Abstract. [Purpose] To describe the effect of a physical therapy program in function improvement and pain reduction in patients older than 60 years with complex regional pain syndrome (CRPS) type I after distal radius fracture (DRF) treated conservatively. [Participants and Methods] Fifty-four patients received a 6 weeks physical therapy program that included in hydrotherapy, manual therapy, and exercises based on motor skill training. Two evaluations were performed, the wrist/hand function was assessed with Patient-Rated Wrist Evaluation (PRWE) questionnaire, the upper extremity function with the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, grip strength with Jamar Dynamometer, and pain intensity with the Visual Analog Scale (VAS). [Results] At the end of the treatment, PRWE showed a decrease of 30.9 points, DASH 34.7 points, and the VAS, 3.4 cm. The grip strength showed an increase of 14.4%. [Conclusion] A physical therapy program based on hydrotherapy, manual therapy, and exercises in a short term improves the function and reduces the pain in patients older than 60 years with CRPS I after DRF treated conservatively.

Key words: Complex regional pain syndrome, Distal radius fracture, Physical therapy

INTRODUCTION

Distal radius fractures (DRF) are among the most common musculoskeletal injuries, representing 15% to 20% of total fractures treated in emergency services1,2. Epidemiologic studies have reported a high incidence in white populations, especially among elderly patients3. DRF in patients older than 60 years is typically treated conservatively with closed reduction and plaster cast immobilization4. The reported complication rates of DRF in the literature are highly variable, and these complications may occur from the fracture or its treatment5. The loss of motion (marked deformity, decreased range of motion, finger stiffness), delayed/nonunion consolidation, and Complex regional pain syndrome (CRPS) present the highest levels of incidence6.

CRPS is a term coined by the International Association for the Study of Pain (IASP) to describe disorders characterized by spontaneous or stimulus-induced pain that is disproportionate to the inciting event and accompanied by a wide variety of autonomic and motor disturbances in highly variable combinations7. This condition usually, but not exclusively, manifests in response to acute trauma or surgery8. The IASP proposed a taxonomy and consensus-based diagnostic criteria, the umbrella term CRPS has been subdivided into type I and type II. CRPS I is intended to encompass reflex sympathetic dystrophy.
and similar disorders without a nerve injury; while CRPS II occurs after damage to a peripheral nerve8, 10). The diagnostic criteria originally proposed by IASP have not been widely accepted, and were shown to lack specificity and internal validity11, 12). The Budapest criteria13), have enhanced diagnostic accuracy and are now widely accepted19). The pathophysiological mechanisms underlying CRPS are not fully understood14). Current understanding implicates multiple mechanisms including complex contributions from a maladaptive pro-inflammatory response and a disturbance in sympathetically mediated vaso-motor control, together with maladaptive peripheral and central neuronal plasticity14–17).

Guidelines for the treatment of CRPS I recommend an interdisciplin ary multimodal approach, comprising pharmacological and interventional pain management strategies together with Physical Therapy (PT), psychological therapy and educational strategies8, 18–20). PT programs (therapeutic exercises, manual therapy, or physical agents) are considered the first-line treatment for CRPS I1, 21, 22), however its effectiveness remains unclear. One review suggests that some PT interventions may assist in the management of patients with CRPS type I, however, since numerous methodological weaknesses it was not possible to determine the effectiveness of PT23). One systematic review showed level II of evidence that graded motor imagery is effective in reducing pain in adults with CRPS I, and no evidence was found to support PT interventions frequently recommended in clinical guidelines24). Other systematic review showed that graded motor imagery and mirror therapy may provide clinically meaningful improvements in pain and function in people with CRPS I although the quality of the supporting evidence is very low. The effectiveness of other PT interventions is absent or unclear25).

The objective of the study is to describe in the short term the effect of a PT program in function improvement and pain reduction in patients older than 60 years with CRPS type I after DRF treated conservatively.

PARTICIPANTS AND METHODS

The study was conducted in the physical therapy department at the Clinical Hospital San Borja Arriarán, with the approval of the Ethics Committee of the Central Metropolitan Health Service of Chile. The Ethics Committee of the Central Metropolitan Health Service of Chile approved the study protocol on 14 February 2017. The approval number is 048975. Between 2017 and 2018, fifty-four prospective patients over 60 years old with CRPS type I after DRF were recruited. The diagnosis was performed by a physician based on the Budapest criteria13). Patients with psychiatric treatment history before diagnosis with CRPS, with peripheral or central nervous system lesions affecting the upper limb, and with cardiac, pulmonary or neurological diseases, were excluded.

Under prior informed consent, two evaluations were performed, one at the beginning of the treatment and the other on week 6, at the end of the PT program. In these assessments, the wrist/hand function was evaluated with the Patient-Rated Wrist Evaluation (PRWE) questionnaire26), the upper extremity function with the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire27), grip strength with Jamar Dynamometer28), and pain intensity with the Visual Analog Scale (VAS)29).

All patients received a PT program consisted of 15 minutes of active wrist and hand exercises in a whirlpool at a temperature of 34°C30). Then, joint mobilization was applied to the radiocarpal joint. During the first 2 weeks, participants received grade II or III of Maitland techniques, at a dose of 1 cycle per second for 1 minute. In the remaining 4 weeks, sustained grade I gliding Kaltenborn method was performed in both anteroposterior and posteroanterior directions, in a neutral position with the distal radius stabilized. Treatment then progressed to incorporate the end of range movement with the mobilization grade II technique31, 32). The applied dose was left to the discretion of the physical therapist but based on examined findings and the patient’s tolerance. Finally, exercises based on motor skill training were prescribed to reorganize cortical plasticity and achieve motor learning33–35). Three specific exercises were performed: (1) controlled grip strength exercise with visual pressure biofeedback; (2) a reverse dart-throwing exercise with precision of the first intersosseous space; and (3) a scapular retraction exercise. To avoid pain and muscle fatigue, patients were doing short duration and low-intensity exercises. The dose was 8–10 times for each exercise, maintaining the task for 5 seconds with 10–30 seconds of rest in between. The program consisted of 12 sessions, 2 times a week, and approximately 1-hour-long session36).

All collected data were entered into the Excel for tabulation, and the statistical analysis was performed with the Stata 11.0 program. The quantitative variables are presented as a mean and standard deviation (SD). To determine the statistical tests to be used to analyze the data, normal distribution was first evaluated with the Shapiro-Wilk test. To perform the comparison of the data pre and post treatment for the PRWE, DASH, grip strength, and VAS variables, the t-test or the Mann-Whitney test was used. A value of p<0.05 was accepted as statistically significant.

RESULTS

The results of the basal characteristics of the group studied are presented in Table 1. During the study there were no losses or withdrawals, and at the end of the PT program no patient informed of complications associated to the treatment received.

At the moment of analyzing the normality hypothesis with the Shapiro-Wilk test, this was rejected for the grip strength and VAS variables (p<0.05). In accordance with this, the t-test was used to carry out the comparison of the PRWE and DASH variables, and the Mann-Whitney test was used for the grip strength and VAS variable. Table 2 shows the values of the evaluated variables pre and post PT treatment, and the effect of the treatment. For the functional variables, the PRWE showed...
The current evidence supports sensorimotor system alterations as the most clinically relevant impairment after DRF. All patients began with 15 minutes of active wrist and hand exercises in a whirlpool, we used thermoneutral water immersion (34 °C), which decreases the activity of the sympathetic nervous system, and when combined with the effects of hydrostatic pressure, helps reduce edema and pain perception. In addition, performing active movements in a pain-free range of motion, and in a comfortable environment for the patient, decreases associated reactive and/or evasive behavior as a means of self-protection, thereby reducing the apprehension of movement in the affected area. Then, joint mobilization was used taking as reference the study of Coyle et al., they showed that in the first 2 weeks of treatment, when pain levels are high, the oscillatory techniques are better tolerated and more effective in pain relief and increase wrist function. From week number 3, when pain levels are lower, mainly at rest, the sustained gliding techniques are more effective.

The current evidence supports sensorimotor system alterations as the most clinically relevant impairment after DRF. These deficits have been suggested to result from cortical reorganization, which would be influentially associated with persistent and recurrent pain, and have been significantly correlated with poor results in reported functionality and disability. The gradual reintroduction of functional activity using therapeutic exercise with a focus on graduated corticmotor

**Table 1.** Baseline characteristics of patients with CRPS I after DRF treated conservatively

| Variables                          | Patients with CRPS I (n=54) |
|------------------------------------|-----------------------------|
| Gender female, number (%)         | 46 (85.2)                   |
| Age (years), mean ± SD             | 65.3 ± 3.9                  |
| Symptoms duration (weeks), mean ± SD | 5.5 ± 1.2                  |
| Dominant hand affected, number (%) | 40 (74.1)                   |

CRPS: Complex Regional Pain Syndrome; DRF: Distal Radius Fracture; SD: Standard Deviation.

**Table 2.** Comparison of the results between baseline and the 6th week

| Variables                       | Baseline (mean ± SD) | At 6th week (mean ± SD) | Difference (mean ± SD) | CI 95% difference | p value |
|---------------------------------|----------------------|-------------------------|------------------------|-------------------|---------|
| PRWE (0–100 points)             | 68.7 ± 10.5          | 35.6 ± 15.8             | 30.9 ± 13.7            | 40.6–20.2         | 0.00 †  |
| DASH (0–100 points)             | 70.8 ± 6.5           | 35.3 ± 13.4             | 34.7 ± 13.4            | 43.1–24.4         | 0.00 †  |
| Grip strength (*) (0–100 %)     | 18.8 ± 13.5          | 32.2 ± 23.5             | 14.4 ± 12.1            | 22.3–1.5          | 0.18 ‡  |
| VAS (0–10 cm)                   | 7.6 ± 0.97           | 3.8 ± 1.5               | 3.4 ± 1.1              | 4.4–2.8           | 0.00 †  |

SD: Standard Deviation; CI 95%: Confidence Intervals 95%; PRWE: Patient-Rated Wrist Evaluation questionnaire; DASH: Disabilities of the Arm, Shoulder and Hand questionnaire; (*): The result was expressed as a percentage relative to the unaffected side; VAS: Visual Analog Scale.

† p value: obtained with Student’s t-test for dependent samples.
‡ p value: obtained with the Mann-Whitney test for dependent samples.

The gradual reintroduction of functional activity using therapeutic exercise with a focus on graduated corticmotor

**DISCUSSION**

This study was aimed to describe the effect of PT program in function improvement and pain reduction in patients older than 60 years with CRPS I after DRF. Our results showed that in the short term a PT program that included hydrotherapy, manual therapy, and exercises based on motor skill training improved significantly the wrist/hand and upper extremity function, and pain relief, but not a significant increase in grip strength.

Epidemiological studies have reported that 37 to 58% of persons undergoing closed treatment and cast immobilization following DRF go on to develop CRPS type I. The demographic data of the patients included in our study are similar to those described in the literature. The women are 5.8 times more likely than men to develop CRPS after DRF, and the persons who sustain low to medium energy impact DRF are 7.7× more likely to develop CRPS than those who sustain high impact fractures. In relation to the duration of symptoms, in a prospective study CRPS type I arose most frequently at the third or fourth week after the cast removal, especially in women with severe pain and impairment of physical QOL.

The risk factors of CRPS I are multifactorial, a recent systematic review on potential risk factors for the onset of CRPS I showed that being female (particularly postmenopausal), ankle intra-articular fractures, distal radius fractures, immobilization, and intense pain in the early phases after trauma are risk factors for the onset.

Since the pathophysiological mechanisms of CRPS are essentially unknown and the mechanisms are likely to differ between individual patients, treatment of these disorders is based on trial and error. In our study, we applied a standardized PT program used in patients older than 60 years with DRF extraarticular without immediate complications. All patients began with 15 minutes of active wrist and hand exercises in a whirlpool, we used thermoneutral water immersion (34 °C), which decreases the activity of the sympathetic nervous system, and when combined with the effects of hydrostatic pressure, helps reduce edema and pain perception. In addition, performing active movements in a pain-free range of motion, and in a comfortable environment for the patient, decreases associated reactive and/or evasive behavior as a means of self-protection, thereby reducing the apprehension of movement in the affected area. Then, joint mobilization was used taking as reference the study of Coyle et al., they showed that in the first 2 weeks of treatment, when pain levels are high, the oscillatory techniques are better tolerated and more effective in pain relief and increase wrist function. From week number 3, when pain levels are lower, mainly at rest, the sustained gliding techniques are more effective.

The current evidence supports sensorimotor system alterations as the most clinically relevant impairment after DRF. These deficits have been suggested to result from cortical reorganization, which would be influentially associated with persistent and recurrent pain, and have been significantly correlated with poor results in reported functionality and disability. The gradual reintroduction of functional activity using therapeutic exercise with a focus on graduated corticmotor
retraining is founded on the neurophysiology of motor learning\(^3\). The conscious and voluntary learning of specific motor skills, such as control of scapular retraction, gradual wrist prehensile activity, and subtle manual skills require precision, decreasing the fear of the perceived threat of pain, reducing local rigidity, and modifying the cortical representation of the musculature affected by trauma\(^13, 35, 42\). This standardized PT program at short- and medium term reduced pain and improved function in patients with DRF extraarticular without complications\(^46\).

There are few studies regarding the effect of PT program in patients with CRPS I after DRF. One randomized clinical trial (RCT) showed that pulsed electromagnetic field treatment does not provide additional benefit to calcitonin and exercise in forty patients with CRPS I after Colles Fracture\(^44\). Other RCT showed that a six weeks program of graded motor imagery is more effective than usual physiotherapy plus medical management in reducing pain in patients with CRPS after wrist fracture\(^45\). The last RCT showed that the order in which the components of graded motor imagery are presented affect the magnitude of pain reduction, with laterality recognition followed by imagined movements and mirror movements producing the greatest pain reduction in patients with CRPS after wrist fracture\(^46\).

Regarding our results, the PRWE questionnaire showed a statistically significant decrease, and the difference of 30.9 points is considered a minimal clinically important difference\(^47\). The DASH questionnaire showed a statistically significant decrease, and the difference of 34.7 points also is the minimum clinically important difference\(^48\). For the intensity of pain the VAS showed a clinically and statistically significant decrease. The grip strength is the only variable that did not show statistically significant changes at the end of the PT program, despite the increase of 14.4%, these results suggest that while hand strength can improve in patients with CRPS I after DRF, many of these patients do not achieve normal strength at the end of a 6-week intervention.

This study has several limitations. Since it is a descriptive study it does not have a control group, neither was a randomized sample strategy used to select the patients. And also a follow-up was not considered to evaluate the results in the long term. In summary, a PT program based on hydrotherapy, manual therapy, and exercises based on motor skill training in a short term improves the function and reduces the pain in patients older than 60 years with CRPS I after DRF treated conservatively.

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**Conflict of interest**

The authors declare to have no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

**REFERENCES**

1) Bengtner U, Johnell O: Increasing incidence of forearm fractures. A comparison of epidemiologic patterns 25 years apart. Acta Orthop Scand, 1985, 56: 158–160. [Medline] [CrossRef]
2) Sahlin Y: Occurrence of fractures in a defined population: a 1-year study. Injury, 1990, 21: 158–160. [Medline] [CrossRef]
3) MacIntyre NJ, Dewan N: Epidemiology of distal radius fractures and factors predicting risk and prognosis. J Hand Ther, 2016, 29: 136–145. [Medline] [CrossRef]
4) Chung KC, Shauver MJ, Birkmeyer JD: Trends in the United States in the treatment of distal radial fractures in the elderly. J Bone Joint Surg Am, 2009, 91: 1868–1873. [Medline] [CrossRef]
5) Turner RG, Faber KJ, Athwal GS: Complications of distal radius fractures. Hand Clin, 2010, 26: 85–96. [Medline] [CrossRef]
6) McKay SD, MacDermid JC, Roth JJ, et al.: Assessment of complications of distal radius fractures and development of a complication checklist. J Hand Surg Am, 2001, 26: 916–922. [Medline] [CrossRef]
7) Borchers AT, Gershwin ME: Complex regional pain syndrome: a comprehensive and critical review. Autoimmun Rev, 2014, 13: 242–265. [Medline] [CrossRef]
8) Goebel A: Complex regional pain syndrome in adults. Rheumatology (Oxford), 2011, 50: 1739–1750. [Medline] [CrossRef]
9) Merskey H, Bogduk N: Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms. 2nd ed. Seattle: IASP Press, 1994.
10) Todorova J, Dantchev N, Petrova G: Complex regional pain syndrome acceptance and the alternative denominations in the medical literature. Med Princ Pract, 2013, 22: 295–300. [Medline] [CrossRef]
11) Bruehl S, Harden RN, Galer BS, et al. International Association for the Study of Pain: External validation of IASP diagnostic criteria for Complex Regional Pain Syndrome and proposed research diagnostic criteria. Pain, 1999, 81: 147–154. [Medline] [CrossRef]
12) Harden RN, Bruehl S, Galer BS, et al.: Complex regional pain syndrome: are the IASP diagnostic criteria valid and sufficiently comprehensive? Pain, 1999, 83: 211–219. [Medline] [CrossRef]
13) Harden RN, Bruehl S, Perez RS, et al.: Validation of proposed diagnostic criteria (the “Budapest Criteria”) for complex regional pain syndrome. Pain, 2010, 150: 268–274. [Medline] [CrossRef]
14) Bruehl S: An update on the pathophysiology of complex regional pain syndrome. Anesthesiology, 2010, 113: 713–725. [Medline]
15) Bruehl S: Complex regional pain syndrome. BMJ, 2015, 351: h2730. [Medline] [CrossRef]
16) Marinus J, Moseley GL, Birkinfe F, et al.: Clinical features and pathophysiology of complex regional pain syndrome. Lancet Neurol, 2011, 10: 637–648. [Medline] [CrossRef]
17) Parkinpy L, McAuley JH, Di Pietro F, et al.: Inflammation in complex regional pain syndrome: a systematic review and meta-analysis. Neurology, 2013, 80: 106–117. [Medline] [CrossRef]
18) Stanton-Hicks MD, Burton AW, Bruehl SP, et al.: An updated interdisciplinary clinical pathway for CRPS: report of an expert panel. Pain Pract, 2002, 2: 1–16. [Medline] [CrossRef]
19) Perez RS, Zollinger PE, Dijkstra PE, et al.: CRPS I task force: Evidence based guidelines for complex regional pain syndrome type I. BMC Neurol, 2010, 10: 20. [Medline] [CrossRef]
20) Harden RN, Oaklander AL, Burton AW, et al. Reflex Sympathetic Dystrophy Syndrome Association: Complex regional pain syndrome: practical diagnostic and treatment guidelines, 4th edition. Pain Med, 2013, 14: 180–229. [Medline] [CrossRef]
21) Rho RH, Brewer RP, Lamer TJ, et al.: Complex regional pain syndrome. Mayo Clin Proc, 2002, 77: 174–180. [Medline] [CrossRef]
22) Bussa M, Mascaro A, Caffaro L, et al.: Adult complex regional pain syndrome type I: a narrative review. PM R, 2017, 9: 707–719. [Medline] [CrossRef]
23) Smith TO: How effective is physiotherapy in the treatment of complex regional pain syndrome type I? A review of the literature. Musculoskelet Care, 2005, 3: 181–200. [Medline] [CrossRef]
24) Daly AE, Bialocerkowski AE: Does evidence support physiotherapy management of adult Complex Regional Pain Syndrome Type One? A systematic review. Eur J Pain, 2009, 13: 339–353. [Medline] [CrossRef]
25) Smart KM, Wand BM, O’Connell NE: Physiotherapy for pain and disability in adults with complex regional pain syndrome (CRPS) types I and II. Cochrane Database Syst Rev, 2016, 2: CD010853. [Medline] [CrossRef]
26) MacDermid JC: Development of a scale for patient rating of wrist pain and disability. J Hand Ther, 1996, 9: 178–183. [Medline] [CrossRef]
27) Hudak PL, Amadio PC, Bombardier C: The Upper Extremity Collaborative Group (UECG): Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. Am J Ind Med, 1996, 29: 602–608. [Medline] [CrossRef]
28) Richards L, Palmer-Thompson P: Grip strength measurement: a critical review of tools, methods, and clinical utility. Crit Rev Phys Rehabil Med, 1996, 8: 87–109. [CrossRef]
29) McCormack HM, Horne DJ, Sheather S: Clinical applications of visual analogue scales: a critical review. Psychol Med, 1988, 18: 1007–1019. [Medline] [CrossRef]
30) Barker AL, Talevski J, Morello RT, et al.: Effectiveness of aquatic exercise for musculoskeletal conditions: a meta-analysis. Arch Phys Med Rehabil, 2014, 95: 1776–1786. [Medline] [CrossRef]
31) Coyle JA, Robertson VJ: Comparison of two passive mobilizing techniques following Colles’ fracture: a multi-element design. Man Ther, 1998, 3: 34–41. [Medline] [CrossRef]
32) Boudreau SA, Farina D, Falla D: The role of motor learning and neuroplasticity in designing rehabilitation approaches for musculoskeletal pain disorders. Man Ther, 2010, 15: 410–414. [Medline] [CrossRef]
33) Snodgrass SJ, Heneghan NR, Tsao H, et al.: Recognising neuroplasticity in musculoskeletal rehabilitation: a basis for greater collaboration between musculoskeletal and neurological physiotherapists. Man Ther, 2014, 19: 614–617. [Medline] [CrossRef]
34) Muratori LM, Lamberg EM, Quinn L, et al.: Applying principles of motor learning and control to upper extremity rehabilitation. J Hand Ther, 2013, 26: 94–102, quiz 103. [Medline] [CrossRef]
35) Gutiérrez-Espinoza H, Rubio-Oyarzún D, Olguin-Huerta C, et al.: Supervised physical therapy vs home exercise program for patients with distal radius fracture: a single-blind randomized clinical study. J Hand Ther, 2017, 30: 242–252. [Medline] [CrossRef]
36) Atkins RM, Duckworth T, Kanis JA: Features of algodystrophy after Colles’ fracture. J Bone Joint Surg Br, 1990, 72: 105–110. [Medline] [CrossRef]
37) Demir SE, Ozarar N, Karamehmetoglu SS, et al.: Risk factors for complex regional pain syndrome in patients with traumatic extremity injury. Ulus Travma Acil Cerrahi Derg, 2010, 16: 144–148. [Medline] [CrossRef]
38) Jellad A, Salah S, Ben Salah Frih Z: Complex regional pain syndrome type I: incidence and risk factors in patients with fracture of the distal radius. Arch Phys Med Rehabil, 2004, 95: 487–492. [Medline] [CrossRef]
39) Pons T, Shipston EA, Willman J, et al.: Potential risk factors for the onset of complex regional pain syndrome type 1: a systematic literature review. Anesthesiol Res Pract, 2015, 2015: 956539. [Medline] [CrossRef]
40) Vaides K, Naughton N, Algar L: Sensorimotor interventions and assessment for the hand and wrist: a scoping review. J Hand Ther, 2014, 27: 277–285. [CrossRef]
41) Moseley GL, Flor H: Targeting cortical representations in the treatment of chronic pain: a review. Neuororehabil Neural Repair, 2012, 26: 646–652. [Medline] [CrossRef]
42) MacDermid JC, Donner A, Richards RS, et al.: Patient versus injury factors as predictors of pain and disability six months after a distal radius fracture. J Clin Epidemiol, 2002, 55: 849–854. [Medline] [CrossRef]
43) Durmus A, Cakmak A, Disci R, et al.: The efficiency of electromagnetic field treatment in complex regional pain syndrome type I. Disabil Rehabil, 2004, 26: 537–545. [Medline] [CrossRef]
44) Moseley GL: Graded motor imagery is effective for long-standing complex regional pain syndrome: a randomised controlled trial. Pain, 2004, 108: 192–198. [Medline] [CrossRef]
45) Moseley GL: Is successful rehabilitation of complex regional pain syndrome due to sustained attention to the affected limb? A randomised clinical trial. Pain, 2005, 114: 54–61. [Medline] [CrossRef]
46) Walenkamp MM, de Muinck Keizer RJ, Goslings JC, et al.: The minimum clinically importance difference of the patient-rated wrist evaluation scores for patients with distal radius fracture. Clin Orthop Relat Res, 2015, 473: 3235–3241. [Medline] [CrossRef]
47) Franchignoni F, Vercell S, Giordano A, et al.: Minimal clinically important difference of the disabilities of the arm, shoulder and hand outcome measure (DASH) and its shortened version (QuickDASH). J Orthop Sports Phys Ther, 2014, 44: 30–39. [Medline] [CrossRef]