

REHABILITATION OF DISTAL RADIUS FRACTURES

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ABSTRACT

The aim of this study was to assess the evidence regarding the adoption and effectiveness of therapeutic procedures employed for rehabilitation of distal radius fractures. This systematic review used the following databases: PubMed, Lilacs, PEDro, Cochrane, Scielo and OTseeker, without time restrictions. The following keywords were searched for: distal radius fracture, rehabilitation, occupational therapy, physiotherapy including reports in English, Spanish, French, and Portuguese. Twenty-two studies were retrieved and analyzed by two independent investigators following the PEDro scale criteria. Other non-experimental studies were included for additional information regarding certain rehabilitation approaches. Of the 14 randomized controlled clinical trials, four compared early mobilization to

conventional therapy, showing moderate evidence in favor of earlier mobilization. Seven compared home therapy based on orientations to individual conventional therapy and found conflicting evidences. Three studies also analyzed the efficacy of the following specific therapeutic procedures: Pulsating magnetic field, lymphatic drainage, and ultrasound, which showed limited empirical support. The nine non-experimental studies did not add sufficient information regarding these issues. There was a trend to employ general principles of rehabilitation when elaborating these therapeutic approaches, but these procedures were not adequately supported by literature.

Keywords: *Hand Injuries. Physical Therapy Modalities. Occupational therapy. Rehabilitation. Colles' fracture.*

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INTRODUCTION

Distal radius fracture (DRF) is a wrist condition frequently found by orthopaedic doctors in emergency services. This condition has been a source of concern for healthcare professionals, particularly for the experts in upper limbs, surgeons and hand therapists. DRF can be found in any age group. Brazilian literature¹ points out to a variable incidence rate of 1% to 31%. It is frequently associated to falls over the hand with the wrist extended at the moment of impact; thus, it is very important in advanced age individuals.¹

Several authors have suggested different classifications for DRFs. Among the most used ones today are the Classification by Frykman², the ASIF/AO (Swiss Association for the study of internal fixations)² and the classification by eponyms. In the Frykman's classification, the higher the Roman number assigned to a fracture, the higher its complexity will be. The same happens with the AO classification, which presents an order of fractures using numbers (1,2,3) and letters (A,B,C). According to the degree of complexity, different levels of soft tissue injuries occur, which will lead to different diagnoses.^{3,4} The kind of fracture also determines the recommended treatment approach, ranging from conservative to several different surgical techniques.

DRF can bring complications, including reflex sympathetic dystrophy, joint stiffness, lost apprehension strength and power, neuromotor changes resulting from median nerve injuries, residual deformity of the wrist joint, mid-carpal instability, among others.⁵ Rehabilitation of DRFs is indicated in order to prevent complications and deformities, as well as to accelerate functional improve-

ment. It is believed that treatment can provide an earlier return to daily life activities⁵, particularly in cases where the patient's job significantly demands the affected limb.

Following the evidence-based practical models, it is important that the therapeutic approach is well documented and scientifically validated. Therefore, the objective of this study was to conduct a systematic analysis of literature in order to assess the scientific evidences concerning the most appropriate therapeutic approach for rehabilitation following DRF.

METHODOLOGY

The following databases have been consulted in our bibliographic research: PubMed, Lilacs, Pedro, Cochrane, Scielo and Otseeker. The searched keywords were the following: fracture, distal radius, Colles, rehabilitation, occupational therapy, physiotherapy, hand therapy, and combinations of these. Restrictions were made to languages different from English, Spanish, French and Portuguese. No limits were established for date of publication. The articles found had their references carefully examined with the purpose of finding new relevant studies for our investigation.

We considered only the studies addressing rehabilitation or therapeutic approaches concerned to guidance on affected limb movements after DRF, available in libraries throughout Latin America or by contacting the authors by e-mail.

Due to controversies on results, the selected scientific papers were divided into two groups, according to the methodology employed: experimental studies and non-experimental studies. The first group

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was assessed by both authors, according to the evaluation parameters of PEDro scale, which presents an adequate reliability.⁶ This scale is divided into external validity criterion (criterion 1) and internal validity criterion (criterion 2 to 11) and scores 1 to each of the following criteria:

- Criterion 1: Explanation of the eligibility criteria (inclusion/ exclusion);
- Criterion 2: Random allocation;
- Criterion 3: Hidden allocation (first, the inclusion criteria were applied and then the randomization was done);
- Criterion 4: Similar groups concerning the most relevant prognostic factors;
- Criterion 5: Blinded subject;
- Criterion 6: Blinded therapist;
- Criterion 7: Blinded evaluator;
- Criterion 8: Subjects loss below 15%;
- Criterion 9: Data of the last measurement follow the principles of the intention-to-treat;
- Criterion 10: Appropriate statistical comparison among groups in the last measurement;
- Criterion 11: Explanation of variability and measurement points.

The sum of the scores enabled us to determine the quality of each study, regarding as low-quality the scores up to 4 (four), according to the internal validity criteria, and high-quality studies when the scores were above 5 (five). Any disagreement between authors was solved with discussions until a common sense was reached. The non-experimental studies were included in an attempt of clarifying questions asked by the present study, which were not solved with the experimental studies found, and of identifying potential literature agreements about the topic addressed. The analysis of these mainly occurred in searching for data relatively to the distribution of therapeutic approaches used in DRF rehabilitation.

For determining scientific evidence, the following criteria were employed:⁷

Strong evidence: consistent results in multiple high-quality CRSs;

Moderate evidence: consistent results in a high-quality CRS and in one or more multiple low-quality CRSs;

Limited or conflicting evidence: a high- or low-quality CRS or inconsistent results in multiple CRSs;

No evidence: no CRS

RESULTS

Twenty-two studies were found addressing or testing any therapeutic approach for rehabilitation of DRFs. Among these, 14 have been

identified as CRSs, two as descriptive, six observational cross-sectional, including a cohort study.

Of the 14 studies assessed, seven were regarded as high-quality and the remaining six as low quality.

In order to facilitate the analysis, experimental studies were subdivided into groups according to the objectives determined and to therapies compared.

Of the 14 assessed studies, four were focused to investigating the effectiveness of early mobilization. Table 1 also shows a summary of these investigations, presenting low-quality CRSs (grade 4 on PEDro scale) in favor of mobilization, and a prospective cohort study reporting no differences between compared therapies. The latter was included because it represented a research with strong scientific validity, but there are no valid and reliable specific parameters to evaluate the quality of cohort studies, which rendered that study only illustrative. The combination of these conclusions indicated **moderate evidence** in favor of early mobilization, due to consistent results in multiple low-quality controlled studies.

Among the CRSs found, seven addressed the comparison between physiotherapeutic treatment and exercises at home as a therapy for DRFs. Table 2 shows a summary of the methodologies employed in five high-quality studies (grades 8,5,6,5,8), with three proving the effectiveness of physiotherapeutic approach, while two indicated no differences between the approaches. The other two studies have been considered as low-quality (grade 1), both concluding in favor of null hypothesis. The presented results, thus, pointed out to a **conflicting evidence** for the effectiveness of a physiotherapeutic approach after DRFs when compared to physical exercises at patients' home, since high-quality studies presented controversial results among each other. It is worthy to highlight as an additional conflicting issue that each study used a different rehabilitation protocol, with differences also being found in the ways the results were measured. These procedures made the comparability between studies difficult, and may also be a justification for such different results.

SPECIFIC THERAPEUTIC TECHNIQUES

Only three authors tried to prove, specifically, the effectiveness of specific therapeutic techniques. Haren et al.⁸ evidenced the effect of lymphatic drainage in reducing edema, while Cheing et al.⁹ indicated good results with the use of pulsed electromagnetic field (PEMF). Basso and Pike¹⁰ concluded that there are no

Table 1 – Studies comparing Early Mobilization vs. Conventional Treatment

Study	PEDro grade	Group	Kind of Fracture	Approach	Confirmed therapy	Quality of the study
McAuliffe et al., 1978 ²⁴	—	—	—	Early mobilization vs. range of motion (ROM)	No differences	—
Dias et al., 1978 ²⁵	2	A	w/o deviation	Plastered cast for 5 weeks	Early mobilization: Groups B and D with stronger effect for edema and ROM, no occurrences of fracture deviation	LOW
		B	w/o deviation	Bandage + early mobilization		
		C	with deviation	Plastered cast for 5 weeks		
		D	with deviation	Modified plastered cast + early mobilization		
Millet & Rushton, 1995 ²⁶	4	A	—	Plastered cast for 5 weeks in ulnar deviation and supination	Early mobilization: Group B showed better outcomes for apprehension strength and ROM at three months	LOW
		B	—	Plastered cast for 3 weeks with neutral position wrist + flexible splint + early mobilization		
Solanki et al., 2000 ¹⁶	2	A	—	Early mobilization: Guided active and resistive exercises activity	Early mobilization	LOW
		B	—	Rarely participated of the guided activity		
SUM					MODERATE EVIDENCE	

(*) Prospective cohort study

Table 2 – Studies comparing Physiotherapy vs. Exercises at Home

Study	PEDro grade	Protocol employed on medical office	Group	Approach	Confirmed therapy	Quality of the study
Pasila et al., 1974 ¹⁴	1	Active supervised exercises	A	Home program (written)	No differences	LOW
			B	Home program (written) + treatment at the medical office		
Oskarsson et al., 1997 ²⁷	1	Not described	A	Home program (oral)	No differences	LOW
			B	Treatment at medical office		
Wakefield & McQueen, 2000 ¹⁵	8	Kinesiotherapy, passive accessory joint mobilization, functional exercises.	A	Home program (written)	Group B: > Flexion and extension ROM of the wrist	HIGH
			B	Home program (written) + treatment at medical office		
Kay et al., 2000 ¹¹	6	Kinesiotherapy, guidance for protecting the fracture, edema control, skin restoration.	A	Home program (illustrated)	Group B: > Flexion ROM of the wrist. No differences for pain, function and apprehension strength	HIGH
			B	Home program (illustrated) + passive joint mobilization		
Watt et al., 2000 ¹⁷	5	Active exercises, passive accessory joint mobilization.	A	Home exercises program	Group B	HIGH
			B	Treatment at medical office		
Christensen et al., 2001 ²⁸	5	Kinesiotherapy, edema prevention, sensitivity stimulation, drills of daily life activities.	A	Home program (oral)	No differences	HIGH
			B	Home program (oral) + treatment at medical office		
Maciel et al., 2005 ¹⁹	8	Hand therapy, activity drills with segmented tasks, feedback.	A	Home program	No differences	HIGH
			B	Treatment at medical office		
SUM					CONFLICTING EVIDENCE	

differences in terms of range of motion (ROM) gain with or without combined ultrasound (US) during exercises. Among these, the first two applied a high-quality methodology (grades 6 and 7, respectively), while the last one was regarded as low-quality (grade 4) in addition of presenting important technical failures when selecting the procedures carried out on the compared groups. The Kay study¹¹, included on the previous group and with grade 6 on the PEDro scale, detected the effectiveness of joint mobilization for gaining flexion ROM of the wrist, since this procedure was the only difference found between control and treatment groups.

Despite of the differences in methodology quality, the three studies showed **limited evidences** on their conclusions, because they were the only ones attempting to compare the effects of these specific therapeutic techniques. Table 3 presents a summary of these studies.

Once the existent experimental studies in current literature were not enough to answer all the questions asked by this systematic review, we chose to include non-experimental studies seeking for consensus to guide a hand therapist when treating patients with DRF:

Non-experimental and qualitative studies

Nine non-experimental studies were found addressing or describing the recommended rehabilitation after DRF. The analysis of these studies showed a potential consensus towards a recommended therapeutic approach, with only one publication specifically addressing Brazilian population. Controversies have not been found between authors; therefore, one supplements the other without implying on disagreements in terms of procedures and proposed objectives. Most authors recommended that the physiotherapeutic treatment should be established as soon as possible³⁻⁵ and the initial goals should prioritize edema reduction^{3,4,12}, the restoration of ROMs of the hand and wrist^{3-5,12} and the maintenance of movements in non-affected joints.^{3,5}

ROM gained in the wrist and fingers should start with active movements^{3,12} progressing to passive movements^{3,5,12} and joint motion³, should the first one could not alone fully restore the limitation. The authors emphasized the prone-supine movements of the forearm, flexion/ extension⁵ and ulnar/ radial displacements of the wrist⁴, elbow flexion/ extension^{3,5}, fingers flexion/ extension^{3-5,12} and shoulder movements.^{3,5}

Table 3 – Studies investigating the effectiveness of physiotherapeutic procedures

Study	PEDro grade	Description of rehabilitation	Group	Approach	Confirmed therapy	Quality of the study	Evidence level
Basso & Pike, 1998	4	One low-frequency ultrasound (US) session simultaneously to active mobilization.	A	US + active mobilization	No differences	LOW	Limited
			B	US placebo+ active mobilization			
Haren et al., 2000 ⁸	7	Lifting and compression with elastic bandage: kinesiotherapy, home exercises program, guidance.	A	rehabilitation	Group B	HIGH	Limited
			B	rehabilitation + lymphatic drainage			
Cheing et al., 2005 ⁵	6	Home exercises program, kinesiotherapy, cryotherapy, pulsed electromagnetic field (PEMF).	A	ice + PEMF	Pain: group A Edema: A>C>D Flexion ROM: A, C Pronation ROM: A>D	HIGH	Limited
			B	ice + placebo PEMF			
			C	PEMF			
			D	placebo PEMF			

Among the procedures carried out with the purpose of reducing edema, the following were mentioned: limb lifting associated to active movements of the joints^{3,5,12}, particularly of the wrist and fingers; mechanical compression^{3,4} with Coban band, digital gloves, compressive socks, twinning with strings³, retrograde massage^{3,4}, cryotherapy⁴ and contrast baths.¹² Wound care using the deep transverse rubbing technique^{3,12} and the differential tendons sliding^{3,4,12} were procedures recommended both for open and closed reduction fractures.

No studies objectively responding or clarifying the questions regarding the role played by rehabilitation in preventing complications and reducing the time for returning to daily life activities were found. Attempts to use qualitative methodology to prove the effects and the importance of rehabilitation in DRFs have not yet been documented by literature.

DISCUSSION

The group of studies assessing the benefits of early mobilization did not answer the questions asked by this systematic review. However, the expressive number of CRSs addressing this issue calls our attention, and, somehow, represents the need of joint mobilization after DRF, which is regarded as the primary goal of physiotherapeutic follow-up.^{3-5,12}

The improper methodological strictness of the assessed studies renders the generalization of their findings impossible. In addition to the low scores on the PEDro scale, other failures can be found in their designs. Among these, we can mention the lack of standardization of the kind of fracture experienced by the sample subjects. The control of that variable is extremely relevant, once fractures of several different complexity levels will present different prognoses.^{2,13} Only the studies by Pasila et al.¹⁴ and Wakefield et al.¹⁵ controlled this variable on their sample subjects. Another bias found in the studies was the absence of detailing in the use of results measurement methods which, sometimes, had no psychometric properties tested and/or appropriate. Only the studies by Cheing et al.⁹, Haren et al.⁸, Solanki et al.¹⁶ and Watt et al.¹⁷, correctly measured the effects tested.

Attention should be drawn to the scarcity of studies measuring functional results. Since the development of the International Classification of Functionality (ICF), concerns are growing among professionals involved with rehabilitation in order to develop methods for measuring the functional improvement of patients focusing activity and participation constructs. Some questionnaires and scales have already been validated, with duly proven reliability and responsiveness, and could evidence therapeutic effects in wrist injuries, among which we can mention the Patient Related of Wrist Evaluation (PRWE), and the Disability Assessment of Shoulder and Hand (DASH), which have already been proven as appropriate for DRF.^{3,18} The failure to use these tools can be an explanation for studies failing to bring consistent data, once functional measures constitute the best way to measure rehabilitation benefits.¹⁸ Maciel et al.¹⁹ used the PRWE and Wakefield et al.¹⁵, the Short Form (SF-36) to measure functional gains of patients, being the only ones to correctly provide these measurements.

The CRSs focused on comparing the instructions of exercises to be done at home by the patient to the treatment followed up by hand therapists are most frequently found in literature when the search is for rehabilitation of DRFs topics. This increased frequency is possibly due to the easy sample enrollment when compared to studies addressing the effectiveness of specific therapeutic procedures. Both suggested treatment approaches provide the individuals with the certainty that they are receiving the appropriate treatment, i.e., regardless of the group they have been randomly assigned to,

the subjects are informed that they will do the same exercises. Furthermore, the treatment group employed by all CRSs had a visit schedule of twice a week at most, leaving the patients with the responsibility of doing the therapeutic exercises on their own. The fact is that control and treatment groups had minimal differences, which can explain the lack of sufficient scientific evidences.

Rehabilitation is characterized by customization and continuous follow-up, which means that the patient is reassessed at each visit, and the therapist can apply progressive exercises in order to achieve some motion abilities earlier. In a weekly follow-up visit, patients are deprived of the opportunity of continuously working at the top of their abilities, potentially delaying their recovery. So, it is not uncommon to see a patient refusing to participate on a study. Furthermore, studies designed to test specific therapeutic procedures are difficult to be approved under the evaluation of a committee of ethics, once the control group could have its evolution impaired as a result of not being submitted to the same procedures as the treatment group. One alternative when testing the effectiveness of these procedures could be the use of qualitative methodology, measuring improvement under the perspective of the patient him/herself.

Another consideration to be made to the studies found here was the moment of measuring the results throughout the treatment. Most of the studies evidenced that, in the long term (3 and 6, 9 and 12 months), DRFs had the same functional results with or without physiotherapeutic follow-up. No attention was given to the possibility of rehabilitation accelerating patients' functional improvement for them to be able to return to their daily activities early, and such difference could be found if the results were compared on a weekly or monthly basis.

Treatment based on exercises at home, despite being indicated by some authors, presents several practical issues, including the challenge in adherence and/or compliance to this kind of treatment and the different social-cultural level of the patients. Compliance to instructions has been previously mentioned in literature as an issue.²⁰ Studies demonstrate significant compliance prediction to home exercises program in patients perceiving a positive self-effectiveness and external control locus.²⁰ The same happens when a patient has a high level of expectations concerning the outcomes of treatment, since by the need and desire of accelerating improvement, he/she more actively engages on the treatment. Therefore, by impelling a home program to patients, a therapist must make sure that the patient has the right profile, because this is not a "one size fits all" program. Otherwise, poor results, not reflecting reality, can potentially be found.²⁰

Concerning the studies that attempted to prove the effectiveness of therapeutic procedures, Basso & Pike 1998¹⁰, intended to check the effects of applying ultrasound therapy on the improvement of wrist ROM. However, the study methodology presented several failures, including the lack of specification of how ROM was measured, since there are conclusive studies comparing different goniometry techniques for hand and wrist joints.²¹ Other studies, for being well controlled and presenting a satisfactory methodology, couldn't provide stronger scientific data just because they were the only ones attempting to prove the described techniques.

Considering non-experimental researches, most of these briefly described the recommended physiotherapeutic treatment after DRF, turning the understanding about the approach and the progression of muscular strengthening and functional exercises scarce and poor. The gain on wrist flexion and extension, which is the movement most affected after DRF, since all experimental studies used this parameter to measure results, was mentioned by only one of the nine non-experimental studies included here.

A shortage was also found in designing more specialized treatments. This gap can be exemplified by the fact that no author has suggested joint protection drills, load release, and functional return to sports or occupational activities. Recreational tennis, squash, shuttlecock, volleyball players, among others, are not uncommon in medical offices. Physiotherapists, thus, usually count only on their creativity in a clinical situation, fully deprived of evidences or scientific trends when treating patients with this profile, who have eventually had a DRF.

Hand laborers (such as industry workers, carpenters) or those demanding strong fine coordination (jewelers, surgeons, artists) could also be impaired by this literature gap, as a result of delayed return to their previous levels of ability. Even the most usual activities of the daily life, such as standing up from a chair supported by the hands, carrying a bottle, washing clothes, would be impaired in the absence of exercises training these abilities. Bialocerkowski²² and Bialocerkowski et al.²³ investigated the challenges associated to wrist disorders and pointed to similar tasks.

The stress loading program or even load release exercises on the affected limb¹³ can be an alternative for solving this deficiency on the proposed treatments, and are frequently employed in clinical practice when treating individuals after DRF and other wrist conditions.

CONCLUSIONS

This study aimed to assess scientific evidences associated to the most appropriate therapeutic approach in rehabilitation after DRF, and pointed out to the need of further researches. The studies found were not enough to validate the effect of hand therapy by preventing complications and reducing the time for these patients to return to their daily life activities. Literature shows a trend from authors to use general principles of rehabilitation when designing therapeutic approaches, but the procedures usually employed are not well documented and evidenced, turning the evidence-based practice difficult for professionals trying to recover patients with the condition. The use of qualitative methodology should be assessed as a potential alternative for filling the gap found in literature.

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