

Effects of different rehabilitation approaches after surgery for flexor tendon injuries of the hand: A Cochrane review summary with commentary

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The aim of this commentary is to discuss in a rehabilitation perspective the Cochrane Review “Rehabilitation following surgery for flexor tendon injuries of the hand”^[1] by Peters, Jha, Ross published by Cochrane Bone, Joint and Muscle Trauma Group. This Cochrane Corner is produced in agreement with the *Turkish Journal of Physical Medicine and Rehabilitation* by Cochrane Rehabilitation with views* of the review summary authors in the “implications for practice” section.

Flexor tendon injuries of the hand are commonly seen and may result in sequelae; thus, rehabilitation is crucial after surgical repair of flexor tendon injuries to prevent long-term loss of functions, enhance tendon gliding and minimize adhesions.^[2-4] Although many different rehabilitation approaches have been developed over time, as the physiology of tendon healing has been better understood over the years, protocols that provide early active mobilization have become more of an interest.^[5] While applying stress in the early postoperative period to promote tendon gliding is a critical part of rehabilitation, rehabilitation should still be maintained in a balanced way by early mobilization to gain range of motion (ROM) without loading too much stress on the surgical repair.^[3] Although

it is suggested that tendon ruptures are not a major problem if up-to-date repair protocols are applied, in the light of the available evidence so far, there is no consensus on the optimal postoperative rehabilitation protocol.^[2,6] A Cochrane review evaluated the effects of different postoperative rehabilitation approaches for flexor tendon injuries of the hand.^[1]

Rehabilitation following surgery for flexor tendon injuries of the hand (Peters et al., 2021)^[1]

What is the aim of this Cochrane review?

The aim of this Cochrane review was to assess the benefits and harms of different postoperative rehabilitation approaches for flexor tendon injuries of the hand.

What was studied in the Cochrane review?

The population addressed in this review was individuals who underwent rehabilitation after repair or reconstruction of one or more flexor tendons of the hand injured in any flexor zone. Trials evaluating the efficacy of tendon transfers for neurological disorders were not included. The authors aimed to include all types of rehabilitation approaches (except for wound care, oral pharmacological interventions, and

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topical pain relief ointments) to compare the effects of different orthosis types, positions and wearing regimens; exercise regimens; timing of mobilization and strengthening; applications for scar management; and dose, frequency, or number of interventions. Interventions were compared to control or sham. In cases where this was not possible, such as exercise studies, the least aggressive protocol was chosen as the control group. Primary outcomes were functional evaluation with a patient-reported outcome measure, goniometric measurement of active finger ROM and all types of adverse events. Secondary outcomes were goniometric measurement of passive finger ROM, hand strength, achieving previous activity level, functional evaluation with an objective measure, quality of life evaluation with a patient-reported measure, and patients' satisfaction about surgery after three or more months. All outcomes were evaluated as short-term (three months or less), mid-term (over three months to six months), and long-term (more than six months).

Search methodology and up-to-dateness of the Cochrane review?

The review authors searched for studies that were published up to August 2020 in electronic databases including the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register, CENTRAL, MEDLINE, Embase, CINAHL Plus, AMED, WHO ICTRP and ClinicalTrials.gov.

What are the main results of the Cochrane review?

The review included a total of 17 studies consisting of 16 randomized-controlled trials and one quasi-randomized-controlled trial using a parallel-group design with two intervention arms. The included trials were from 13 countries (two studies from India, Iran, Sweden, and the USA and one from Brazil, Denmark, Egypt, France, Germany, Netherlands, Norway, Türkiye, and UK) and were mainly single-center studies conducted in a variety of different clinical settings. A total of 1,108 participants were included with participants ranging from 25 to 112 per trial. Most of the participants were male (74%), although not all studies reported sex distribution at baseline. The age distribution ranged from 7 to 72 years, based on data from the studies that reported age. All flexor tendon zones were included in the trials with the majority being flexor tendon Zone II injuries. In most of the studies, the participants had one or more than one digit injury, except for two studies which specifically excluded multiple digit injuries. Ten studies compared different exercise regimens including:

- Early active flexion plus controlled passive exercise regimen versus early controlled passive exercise regimen
- Early active flexion plus passive exercise regimen versus controlled passive exercise regimen
- Active flexion plus active extension exercise regimen versus passive flexion plus active extension exercise regimen
- Active flexion exercise regimen versus controlled passive exercise regimen
- Active exercise regimen versus immobilization regimen
- Early place and hold progress to tendon gliding exercise regimen versus early passive progressed to active exercise regimen
- Place and hold exercise regimen versus controlled passive exercise regimen
- Early passive flexion exercise regimen versus early controlled passive exercise regimen.

The rest of the interventions other than exercise varied: one study compared duration of rehabilitation program, two studies investigated the effects of devices (exoskeleton and continuous passive motion device), two studies investigated effects of physical therapy modalities (therapeutic ultrasound and laser therapy), and one study investigated the effects of motor imagery. Six of the 17 trials reported functional status with a patient-reported measure (Visual Analog Scale [VAS] in three trials, Michigan Hand Questionnaire [MHQ] in one trial, Disability of the Arm, Shoulder, and Hand [DASH] in three trials). Although different classification systems were used, active ROM was evaluated in all trials except for one (with the Strickland-Glogovac in two, Strickland or Modified Strickland in seven, Tang in one, International Federation of Societies for Surgery of the Hand [IFSSH] in one, Louisville in three, Tsuge in one, Buck-Gramcko in two, and total active motion [TAM] in six trials, a non-validated, non-standardized classification system in one trial). Fifteen studies reported adverse events. Although tendon rupture was the only commonly reported adverse event among the trials that reported adverse events (a total of 41 tendon ruptures ranging from 0 to 13 across the studies), it was not clearly reported whether these patients underwent secondary surgery or not. It was reported by three studies that 21 patients had tenolysis. One study reported infection rate, two

reported delayed wound healing, two reported complex regional pain syndrome, and five studies reported flexion contracture/extension deficit. Considering secondary outcome measures, one study reported passive finger ROM, nine studies reported hand grip strength, three studies reported returning to previous activity level, one study reported functional status with objective measures (Jebsen-Taylor hand function score and the Purdue Pegboard dexterity test), and four studies reported patient satisfaction with the treatment. No study evaluated quality of life.

No studies evaluated the effects of different orthosis types, orthosis wearing regimens, timing of mobilization or strengthening, or applications for scar management.

Although 14 comparisons evaluating different rehabilitation approaches after flexor tendon injury surgery were made in the original review, the results of the comparisons of exercise regimens that are frequently used in current clinical practice are summarized here, as follows:

Early active flexion plus controlled passive exercise regimen versus early controlled passive exercise regimen alone

- One study evaluated the effects of adding active flexion exercises to controlled passive exercise regimen (standard hand therapy using modified Kleinert protocol) starting from day one after surgery for flexor tendon injuries of the hand with the majority of Zone II flexor tendon repairs (68%), and the rest being Zone I and III.
- According to data obtained from 62 fingers at six months and 63 fingers at 12 months for functional assessment using a patient reported outcome measure (VAS, 0 to 10; higher score= better function), no difference was found between the groups (reported $p=0.942$ and 0.113 , respectively). The certainty of evidence was very low, downgraded for very serious risk of bias and serious imprecision and indirectness.
- When data on goniometric measurement of active finger ROM from 63 fingers at six and 12 months were evaluated, the difference between the groups was not considered meaningful. The certainty level of evidence was very low which was downgraded for very serious risk of bias and serious imprecision.

- Data obtained from 69 fingers at 12 months showed a slightly lower risk for total number of adverse events (6/37 versus 9/32; RR 0.58, 95% CI 0.23 to 1.44) and a slightly higher risk for tendon ruptures (2/37 versus 1/32; RR 1.73, 95% CI 0.16 to 18.20) for adding early active flexion exercises to an early controlled passive exercise regimen. The certainty level of the evidence was very low and was downgraded for very serious risk of bias and imprecision.

Active exercise regimen versus immobilization regimen

- One study compared active exercises plus dorsal splinting to immobilization in a dorsal splint for three weeks after surgery for Zone II flexor tendon injuries of the hand. Active exercise regimen started the day after surgery.
- Functional assessment using a patient-reported outcome measure was not reported in this study.
- According to the ROM data from 84 participants at 12 to 36 months, all participants categorized as “poor” (using Strickland classification) were in the immobilization group. Active exercise regimen had a lower risk for poor outcome for active range of movement (0/37 versus 7/47; RR 0.08, 95% CI 0.00 to 1.43), although the certainty level of the evidence was very low due to very serious risk of bias, serious indirectness and low number of events and wide confidence intervals.
- According to data from 84 participants on adverse events necessitating surgery, the active exercise group had a slightly lower risk compared to immobilization regimen (5/37 versus 10/47; RR 0.64, 95% CI 0.24 to 1.70; very low-certainty evidence). All five adverse events reported in the active exercise group were tendon ruptures whereas all 10 adverse events reported in the immobilization group were in participants whose ROM deficit required tenolysis.

Place and hold exercise regimen versus controlled passive exercise regimen

- Three studies compared place and hold exercise regimen to controlled passive exercise regimen after surgery for flexor tendon injuries of the hand. The majority were Zone II injuries in these studies, but one study also

included Zone I and III injuries. Although the form of exercise differed between studies, all exercise programs (both intervention and control groups) were initiated three days after surgery.

- According to data obtained from one trial consisting of 26 participants at six months for functional assessment using a patient-reported outcome measure (DASH Questionnaire; 0 to 100; higher scores = worse disability), no difference was found between the groups (MD -1.10, 95% CI, -14.44 to 12.24). The certainty level of evidence was very low which was downgraded for very serious risk of bias and serious imprecision.
- According to data obtained from one trial including 89 participants at 12 months for functional assessment using a patient-reported outcome measure (DASH Questionnaire) no difference was found between the groups (MD -1.10, 95% CI, -2.77 to 0.57). The certainty level of evidence was very low which was downgraded for very serious risk of bias and serious imprecision.
- When data on goniometric measurement of active finger ROM from one trial consisting of 89 fingers (102 digits) at 12 months were evaluated, active finger ROM in the intervention group was higher than in the control group (MD 28.00 degrees, 95% CI, 18.87 to 37.13). The certainty level of evidence was very low which was downgraded for very serious risk of bias and serious imprecision.
- According to data on tendon ruptures from 196 tendons (three trials), there was no evidence of a difference between groups (3/96 participants or tendons versus 4/100; RR 0.81, 95% CI 0.19 to 3.50; very low-certainty evidence downgraded twice for bias and imprecision).

How did the authors conclude?

The authors concluded that the evidence from randomized-controlled trials on the effects of rehabilitation interventions following surgery for flexor tendon injuries of the hand is very limited and of very low certainty. Therefore, they were uncertain about the estimation of the effects for all outcomes for which data were available (eight comparisons comparing different exercise protocols and six comparisons evaluating different interventions such as timing of return to activities of daily living,

external devices, and physical modalities). They also reported that there was a remarkable lack of data on adjunctive treatments such as wound management, early edema control, and orthotics types. As a result, they reported that there was limited evidence on which rehabilitation approach was the safest and the most effective in restoring function and movement after surgery for flexor tendon injuries of the hand.

What are the implications of the Cochrane evidence for practice in rehabilitation?

Although there is limited evidence supporting their effectiveness, early active rehabilitation models have come to the fore over time.^[5] This Cochrane review has shown that there is considerable variation in the timing and types of exercises, exercise protocols, orthosis designs, and duration of wearing an orthosis in all rehabilitation protocols in general including early active mobilization protocols. Nevertheless, general applicability of the data obtained from this review is limited, as it was seen that many studies did not provide demographic data and in those that did, the participants were mostly young adult males. In addition, all studies were of small sample size. Caution should be exercised while applying the findings of this review to clinical practice where more complex injuries are encountered, since most of the studies included in this review comprised flexor Zone II tendon injuries and simple lacerations. Another shortcoming of the studies in this review is the lack of studies on the rehabilitation of children. Similar to complex injuries, it should be kept in mind that the results obtained from this review may not be applicable for children. Future research could focus on the effects of telerehabilitation, time of initiation of interventions, early-stage interventions such as oedema and wound management, orthosis types and regimens (particularly studies assessing inclusion of the wrist, since there are no randomized clinical trials on this topic), and evaluation of patients' compliance with treatment protocols (since patient compliance has been reported to be difficult).^[1,3,4] It is recommended that researchers use consistent outcome measures such as goniometric measurement of ROM, functional performance assessments, return to work status, state minimal clinically important differences and clearly report the unit of analyses, surgical technique, and rehabilitation protocol using standardized terminology.^[1,5]

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