MEDS Clinical Medicine (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/medsc.2024.050314
ISSN 2616-1907 Vol. 5 Num. 3

Efficacy of rehabilitation therapy for adults with distal radius fractures: A systematic review

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Keywords: Distal radial fracture, cross-education hand therapy, polychromatic light therapy, mental exercises and mirror therapy, splinting, scapular exercises, pneumatic compression, supervised physiotherapy

Abstract: Distal radial fracture(DRF) is one of the most common fractures in the elderly population. Different rehabilitation measures can result in different outcomes.To assess the effectiveness of various rehabilitation interventions in adults aged over 40 years with distal radial fractures. This systematic review searched in Cochrane Database, PubMed and Embase. All included literature was randomized clinical trials (RCTs) with a publication date before January 2022. A total of 10 RCTs were included. Different rehabilitation treatment protocols were evaluated: cross-education, hand therapy, polychromatic light therapy, mental exercises and mirror therapy, splinting, scapular exercises, pneumatic compression, and supervised physiotherapy. Hand strength exercises and supervised home exercises showed significant differences in the medium term. Supervised home exercise, mental exercises and mirror therapy indicated statistic difference in both short and medium term compared to the control group. However, pneumatic therapy did not find significant differences in all outcome indicators in the short term. For all other interventions, only moderate, limited, contradictory or no evidence was found. There is still no strong evidence that rehabilitation measures are effective in mid-aged and elderly patients with DRF. However, some rehabilitation measures (e.g.hand strength exercises, cross-education and supervised home exercise) have been shown to provide benefits, but further high quality research is still needed.

1. Introduction

Distal radius fracture (DRF) is one of the most common upper limb fracture across the world, and its incidence still continued to rise in these years.[1-11] The age distribution of DRF shows a bimodal pattern. Adolescents and elders are more prone to suffer from DRF.[1-4] DRFs account for 25% and 18% of all fractures in the pediatric and geriatric populations, respectively.[3] However, their causes are different. The most common causes of DRF in the adolescent population are activities and traffic accidents.[2, 5] In contrast, unlike adolescents, the most common mechanism of injury in older adults population is low-energy trauma, especially due to falls.[1, 5] DRF is the second most common fracture in the elderly,2, 3 second only to hip fracture.2 The high risk of DRF in elders is associated with bone mineral density (BMD).[2-4, 6, 7] Some evidence found elderly

DRF patients had obviously lower BMD than population who did not experience DRF. Furthermore, DRF appears to occur more often in the middle-aged and elder population. Women over the age of 50 have a 15% risk of DRF, while the incidence in men remains low.5 A study[5] reported that the risk of DRF in women aged over 60 years is approximately five times higher than in men. The possible reason is lower bone strength in women.[1, 3, 5]

Unfortunately, DRF can cause a huge impact on the elder patients. Chronic pain and functional disability are common ongoing problems after DRF,5 which seriously hinder independence and impair quality of life.7 At the same time, the financial expenditure is also a heavy burden for patients.[2, 8, 9] The Medicare system is estimated to spend 385 to 535 million annually.[8] As the elderly population grows, this cost will increase continuously and cause serious consequences for society.

Rehabilitation is a common treatment for DRF in order to relieve pain, enhance range of motion (ROM) and strength, and restore function,[11,12] such as range of motion and grip strength. A guideline for DRF recommend rehabilitation during fixation of the cast and after its removal.[13] There is no definitive conclusion on the best time to start rehabilitation. Iitsuka13 found that starting rehabilitation within 3 days after surgery is better for recovery of hand function. These measures include physical therapy, occupational therapy, orthotics and so on. The entire rehabilitation process can be basically divided into three phases: splinting, activity and strengthening.[14] The efficacy of various rehabilitation measures for DRF has been demonstrated in some literature and also evaluated or summarized in a number of systematic reviews. Trzeciak[15]and Roll[16] reported different occupational therapy for DRF. Handoll[17] compared the effectiveness of total [26] rehabilitation intervention focused on DRF. Yalan[18] integrates and explores the effects of various intelligent rehabilitation APPs on the recovery of DRF. However, despite the high risk of DRF on elderly population, recent evidence analyzed variety of rehabilitation therapy focused adults rather than only elderly. Therefore, the purpose of this study is to assess the evidence for the effectiveness of various rehabilitation measures for the treatment of DRF in the middle-aged and elderly population.

2. Methods

2.1 Search strategy

The Cochrane Database, PubMed and Embase were searched to identify related systematic reviews and randomized controlled trials (RCTs) on rehabilitation interventions for DRF (up to January 2022). Keywords which were relevant to DRF such as ‘distal radius fracture’, ‘wrist fracture’, ‘Colles’s fracture’, ‘Smith’s fracture’ and ‘Barton’s fracture’ were included. The complete search strategy could be found at table 1.

Table 1: Research strategy.

rehablitation AND	OR occupational therapy, physical therapy, physiotherapy, AROM, PROM, assistive technology, athletic training, biofeedback, body mechanics, exercise, functional training, hand therapy, home modification, interventions, modify, physical agent modalities, postural training, preprosthetic and prosthetic training, therapy, training, treatment
distal radius fractures AND	OR DRF, wrist fracture, Colles’s fracture’, ‘Smith’s fracture’ and ‘Barton’s fracture
mid-aged and elderly adults	OR age≥40, age≥60, middle aged, elder, old, aged

2.2 Inclusion criteria

RCTs were considered available for inclusion according to all the following criteria: (1) Age≥40 years, (2) patients with DRF were included (3) Interventions for treating DRF were rehabilitation therapy, including physiotherapy, occupational therapy and prosthetics-and orthotics, such as active and passive mobilization exercises, and training for activities of daily living. (4) results on range of movement (ROM) (digits, wrist, forearm, elbow and shoulder mobility), pain, grip strength, activities of daily living and functional outcome were reported and (5) the article was written in English.

2.3 Risk of bias

The risk quality of all RCTs included in this review were assessed by CBRG (The Cochrane Library 2008, issue 4), a 12 quality criteria which was suggested by Andrea D. Furlan.[19] Each study was scored as "yes", "no", or "don't know". The study could be assessed as “low risk of bias” if 6 of total 12 criteria were met and there was no serious flaw. However, studies with serious mistakes or not met 6 criteria were assessed as “high risk of bias”.

2.4 Data extraction and synthesis

All data were extracted in a standardized form including study design, sample size, characteristics of participants, detailed intervention, outcome measure and trial limitations.

Due to the heterogeneity of the information in included studies (e.g. study populations, interventions and outcome measures), all studies were synthesized by a best-evidence synthesis[20], [21] rather than meta analysis or quantitative analysis. The method to assess level of evidence recommended the Cochrane Collaboration Back Review Group[22] which suggested 5 levels of evidence as following:

Strong level of evidence = consistent findings among multiple high quality RCTs*

Moderate level of evidence = consistent findings among multiple low quality RCTs and/or CCTs and/or one high quality RCT

Limited level of evidence = one low quality RCT and/or CCT

Conflicting level of evidence = inconsistent findings among multiple trials (RCTs and/or CCTs)

No evidence from trials level of evidence = no RCTs or CCTs

3. Results

3.1 Study selection

The whole process of studies searching is illustrated in Figure 1.

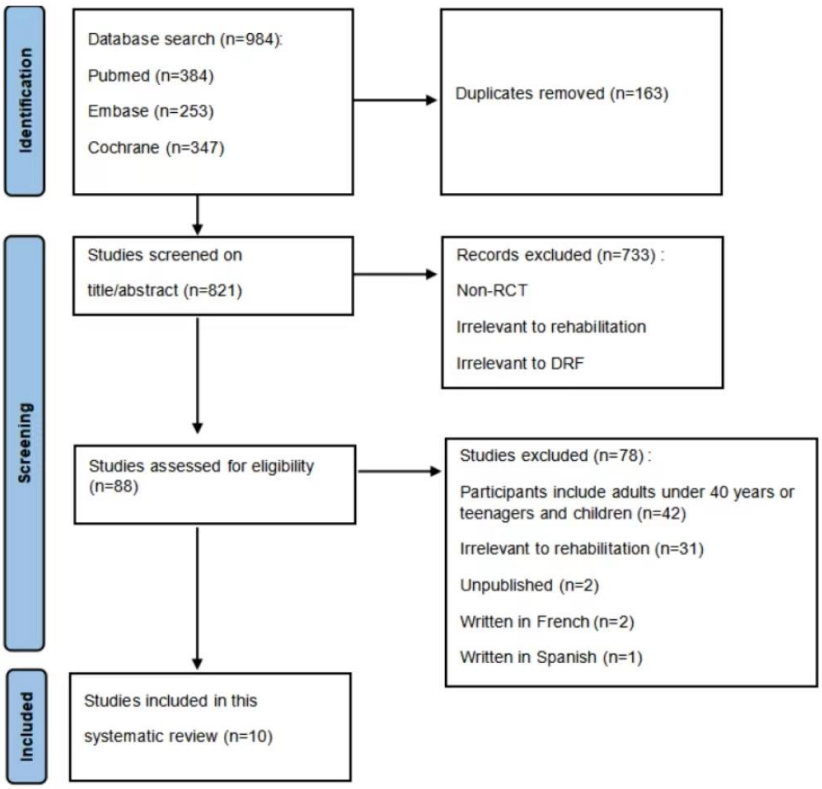

Figure 1: Identification of studies via databases and registers.

3.2 Summary of studies

In total, 10 RCTs23-32 were included; The total number of patients was 674, with sample sizes ranging from 29 to 115 patients. All 10 studies had a predominance of women, with the lowest proportion being 0% men; 100% women[23-25, 29] and the highest being 49% men; 51% women.[26] The mean age ranged from 62 to 82 years.

3.3 Diagnosis

All studies were included according to the common essential diagnosis criteria: DRF, which was based on the clinical presentation or radiological assessment. Five studies required patients were managed with closed orthopaedic treatment and cast immobilization.[25-29] Patients of three studies started treatment after surgery.[29, 31, 32] Two studies required the detailed type of DRF. Both studies required patients with A3 extra-articular multi-fragmentary DRF type according to the AO/ASIF classification system.[26]

3.4 Outcome measures

Various measures were included in studies in the review to evaluate outcome. Eight studies recorded grip strength.[23, 24,27-32] Eight studies recorded ROM.[23-25, 28-32] Seven studies used visual analogue scale (VAS) for pain.25-30, 32 In order to assess the wrist function, five studies[23, 24, 26, 27, 29] used Patient Rated Wrist Evaluation (PRWE) and five studies[24, 26, 28, 29, 31] used the disabilities of the arm, shoulder and hand (DASH) questionnaire. Other outcome measures which were used in no more than one study included modified Mayo Wrist Score (MMWS),[31] EQ-5D24 questionnaire SF-36[32] and Canadian Occupational Performance Measure (COPM).[32]

3.5 Risk of bias

All 10 RCTs[23-32] indicated various risks of bias in table 2. The most common problem was blinding of patients and caregivers. There was one study[25] rated as high risk of level. Five studies[25, 27, 30-32] did not demonstrate allocation. Two studies[25, 31] did not demonstrate blinding of outcome assessors. Two studies[25,32] did not demonstrate the similarity of baseline characteristics.

Table 2: Quality of risk.

	Charlene R.A.[23]	Heide [24]	Mirjana I[25]	Héctor [26]	Héctor [27]	Nguyen [28]	Gamo [29]	Wakefiel[30]	Christia n[31]	Alkner [32]
Adequate randomization?	Y	?	?	Y	Y	Y	Y	Y	Y	Y
Allocation concealment?	Y	Y	?	Y	?	Y	Y	?	?	?
Blinding: patients?	N	N	N	N	N	N	N	N	N	N
Blinding: caregiver?	N	N	N	N	N	N	N	N	N	N
Blinding: outcome assessors?	Y	Y	?	Y	Y	Y	Y	Y	N	Y
Incomplete outcome data addressed: drop-outs?	Y	Y	Y	N	Y	Y	Y	N	Y	Y
Incomplete outcome data: ITT analysis?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Free of suggestions of selective outcome reporting?	?	?	Y	Y	Y	Y	Y	N	?	?
Similarity of baseline characteristics?	Y	Y	?	Y	Y	Y	Y	Y	Y	?
Cointerventions avoided or similar?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Compliance acceptable in all groups?	N	N	?	?	?	Y	?	?	?	?
Timing of the outcome assessment similar?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Total positive scores per item	8	7	5	8	8	10	9	6	6	6

4. Discussion

This systematic review summarizes an overall of total 10 studies[23-32] that evaluated the effectiveness of various rehabilitation therapies for DRF. Most studies reported efficacy of related therapies in short term. Home exercise with supervision,[27] hand strength exercise[28] and physiotherapy[29] led to significant difference in mid-term. No evidence found difference in long

term. Only home exercise with supervision[27] improved all of the outcome measures including ROM, grip strength, pain and wirst function in both short term and mid-term compared with the control group. Both mental practice and mirror therapy[24] could achieve the same effect but the efficacy difference compared control group is small. However, only pneumatic compression[32] found no significant difference in all outcome measures in short term.

5. Limitation

There are some limitations in this review. First, there is a lack of blinding. All literature included in this study did not blind patients and caregivers inevitably because of the design of studies. Secondly, most of the literature included is low quality which increases the risk of bias. Third, no evidence concluded the efficacy of rehabilitation intervention in long term. The follow-up period is relatively short, and the long-term effects of these measures remain unknown.

6. Conclusion

In conclusion, this study summarized that there is still a lack of high-quality literature on the mid-aged and elderly patients with DRF, even though only one literature was rated as high risk of bias. For all interventions, only moderate or limited evidence was found. In terms of short-term effectiveness, cross-education is a considerable option due to the improvement on grip strength and ROM. Supervised home exercise, mental exercises and mirror therapy showed efficacy in both short and med-term. Pneumatic compression and splinting are not suggested.

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