use of joint protection techniques are supported for improvements in function and pain reduction. Minimal evidence exists for paraffin used for the treatment of hand OA.
Conclusions: The current literature supports the use of orthotics, hand exercises, application of heat, and joint protection education combined with provision of adaptive equipment to improve grip strength and function.
Level of Evidence: 2A.
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Hand osteoarthritis (OA) has important functional consequences in regards to pain, reduced hand mobility and grip force, activity limitations, and participation limitations affecting as many as 75% of the women in the United States between the ages of 60 and 70.[1] The joints typically involved are the distal interphalangeal joints (DIPs), the proximal interphalangeal joints, and the first carpometacarpal (CMC) joint of the hand, leading to considerable disability.[2] Individuals with hand OA experience problems wringing out washcloths and opening jars and bottles, a 60% reduction in grip strength, and restricted joint mobility of the hands.

There are five systematic reviews previously published looking at the effectiveness of various nonsurgical treatments on hand OA. In 2005, Towheed[3] looked at the effectiveness of pharmacological and nonpharmacological therapies in patients with hand OA. This review did not identify conclusive studies and determined that consensus guidelines were needed to improve the design and conduct of the randomized controlled trials (RCTs). Based on the 31 analyzed RCTs, the author suggested that there was some evidence for the efficacy for the following interventions that are in the realm of hand therapy: splints for first CMC OA, yoga, spa therapy, and occupational therapy. In 2009, Mahendira and Towheed[4] updated their earlier systematic review and included 13 more studies. A total of 44 RCTs evaluating various pharmacological and nonpharmacological therapies in hand OA were analyzed in the update. The authors reported that generally the RCTs were of low quality and weakened by a lack of consistent case definition and standardized outcome assessments. They found that the methods used for randomization, blinding, and allocation concealment were rarely described. A meta-analysis could not be performed because most of the treatments studied did not have more than one identical comparison to allow pooling of the data.[4]

Zhang et al. developed the EULAR (European League Against Rheumatism) evidence-based recommendations for the management of hand OA. The multidisciplinary consensus supports the following hand therapy interventions for hand OA: joint protection education (JPE), local application of heat (paraffin wax and hot pack) especially before exercise, and

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splints for the base of thumb and orthoses to prevent/correct angular and flexion deformity.[5]

Moe et al.[6] summarized the evidence from four previously published systematic reviews to synthesize the evidence of the effectiveness of nonpharmacological and nonsurgical interventions for patients with hand OA. The authors identified evidence for pain relief from topical capsaicin and favorable functional outcomes for exercise combined with patient education. The evidence that splints are effective for the CMC joint was limited. In conclusion, the authors report that there is insufficient high-quality evidence for nonsurgical interventions, and there is an urgent need for further research.[6]

Egan and Brosseau[7] looked at the efficacy of splinting for CMC OA. Seven studies were included in their review, and they concluded that there was fair evidence for the effectiveness of splinting to relieve pain and improve function. They found no clear evidence of the superiority of one type of splint over another for pain relief, comfort, or function.[7]

Francon and Forestier[8] reviewed RCTs of spa therapy in rheumatology. Spa therapy includes balneology, balneotherapy, hydrotherapy, mud therapy, and mineral water. The authors concluded that spa therapy or hot-water balneotherapy RCTs suggest that patients with both knee and hand OA may benefit from the treatment, but available studies are methodologically inadequate and sample sizes too small to allow definitive conclusions.[8]

There are no specific Cochrane reviews regarding hand OA. There are reviews that looked at the effects of thermotherapy on OA (not specific to the hand) and the effects of thermotherapy on patients with hand rheumatoid arthritis (RA). In 2003, the Cochrane Library published a review on thermotherapy for OA and found that ice massage compared with control had a statistically beneficial effect on range of motion (ROM), function, and knee strength. Cold packs decreased swelling. Hot packs had no beneficial effect on edema compared with placebo or cold application. Ice packs did not affect pain significantly, compared with control, in patients with OA.[9] The Cochrane Library also examined the effects of thermotherapy on patients with hand RA in 2002.[10] They found that there was no significant effect of hot and ice packs applications, cryotherapy, and faradic baths on objective measures of disease activity including joint swelling, pain, medication intake, ROM, grip strength, hand function compared with a control (no treatment) or active therapy. They found no significant difference between wax and therapeutic ultrasound as well as between wax and faradic bath combined to ultrasound for all the outcomes measured after one, two, or three week(s) of treatment. There was no difference in patient preference for all types of thermotherapy. No harmful effects of thermotherapy were reported. The reviewers concluded that superficial moist heat and cryotherapy can be used as a palliative therapy. Paraffin wax baths combined with exercises can be recommended for beneficial short-term effects for arthritic hands. Their conclusions were limited by methodological considerations such as the poor quality of trials.[10]

This systematic review of therapy-specific interventions for hand OA can aid clinicians in the application of the evidence found to guide the clinical choices made when treating clients with the prevalent diagnoses of hand OA. The systematic reviews previously mentioned only include RCTs, and this review includes cohort studies. Because there are a limited amount of RCTs that specifically look at hand OA, the inclusion of cohort studies helps provide information that can be useful when determining the effectiveness of an intervention on hand OA. Hand therapy interventions for patients with OA of the hand can include joint protection technique instruction, adaptive equipment provision and instruction, heat modalities, splinting, strengthening and ROM exercises, adaptive technique instruction, patient education in symptom control techniques, and provision of a home exercise program. This systematic review of therapy interventions for hand OA can be used as a tool by hand therapists for making informed intervention choices concerning clients with the prevalent diagnosis of hand OA. This review is designed to guide therapists with their clinical decision making when the goal of treatment is to provide pain relief, prevent joint deformity, and/or increase hand function in clients with OA.

METHODOLOGY

Data Identification and Study Characteristics

Literature searches were performed using computerized databases. See Quorom diagram (Figure 1). English language-only key word searches were used with combinations of terms including OA, hand, occupational therapy, physical therapy, hand therapy, and interventions (paraffin, exercise, ROM, splinting, and joint protection). The key words were searched in various combinations; for example, osteoarthritis AND occupational therapy, osteoarthritis AND exercise, and so on. The articles were chosen based on the relevance of the information in regard to conservative therapy interventions that hand therapists use in clinical practice when treating patients with OA of the hand. The search was not restricted to RCTs in an effort to find all relevant studies. The diagnosis of all the subjects in the reviewed studies was OA of the hand except for two studies. One study was included in the review because the participants had generalized OA and RA but they reported on self-management techniques (hand joint protection, splints, and exercises) that they used to control

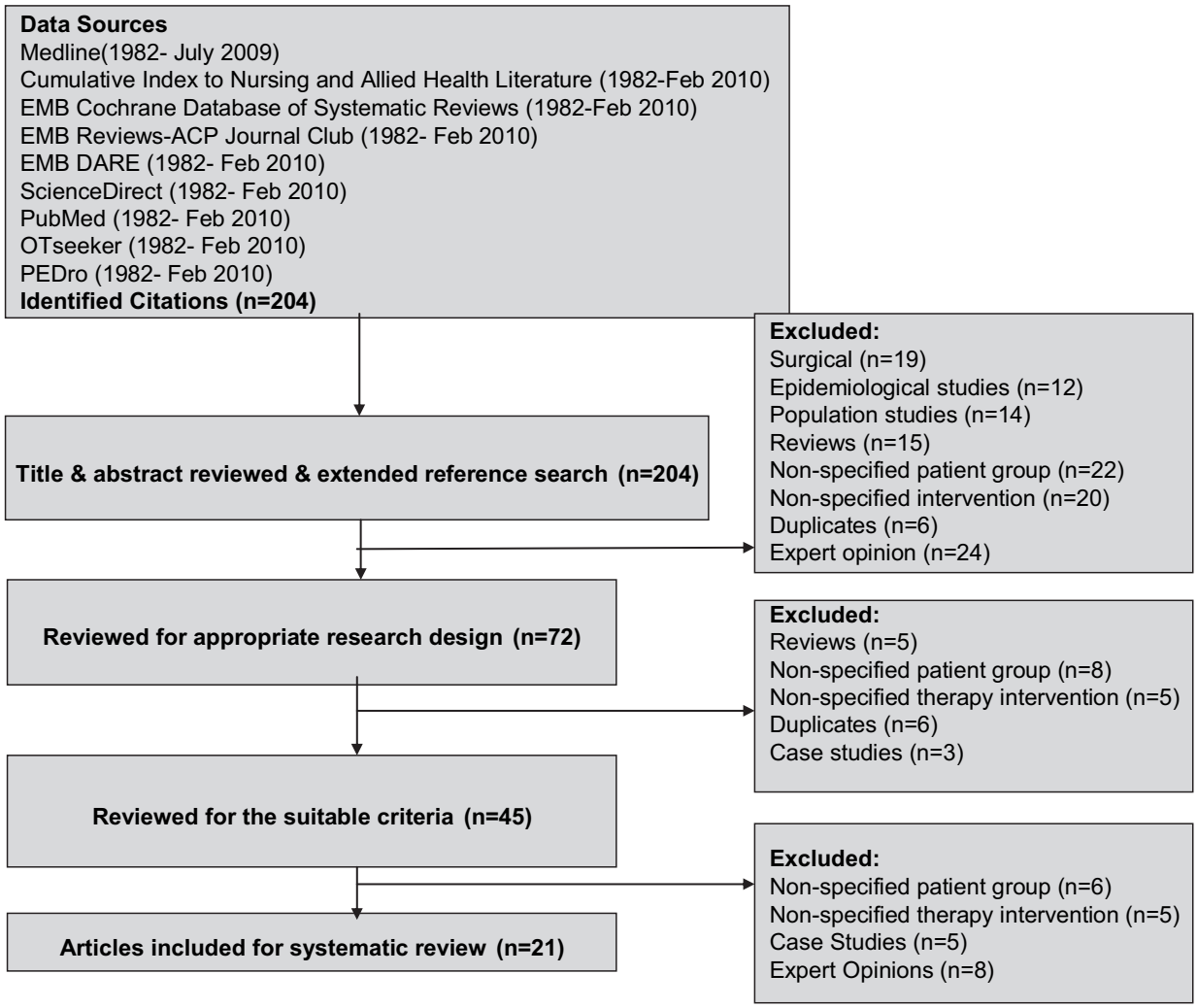

FIGURE 1. *Quorom diagram for literature search.*

their symptoms. The other study was included because 13 of the subjects in the study had the diagnosis of OA and chronic wrist pain.

Studies were included in the review if they addressed conservative hand therapy interventions as related to hand OA. On the basis of this parameter, 21 studies, out of the 204 retrieved articles, dated between 1986 and 2009, were included in the systematic review for full analysis.

The criteria for classification and reporting on OA of the hand include hard tissue enlargement involving two or more of 10 selected joints, swelling in fewer than three metacarpophalangeal joints, and hard tissue enlargement of at least two DIP joints. The 10 selected joints include the second and third distal phalangeal joints, the second and third proximal phalangeal joints, and the trapeziometacarpal joint of both hands.[11]

Critical Appraisal and Quality Assessment

The two primary investigators organized the data extraction and evaluated the quality of the research using the Structured Effectiveness for Quality Evaluation of Study (SEQES)[12] and the level of evidence (LOE).[13] One of the investigators has been a hand therapist for more than 25 years, and the other investigator has been a hand therapist for more than 13 years.

The SEQES, developed by MacDermid, is a standardized 24-item critical appraisal form used to evaluate the quality of a study. The SEQES scores are obtained by totaling the number of points attained from the 24 items. Each item received a score of 0, 1, or 2, with a total score of 48 possible. A score of 2 represents that the study received the highest score for that aspect of study design, a score of 1 represents that the study received a fair rating, and a score of 0 indicates either poor quality or incomplete fulfillment of the criterion. Each article was evaluated for quality using the SEQES by both the authors. The examiners followed the guidelines established by MacDermid for multiple reviewers to a consensus score. Each author was blinded to the other author's scores until scores were compared and consensus was reached. If the authors found disagreement

between scores, a written justification of the score was reviewed, and the authors subsequently came to an agreement on the score (see Table 1).

Studies were considered to be of moderate quality if the scores ranged from 17 to 32. If the studies' score fell below 17, it was considered to be of poor quality. The studies that scored above a 32 were considered to be of high quality.[14]

Level of Evidence

When appraising the quality of each article, the LOE of each article was determined using the Sackett scale.[13] The LOE of the articles chosen range from level 1a and 2b RCTs to level 3 descriptive cohort studies (see Table 2).

RESULTS

Many of the studies reviewed received high scores for study design and for their thorough review of the current literature regarding OA. The more recent studies received higher SEQES scores because the authors were more likely to use standardized outcome measures and reported findings in terms of clinical significance. Four studies by Rogers and Wilder,[15] Boustedt et al.,[16] Rannou et al.,[17] and Brosseau et al.[18] reported their findings in regard to minimally clinically important difference.

The SEQES scores for quality of research ranged from 16/48 to 47/48. The two earliest studies conducted by Moratz et al.[19] published in 1986 and Garfinkel et al.[20] in 1994 received the some of the lowest scores, 21/48 and 20/48, indicating that a fair number of quality criteria were not met. The five most recent 1b and 2b studies published by Brosseau et al.,[18] Rogers and Wilder[15] in 2008, Boustedt et al.[16] in 2009, Rannou et al.[17] in 2009, and Thiele et al.[21] in 2009 received the highest scores ranging from 31/48 to 47/48, fulfilling a larger number of study design criteria. In summary, the more recent 1b and 2b studies fulfilled a higher number of quality research criteria than earlier studies.

The principal weakness of many of the studies was that the authors failed to perform sample size calculations, and adequate power was not established. The strengths of the studies included provision of the appropriate background information, provision of inclusion and exclusion criteria of the subjects, provision of information regarding the recruitment strategy of the studies, the statistical significance of their findings were conveyed, and clinical recommendations directly related to the objectives of the study were made (see Table 3).

Exercise

Six 2b and three level 3 studies using a total of 369 subjects (this total includes the 27 subjects with OA from the Veitiene and Tamulaitiene[22] study) examined the role of exercise in the treatment of patients with hand OA. Quality of scores of these studies ranged from 20 to 42. Eight of the nine studies found that subjects who performed exercises demonstrated gains in grip strength ranging from 1.94 kg to a 25% improvement from the baseline. The studies for the intervention of exercise were of moderate quality and provide moderate support for the intervention of exercise to increase hand strength and decrease pain.

Heat or Cold Modalities

Three 2b studies using a total of 174 subjects (this total only includes the 13 patients with the diagnosis of OA from the Michlovitz et al.[23] study) examined the role of heat in the treatment of patients with hand OA. The quality of the scores of these studies ranged from 33 to 40. Paraffin is a commonly used

TABLE 1. **SEQES Evaluation Scores for Quality of Research**

Citation	*Level of Evidence*	*Score*
Moratz et al.[19]	3	21
Garfinkel et al.[20]	2b	20
Graber-Duvernay et al.[31]	2b	37
Swigart et al.[32]	3	16
Buurke et al.[33]	2b	31
Weiss et al.[34]	2b	30
Berggren et al.[35]	2b	30
Stamm et al.[36]	2b	39
Day et al.[30]	3	27
Lefler and Armstrong[37]	2b	32
Michlovitz et al.[23]	2b	40
Weiss et al.[29]	2b	29
Brosseau et al.[18]	2b	47
Veitiene and Tamulaitiene[22]	3	23
Wajon and Ada[27]	2b	36
Stange-Rezende et al.[38]	2b	33
Rogers and Wilder[28]	3	30
Rogers and Wilder[15]	2b	42
Rannou et al.[17]	1b	44
Thiele et al.[21]	2b	31
Boustedt et al.[16]	2b	35

SEQES = Structured Effectiveness for Quality Evaluation of Study.

TABLE 2. **Explanation of Levels of Evidence of Articles**

Strength of Evidence	*Level of Evidence*	*Study Type*	*Type of Study*
High	1b	Individual RCT (with narrow confidence interval)	Experimental
Moderate	2b	Individual cohort study (including low-quality RCT; e.g., <80% follow-up)	Experimental
Fair	3	Cohort study	Observational

RCT = randomized controlled trial.

TABLE 3. **Summary of Evidence for Conservative Interventions for OA of the Hand**

Study and Evidence Level	*Subjects*	*No of Subjects*	*Randomized/ Blinded? Y/N*	*Intervention*	*Measure*	*Protocol*	*Results*	*Conclusions*
Exercise and orthotics								
Wajon and Ada[27] 2b study	Pts with stage I–III Trapeziometacarpal OA Prospective Inclusion and exclusion criterion cited	40	1. Yes 2. Yes	Study was to compare the effects of two 6-wk splint and exercise regimens for pts with CMC OA Methods: Experimental group: Received a newly designed thumb strap splint and abduction exercise regimen Control group: Received an SO splint and pinch exercises	Pain measured by VAS at rest HF measured by Sollerman test of hand function Tip pinch in kilograms	Palmar abduction against gravity without pain 3× per day increasing from 5 to 10 reps Provided with yellow extra-soft foam block pinch exercises 3× per day increasing from 5 to 10 reps	No significant difference between groups in pain, tip pinch, or HF at 6 wk Mean VAS ↓2.1 cm Mean tip pinch ↑0.65 kg Mean HF score ↑6.4 pts	Both groups improved from the regimens, and neither regimen was superior to the other
Exercise								
Rogers and Wilder[15] 2b study	Pts with radiographic OA of at least one hand joint and symptomatic hand OA determined by minimum physical function subscale score on AUSCAN Cross-over trial with wash-out period between exercise and sham treatment Inclusion and exclusion criterion cited	46	1. Yes 2. No	Study was to investigate the effects of a daily 16-wk home-based hand exercise program among persons with hand OA Methods: Experimental group: 16-wk daily hand exercise intervention standardized and included nine exercises Control group: 16-wk application of nonmedicated hand cream	Physical function subscale of the AUSCAN VA3.1 Grip and pinch in kilograms Dexterity tested with Purdue Pegboard Testing took place at baseline, week 16, week 32, and week 48	Exercise protocol: nine exercises; tabletop, small fist, large fist, okay signs, finger spread, thumb reach, gripping, key pinch, fingertip pinch Performed daily progressing from 10 to 20 reps Sham protocol: over-the-counter nonmedicated hand cream applied 1× per day in nonvigorous manner	Exercise and placebo groups AUSCAN physical function showed ↑ in function but did not meet MCID threshold Dexterity scores unchanged * **Exercise** mean grip ↑3 kg * Mean key pinch ↑1 kg * Mean 3 pt pinch ↑1 kg **Sham** no strength change	Performance of daily HEP modestly improved hand strength Change in AUSCAN scores showed no difference between groups

Rogers and Wilder[28] 3 study	Participants with grade 2+ Radiographic evidence of OA in one or more hand joint Prospective Inclusion and exclusion criterion cited	55	1. No 2. No	Study was to determine the effects of two years of whole body strength training and gripper exercises on hand strength, pain, and HF	Pain: numeric scale 1–10 Grip: in kilograms HF: AMIS2 (score 0 = good 10 = poor)	3× per week strength training program of aerobic warm-up, strength training, and cool-down. Strength training performed on multistation weight stack machine. Gripper exercises performed on gripper machine	* Grip strength ↑1.94 kg * Pain: ↓2.15 pts HF: showed minimum dysfunction At baseline and follow-up	Strength training ↑ static and dynamic grip strength and ↓ pain
Lefler and Armstrong[37] 2b study	Pts 55 years or older with dx of hand OA diagnosed by MD and some hand or finger impairment from OA pain Prospective Inclusion and exclusion criterion cited	19	1. Yes 2. No	Study was to determine the effects of strength training on OA of the hands Methods: Experimental group: performed strength training exercises daily Control group: encourage to continue normal activities for 6 wk	Grip, pinch, and lateral finger strength in kilograms Finger ROM measured as distance from small fingertip to DPC Six-point Likert pain scale	Exercise group: Ricegrabs, pinch grip lifting, and wrist rolls Exercises were initially performed at 40% of maximal effort and were increased to 15 reps before weight was increased	* **Exercise** grip ↑7 lb Palmar pinch ↑3 lb Lateral pinch ↑1 lb * ROM to DPC ↓1 cm Pain ↓0.2 (on 0–6 scale) **Control** Pain ↑0.7 (on 0–6 scale) Grip ↓1 lb Pinch ↓0.5 lb	Grip strength and ROM increased after exercise
Garfinkel et al.[20] 2b study	Pts with OA of DIP and/or PIP joints of the fingers Pts had pain, aching, or stiffness in the hands Prospective Inclusion criterion cited. No exclusion criterion cited	25	1. Yes 2. No	Study was to determine the effect of yoga on the hands of patients with OA Exercise group: consisted of 10-wk program based on supervised yoga and relaxation techniques Program consisted of eight 60-min sessions 1× weekly Control group: received a no change from baseline, drug-based, treatment program	Circumference of finger joints: ring sizer Finger ROM measured with goniometer Grip strength measured in kilograms Joint tenderness: instrument dolorimeter Pain: VAS	Exercise group: sessions included strengthening and stretching exercises emphasizing extension and alignment, group discussion, supportive encouragement, and question and answer period. Pts performed classical yoga poses	**Exercise** * tenderness score improved 2 points Grip ↑5 kg * ROM ↑12° * Activity hand pain ↓4 points **Sham** Tenderness score improved four points Grip ↑3 kg ROM ↑7.5° Activity hand pain ↓1	Pain and joint tenderness decreased, and grip increased after yoga

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TABLE 3. (**Continued**)

Study and Evidence Level	*Subjects*	*No of Subjects*	*Randomized/ Blinded? Y/N*	*Intervention*	*Measure*	*Protocol*	*Results*	*Conclusions*
Exercise and JPE and orthotics								
Boustedt et al.[16] 2b study	Pts with OA in one or both CMC-1 joints, referred by physician Prospective Inclusion and exclusion criterion cited	40	1. No 2. No	Study was to determine if splinting and hand exercise combined with JPE would ↑HF Exercise group: received day and night splints, hot pack, and home exercises and JPE Control group: received 10 group educational-behavioral sessions over a 5-wk period	Pain at night, pain on motion, and stiffness measured with VAS Grip and pinch strength measured in newtons HF measure DASH score	Exercise group: tx session included paraffin tx and hand exercise with paraffin dough including nine different movements to increase ROM and strengthen CMC joint stability	Exercise and JPE * Night pain ↓9 * Motion pain ↓18 * Stiffness ↓20 * DASH score ↓9 points Grip ↑33 newtons Pinch unchanged **Control** Night pain unchanged Motion pain ↓14 Stiffness ↓6 DASH score ↓6 points Grip ↑17 newtons Pinch ↑1 newtons	Pain and stiffness is reduced with splinting, exercise, and JPE compared with JPE only
Veitiene and Tamulaitiene[22] 3 study	Pts with OA of the hip or knee or RA (functional class I or II) between 40 and 80 years of age Descriptive study Inclusion and exclusion criterion cited	53 27 OA 26 RA	1. No 2. No	Study was to determine and compare self-management methods used by patients with OA and RA and to define which methods patients consider the most effective Methods: patients were interviewed regarding the self-management methods they used and were asked to indicate the methods they felt were the most effective	Pts reported what self-management tools they used by answering a yes/no question regarding the use of the method following the description of the method. They then ranked the three most effective methods they used	The self-management methods were exercises, rest, hand joint protection, heat, cold, assistive devices, and splints	* More pts with OA than RA use assistive devices Exercise, assistive devices, and heat were considered the most effective self-management method * More pts with OA considered assistive devices to be the most effective self-management method	OA pts report that the use of assistive devices is the most effective self-management method

JEP and exercise Stamm et al.[36] 2b study	Pts who met criteria for hand OA established by ACR Prospective Inclusion and exclusion criterion cited	40	1. Yes 2. Yes	Study was to evaluate the effect of instruction for JPE combined with hand exercise Methods: Experimental group: Received oral and written instruction for JPE and hand HEP to be performed daily for 3 mo Control group: was given oral and written information about hand OA	Health assessment questionnaire VAS for pain and hand function Grip strength measured in kilograms	Exercises: making a fist, IP flexion, tabletop, opposing thumb to each fingertip, spreading fingers, pushing each finger in the direction of the thumb with hand flat on table, and opposing thumb to base of small finger	**Exercise and JPE** * Grip ↑25% from baseline Global HF score ↑ for 13 of 20 subjects (65%) **Control** * Grip ↑10% from baseline Global HF score ↑ for 4 of 20 subjects (20%) Pain change score not provided but reported no difference between groups	JP and HEP instruction increases grip and global HF
Moratz et al.[19] 3 study	Adults with previously established dx of OA were enrolled from two community centers and a health care center for ambulatory senior citizens Cohort study Inclusion criterion cited No exclusion criterion cited	77	1. No 2. No	Study was to determine if involvement of an OT in the treatment of OA was beneficial	Hand ROM: goniometer Grip and pinch strength in pounds Crepitus, tenderness of hand joints, locking, or triggering of tendons, and presence of cysts and nodules were noted Function: Likert scale 0–3	Interventions included: instruction about and demonstration of exercises for proper hand use; printed directions of hand exercises and provision of adaptive devices for ADL pts were seen every 2 wk for 12 wk	* Mean disability score ↓ from 1.7 to 1.2 Mean women's grip strength ↑5 lbs Mean men's grip strength ↑3 lbs	HF improved after JPE and HEP instruction

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TABLE 3. (**Continued**)

Study and Evidence Level	*Subjects*	*No of Subjects*	*Randomized/ Blinded? Y/N*	*Intervention*	*Measure*	*Protocol*	*Results*	*Conclusions*
JPE and orthotics Berggren et al.[35] 2b study	Potential candidates for operative treatment of OA of the hand. They presented with isolated CMC-1 arthritis on radiograph; no sign of adduction contracture; pain on movement with stress and pain at rest that interfered with work and daily activities Prospective Inclusion and exclusion criterion cited	33	1. Yes 2. Yes	Study was to assess the influence of structured advice, provision of accessories, and splinting on the need for CMC-1 joint replacement Methods: All patients had three individual sessions with hand therapist regarding JPE and work-site modification First group: received adaptive equipment only and had unrestricted access to adaptive equipment Second group: received a semistable fabric splint and adaptive equipment Third group: received a nonstabilizing leather splint and adaptive equipment All regimens lasted 7 mo	Pts subjectively reported if they still needed to have surgery	Adaptive equipment included bread saw, grabber stick, potato peeler, tap handle, pen handle, scissors, cheese cutter, and book support 70% of pts awaiting surgery	After 7 mo, only 10 of the 33 patients wanted surgery. During next seven years, only two more pts wanted surgery	JPE, provision of adaptive equipment, and splinting can reduce the need for surgery

Orthotics								
Rannou et al.[17] 1b study	Pts with thumb CMC OA with pain 30 mm or more on VAS scale, 45–75 yr, radiographic evidence of two of four (osteophytes, joint space narrowing, bone sclerosis, or cysts) and either CMC joint enlargement or closure of first web Prospective Inclusion and exclusion criterion cited	109	1. Yes 2. No	Study was to assess efficacy and acceptability of a splint for CMC OA Methods: Experimental group Custom-made CMC neoprene rigid rest orthoses to be worn at night Control group: received usual care at the discretion of their MD	Pain on VAS HF: Cochin hand function Scale (0 = low level of disability) Pt global perceived disability on VAS Pt global assessment on six-point Likert scale Assessments at 1, 6, 12 mo	Splints were made by three OTs who adjusted the splint for each pt so first web could be opened and thumb placed in opposition with long finger splint was to be worn nightly	Splint group: * Pain ↓22.2 points vs. ↓7.9 in control group * HF: splint group score ↓1.9 vs. ↑4.3 pts control group * Pt perceived disability score ↓11.6 vs. ↑1.5 pts control group Results are from one-year assessment	Wearing a splint ↓ed pain and increased HF
Thiele et al.[21] 2b study	Pts with hx of chronic wrist pain impairing their functional ability Cross-over trial with wash-out period between leather and commercial splint Inclusion and exclusion criterion cited	25 total 6 OA 17 RA 2 other	1. Yes 2. Yes	Study was to compare the effectiveness of custom-made leather splint with commercially available fabric splint on pain and HF on chronic wrist pain Methods: 2-wk period of splint wear followed by 1-wk wash-out period and 2 wk of alternate splint 2 wk wearing Futuro wrist brace 2 wk wearing custom-made leather brace	Grip in kilograms HF: AUSCAN Pain: VAS	Pts were instructed to use splint during periods of pain and discomfort. Wrist was positioned in 15 degrees of extension if possible	Leather splint * ↓Pain 9 points vs. ↓5 points Futuro HF: leather splint score ↓13 points vs. ↓11 points Futuro * COPM: leather splint ↑2.5 points vs. ↑1.7 points Futuro * Grip: leather splint ↑4.7 kg vs. 3.5 kg Futuro Leather splint preferred by 72% subjects	Splint use increases HF, ADL function, and grip and decreases pain and stiffness

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TABLE 3. (**Continued**)

Study and Evidence Level	*Subjects*	*No of Subjects*	*Randomized/ Blinded? Y/N*	*Intervention*	*Measure*	*Protocol*	*Results*	*Conclusions*
Weiss et al.[29] 2b study	Pts with clinical or radiographic evidence of CMC OA. Subjects had stage 1 or 2 OA classification Prospective Inclusion criterion cited Cross-over trial with no wash-out period between splints	21	1.Yes 2. No	Study was to assess level of satisfaction between custom-made (CMT) neoprene (PFN) and which splint was more effective in managing pain Methods: Pts wore each splint for 1-wk period and then changed splints	Pain: VAS Splint satisfaction: VAS Tip pinch: kilograms CMC subluxation: X-ray during pinch ADL: self-rated 22-item scale	Pts wore CMT or PFN for 1 wk and then changed splints. They wore splint whenever they felt symptoms in the thumb, day or night	* Pain at rest: CMT ↓1.83 points * PFN ↓3.13 points Pain with pinch: CMT ↓0.62 patients * PFN ↓1.58 patients * Pinch strength: PFN ↑0.3 kg ADL: CMT 26% easier, PFN 48% easier Preference: CMT 24%; PFN 72%	Splinting helps stabilize CMC joint which ↓ pain and ↑ ADL function. 72% of patients prefer neoprene splint
Weiss et al.[34] 2b study	Pts with radiographic evidence of CMC OA and pain in joint. Pts had stage 1, 2, 3, or 4 OA Prospective Inclusion criterion cited Cross-over trial with no washout period between splints	26	1. Yes 2. No	Study was to assess level of satisfaction between short and LO splint and assess which splint was more effective in managing pain and improving HF Methods: Pts wore each splint for 1-wk period and then changed splints	Pain: VAS Splint satisfaction: VAS Tip pinch: kilograms CMC subluxation: X-ray during pinch ADL: self-rated 22-item scale	Pts wore either splint for 1 wk and then changed splints. They wore splint whenever they felt symptoms in the thumb, day or night	Pain unchanged both splints * Subluxation of CMC ↓ with both splints Pinch strength: no change ADL: long 66% easier, short 42% easier Preference: long 27% short 73%	Splinting helps stabilize CMC joint which ↑ ADL function. 73% of pts prefer short splint

Day et al.[30] 3 study	Pts with isolated pain and tenderness of CMC, X-ray findings of arthrosis or joint subluxation, + Grind test. Pts had stage 1, 2, 3 or 4 OA Prospective Inclusion and exclusion criterion cited	30	1. No 2. No	Study was to evaluate effectiveness of corticosteroid injection and splinting on CMC OA	Pain: VAS ADL: DASH Grip and pinch: kilograms	Subjects received injection in CMC joint and then splinted in cloth thumb spica splint for 3 wk	43% of pts Pain ↓5.5 points at 6 wk. Average grip was 95% of contralateral Average pinch was 90% of contralateral side. DASH score ↓ from severe to minimum difficulty with ADL 57% of pts had no change	More than 80% of pts with stage 1 OA had pain relief for 18 mo vs. 25% of pts with stage 4
Buurke et al.[33] 2b study	Ten pts with OA of CMC joint confirmed by X-ray Prospective comparative pre-experimental study with randomized cross-over design Inclusion criteria cited No exclusion criteria cited	10	1. Yes 2. No	Study was to assess level of satisfaction between three types of orthoses made of either supple elastic material, elastic with semi-rigid thumb, or semi-rigid material Methods: subjects wore each of the three splints for 4-wk period with no wash-out period	Pain: VAS HF: Green test Pinch: in kilograms Cosmesis: VAS Comfort and function: VAS	Subjects wore the splints for 4 wk each. Splints were presented in random order	Supple elastic orthoses was preferred by subjects for comfort and function Semi-rigid orthoses was preferred for cosmesis No difference between orthotics for pain reduction	8 of 10 pts preferred the permanent use of the orthotic. Six pts chose the supple and two pts chose the semi-rigid orthotic
Swigart et al.[32] 3 study	Pts with CMC OA seen for surgical consultation 43% of pts had stage 1 or 2 disease (group A) 57% of pts had stage 3 or 4 disease (group B) Retrospective	74	1. No 2. No	Study was to determine the efficacy of splinting the CMC joint Methods: Pts wore splints for 8-wk period and then returned a postal questionnaire 6 mo later	Pts filled out a self-report questionnaire rating their percentage of perceived improvement since wearing the splint	Pts received an LO splint that they wore continuously for 3–4 wk and then gradually decreased wearing during a subsequent 3–4 period, in which they wore it during heaviest activities and night	76% of pts with stage 1 and 2 OA experienced ↓ pain and average reported improvement was 60% 54% of pts with stage 3 or 4 OA experienced ↓ pain and average reported improvement was 54%	Splinting is a well-tolerated and effective intervention to ↓ pain

(*continued on next page*)

TABLE 3. (**Continued**)

Study and Evidence Level	*Subjects*	*No of Subjects*	*Randomized/ Blinded? Y/N*	*Intervention*	*Measure*	*Protocol*	*Results*	*Conclusions*
Heat								
Michlovitz et al.[23] 2b study	Healthy subjects with wrist pain because of sprain tendinosis, OA, or CTS Prospective Inclusion and exclusion criterion cited	94 OA 13 CTS 24 Sprain/strain 57	1. Yes 2. Yes	Study was to evaluate the therapeutic benefit of continuous low-level heat wrap therapy in treatment of wrist pain Methods: Experimental: 104 degree heat wrap worn for eight hours for three days in a row Control: oral placebo 2 pills 4× daily or acetaminophen two pills four times daily or unheated wrist wrap	Pain: 0–5 verbal rating scale ADL: PRWE Grip: in kilograms Stiffness: 101 pt rating scale	Heat wrap worn for eight continuous hours applied to wrist for three consecutive days	* Pain: wrist wrap group ↓46% * Grip: wrist wrap group ↑ 2.48 kg on day 3 Joint stiffness and PWHE scores similar between all groups	Low-level continuous Heat wrap therapy ↓s pain and ↑s grip strength
Stange-Rezende et al.[38] 2b study	Pts of Rhuematology Outpatient clinic of Vienna General Hospital who met ACR classification criteria for OA Prospective Inclusion and exclusion criterion cited	45	1. Yes 2. Yes	Study examined the effect of infrared radiation of a tiled stove on patients with hand OA Methods: Group A spent time in heated tiled stove room for 3 wk and then received no treatment for 3 wk. Group B was first assigned to control period and then to the stove room for the next 3 wk	Pain: VAS for general pain and hand pain HF: AUSCAN Global function: Short Form Health Status Survey (SF-36) Dexterity: Moberg pick-up test	Group A spent three hours, 3 times per week in a heated tiled stove room. Group B received no treatment for 3 wk. Following the initial 3-wk period, the groups switched interventions	Pain: 14% or 31% pts general pain ↓ following heat * HF: pain domain score improved VAS score for hand pain and SF-36 bodily pain showed moderate improvement Control group: 10 or 22% pts pain ↓	Study did not prove positive effects of tiled stove exposure

Graber-Duvernay et al.[31] 2b study	Pts with a minimum Dreiser functional index score of 5 or ACR criteria, and neither local tx or antiosteorthritic tx during previous 3 mo Prospective Inclusion and exclusion criterion cited	116	1. Yes 2. Yes	Study examined the effect of steam heat treatments to the hands of pts with OA Methods: Experimental group received steam treatments to their hands. Control group applied topical ibuprofen medication to hands 3× daily to affected joints	HF: Dreiser functional Index (lower score means increased function) Grip: in millimeters of mercury Joint circumference: ring sizer Topographic scoring (subjective appearance scoring system designed by examiner):	Steam treatment to the hands through openings in the Berthollet box daily for 15 min for 3 wk	At 6 mo experimental group Pain ↓14 patients vs. 8 for control group. HF: ↓1.14 vs. 0.24 grip ↑19 vs. 6.8 mm mercury Topographic scoring: 3.29 vs. 1.78 At 6 mo, no difference in joint circumference	Berthollet steam treatment superior to topical application of ibuprofen for ↑'ed grip, HF, and ↓ pain
LLLT								
Brosseau et al. 2005 2b study[18]	Subjects met ACR classification of OA of the hand, had experienced pain for at least 3 mo, be between 45 and 80 years, have at least a level 4/10 on VAS, X-ray evidence of OA, ambulatory, be available for tx schedule, and be able to understand English or French Prospective Inclusion and exclusion criterion cited	88	1. Yes 2. Yes	Study was to evaluate if LLLT provides symptomatic relief from OA pain Methods: Experimental group received LLLT treatments for 3 wk vs Sham treatment for control group	Pain: VAS Stiffness: duration of morning stiffness ROM: goniometer Grip and pinch: millimeters of mercury AUSCAN 3 components:(pain, stiffness severity, and ADL difficulty) Pt global assessment	Pts received three LLLT 3× per week for 6 wk to finger joints and three superficial nerves	LLLT group Finger ROM: * ↑opposition * Grip ↑22 mm of mercury Pain relief, morning stiffness and HF demonstrated no difference between groups and did not meet MCID established at 0.80 effect size	LLLT no better than placebo for ↓ pain & stiffness & ↑ HF

Pts = patients; OA = osteoarthritis; CMC = carpometacarpal; SO = short opponens; VAS = visual analog scale; HF = hand function; MCID = minimal clinically important difference; HEP = home exercise program; ROM = range of motion; DPC = distal palmar crease; DIP = distal interphalangeal joint; PIP = proximal phalangeal joint; JPE = joint protection education; tx = treatment; RA = rheumatoid arthritis; ACR = American College of Rheumatology; IP = interphalangeal joint; dx = diagnosis; ADL = activities of daily living; OTs = occupational therapists; kg = kilogram; lb = pound; cm = centimeter; LO = long opponens; wk = week; LLLT = low-level laser therapy; AUSCAN = Australian/Canadian Hand Osteoarthritis Index; AIMS2 = Arthritis Impact Measurement Scale; MD = physician; DASH = Disability of the Arm, Shoulder, Hand; hx = history; COMP = Canadian Occupational Performance Measure; CMT = Custom made thumb splint; PFN = Prefabricated neoprene splint; LO = Long orthoses; CTS = Carpal tunnel syndrome; PRWE = Patient Rated Wrist Evaluation; SF-36=Short Form 36.
*Indicates results statistically significant ↑: Increase ↓: Decrease.

modality for hand OA. Paraffin was an intervention that was included in a multimodal study. The Boustedt et al.[16] study provides some weak support for the use of paraffin because it was not the sole intervention studied against a control group. It was one of the three interventions (paraffin, exercises, JPE) that the subjects received. The interventions of low-level continuous heat wrap and steam treatments were studied against a control group. There is weak to moderate level evidence that support the use of heat modalities to improve grip strength and decrease pain for patients with hand OA. No controlled trials or experimental studies were found that examined the role of cold application for hand OA.

Laser

One 2b study with 88 subjects examined the intervention of low level laser therapy (LLLT) on subjects with hand OA. The SEQES score of the Brosseau et al.[18] study was 47/48. The subjects had improvement in grip and thumb opposition ROM; however, they concluded that LLLT was no better than the placebo for decreasing hand pain or stiffness or improving hand function.

Joint Protection and Adaptive Device Provision

Three 2b studies and two level 3 studies using a total of 217 subjects (this total includes the 27 subjects with OA from the Veitiene and Tamulaitiene[22] study) examined the role of joint protection and provision of adaptive devices in the treatment of patients with hand OA. Quality of scores of these studies ranged from 21 to 39. The studies for the intervention of JPE and adaptive device provision were of fair to moderate quality and provide moderate support for the intervention of JPE.

Orthotics

One 1b study, seven 2b studies, and three level 3 studies with a total of 416 subjects (this total includes the six subjects with the diagnosis of wrist OA from the Thiele et al.[21] study and 27 subjects with OA from the Veitiene and Tamulaitiene[22] study) examined the role of orthotics to immobilize the thumb CMC joint in patients with hand OA. The SEQES scores of these studies ranged from 16 to 44. The studies demonstrated that wearing a splint to immobilize the CMC joint of the thumb can improve hand function and decrease pain. Some studies established that subjects who received the CMC orthotic could postpone or avoid CMC surgery. Many of the subjects preferred the short flexible orthotic over the longer version. There is high to moderate evidence to support the intervention of orthotics.

DISCUSSION

Summary of Evidence

1. There is moderate evidence supporting hand exercises for increased grip strength.
2. There is moderate evidence to support hand exercises for improved function.
3. There is moderate evidence to support hand exercises for improved ROM.
4. There is moderate evidence to support hand exercises for pain reduction.
5. There is moderate evidence to support JPE and provision of adaptive equipment for increased hand function.
6. There is moderate evidence to support JPE and provision of adaptive equipment for pain reduction.
7. There is weak evidence to support the use of paraffin for pain reduction, ROM, or improved function.
8. There is moderate evidence to support the use of low-level continuous heat wrap or steam treatments for pain reduction and increased grip strength.
9. There is high to moderate evidence to support the use of CMC orthotics to decrease hand pain and improve hand function.
10. There is moderate evidence to support the use of CMC orthotics to increase grip strength
11. There is moderate evidence that demonstrates that LLLT is no better than the placebo in improving subjects hand function or decreasing hand pain or stiffness.

This systematic review examined the evidence for efficacy of common clinical rehabilitation interventions for the treatment of OA of the hand by examining both RCTs and level 3 studies. Because the studies that were reviewed were mixed and vary in quality scores, the conclusions are less valid. The evidence of the effectiveness of the interventions is limited by a small number of moderate quality studies. We are in agreement with Towheed[3] that there are a limited number of published RCTs evaluating the interventions available for hand OA. Many of the RCTs have weak methodology. The predominant issues relate to deficiencies with allocation concealment, inadequate description of randomization and blinding methods, failure to use intention-to-treat analysis, inappropriate statistical analysis, and failure to provide sample size calculations. The trend in this systematic review reveals that the more recently published 1b and 2b studies have higher methodological scores. Therefore, newly published studies that are more methodologically sound should provide stronger evidence for hand therapy interventions when their subjects achieve positive clinically important differences.

Clinical Implications

MacDermid et al.[24] reported that pain reduction is the primary goal when treating hand OA because it is the impairment that is most associated with decreased hand function in this population. Barthel et al.[25] performed a level 2b study with 783 subjects to examine the relationship of pain relief with measures of function in OA patients. The authors found that pain relief is correlated with improvements in physical function, stiffness, and global rating of disease in patients with hand OA. The authors suggest that pain or the anticipation of pain inhibits physical function and that any intervention that relieves the pain of hand OA may improve hand function and patient perception of disease severity. Bijsterbosch et al.[26] performed a 2b study to determine the impact of CMC pain and IP joint OA on pain and disability. The authors concluded that CMC joint OA should be emphasized in treatment interventions because it contributes more to pain and disability than IP joint OA. The Rannou et al.[17] 1b study design provides strong epidemiologic evidence supporting the use of orthotics for pain reduction. The other studies that provide moderate to fair evidence for pain reduction include Wajon and Ada,[27] Rogers and Wilder,[28] Garfinkel et al.,[20] Boustedt et al.,[16] Thiele et al.,[21] Weiss et al.,[29] Day et al.,[30] and Micholvitz et al.[23]

The clinician can use the interventions described in the studies to meet patient specific goals. If the goal is to reduce pain, the clinician should consider the use of orthotics, exercise, JPE, and heat modalities. Because there is some evidence that support the use of paraffin and heat wrap, their use could be more efficacious than the use of ultrasound when providing heat. To improve activities of daily living function, the clinician should consider the use of orthotics, exercise, JPE, and the provision of adaptive equipment. Orthotics should be provided to stabilize the CMC joint of the thumb. To gain increased grip strength, the clinician should consider the use of exercise, provide JPE, and orthotics. Specific hand exercises can include the following: paraffin dough squeezing, rice grabs, active ROM exercises, and foam block squeezing; all performed at a low pain level. The efficacy of the use of LLLT has not been established for hand OA.

CONCLUSION

This systematic review synthesizes the evidence of common hand therapy interventions for hand OA. Unfortunately, there is a greater abundance of studies that support conservative therapy interventions for OA of the hip and knee than for hand OA. The shortage of studies for many of the interventions that are currently used in clinical practice makes it difficult to make strong conclusions supporting the efficacy of the interventions. The lack of current evidence weakens the strength of the conclusions that can be drawn for the use of the interventions, but there is support for many interventions that are currently used in clinical practice. This review can be used as a tool by the clinician when making decisions regarding intervention choices and the specifics regarding the application of the interventions to provide effective treatments for hand patients to control their pain, prevent joint deformity, and increase their hand function. Future research investigating specific frequency and durations of common hand therapy interventions that provide pain relief and increase hand function is needed to strengthen epidemiologic evidence. In regard to thermotherapy, future research should address the specific intensity of the intervention, the length of the exposure to the intervention, and comparison studies to determine the most effective method of heat. In the meantime, orthotic provision, light hand strengthening exercises, JPE, paraffin baths, heat wrap, and the provision of adaptive equipment are low-risk interventions that may have a positive impact on decreasing hand pain and increasing hand strength and function for patients with the diagnoses of hand OA.

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#1. The design of the study is
   a. random clinical trials (RTC)
   b. prospective
   c. a case series
   d. a systematic review

#2. The study demonstrated that
   a. home exercise is the least effective
   b. protective splinting is the most effective
   c. a variety of interventions provide a variety of beneficial effects
   d. paraffin baths are the most effective

#3. Regarding cryotherapy, this study reported that
   a. there were no studies that examined cryotherapy's effect with OA
   b. most studies demonstrated the ineffectiveness of cryotherapy
   c. most studies provided support for cryotherapy
   d. all studies equated cryotherapy's effectiveness to that of paraffin

#4. The outcome measures that most studies reported were
   a. pain and AROM
   b. pain and function
   c. AROM and function
   d. grip strength and ADL

#5. The evidence presented
   a. is definitive for clinically managing hand OA
   b. while helpful, is far from definitive for clinically managing hand OA

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