CHAPTER 3

Recovery after fracture of the distal radius

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Abstract
Stretching exercises are an important part of recovery after sustaining a fracture of the distal radius. However, from the patient’s perspective, painful stretching exercises can be counterintuitive after injury. Stretching exercises are straightforward and do not require a significant amount of coaching. It is ultimately the protectiveness, passivity, and sometimes a sense of futility that require coaching. The key for the provider is to empathize with the difficult and counterintuitive nature of the recovery process.
Disability and Impairment

Recovery from a fracture of the distal radius must address both impairment and disability. Impairment is measurable, objective pathophysiology such as limited motion or sensation. Disability on the other hand, is the idea that one is incapable of an action. Patients with distal radius fractures experience disability as inability to trust or depend on the hand. “It probably feels like you’re not going to be able to rely on your hand they way you need to” is a statement that identifies the goal while communicating empathy regarding how difficult and counterintuitive recovery can be for the patient. During recovery from a fracture of the distal radius, as with most illnesses, symptom intensity and disability are determined more by mindset and circumstances than by pathophysiology/impairment.

Impairment

Patients should expect slight to moderate impairment of motion after a fracture of the distal radius. Diaz-Garcia and colleagues’ review of published studies reported a mean arc of wrist flexion and extension of 116° to 133° and forearm rotation of 140° to 175° after recovery from a fracture of the distal radius in older patients, regardless of treatment method. Six months after a conservatively treated distal radius fracture the mean arc of flexion and extension and the forearm rotation were know to be 75% to 97% and 87 to 97%, respectively, compared with the uninjured side. Six months after operative treatment the numbers are similar: mean flexion 67% to 88%, extension 72%-93%, supination 78%-100%, and pronation 87%-100%.

Grip strength—which is partly volitional and therefore not strictly an objective impairment, averaged 53 to 86% after operative treatment and 43% to 92% after nonoperative treatment, compared to the uninjured side six months after injury.

Disability

Patients may have more influence over disability than impairment after fracture of the distal radius. In a study with 57 patients recovering from a wrist fracture and 13 from an ankle fracture, fear and catastrophic thinking were associated with pain intensity and recovery of muscle strength. In another study of wrist, ankle and hip fractures, pain intensity at baseline and post injury anxiety were the most important predictors of pain intensity after the fracture. Souer and colleagues noted that an average of 22 months after volar plate fixation, 71% of the variability in DASH scores (Disabilities of the Arm, Shoulder and Hand) was determined by pain and arc of forearm rotation with 65% resulting from pain alone.

In a study of 120 patients recovering from a fracture of the distal radius, MacDermid and colleagues found that 25% of the variation in the Patient-Related Wrist Evaluation score (PRWE) score 6 months after injury was accounted for by workers compensation, education and prereduction radial shortening, whereas 25% was accounted for by the arc of wrist flexion and extension, with the remaining 50% unaccounted for.

Grip strength is mainly influenced by depression, pain and motivation. Karnezis and Fragkiadakis found that 43% of the variation in PRWE 2 years after nonoperative treatment of a fracture of the distal radius was determined by grip strength, but motion was not significantly affected. A study of 20 patients, found that grip strength correlated with all tasks in the Jebsen Hand Test, but motion correlated only with lifting large objects.

Chung and colleagues assessed 49 patients 1 year after a distal radius fracture, and found that only age and income were associated with disability; whereas radiographic outcomes had no association with disability. In a separate study, Chung and colleagues found no significant differences in disability between younger and older patients 1 year after volar
plate fixation of the distal radius using the Michigan Hand Questionnaire (MHQ). However, income and articular incongruities, but not motion, were significant predictors of the Michigan Hand Questionnaire in younger patients.\(^{17}\)

In a study of 125 patients, Chung and Haas\(^{27}\) plotted receiver operating characteristic (ROC) curves and identified the following thresholds for patient satisfaction: 65\% of grip strength (sensitivity of 0.89, specificity of 0.63), 87\% of pinch strength (sensitivity of 0.60, specificity of 0.86), and 95\% of the arc of wrist flexion and extension (sensitivity of 0.47, specificity of 0.88).

**Disproportionate Pain and Disability**

Finger stiffness is one of the most common sequelae of a fracture of the distal radius. Patients with stiff fingers usually have greater pain intensity and disability than normally would be expected. This disproportionate pain and disability has many labels, some of which are cultural (e.g. algodystrophy in Britain) and others historical (e.g. causalgia, reflex sympathetic dystrophy). The International Association for the Study of Pain currently favors the label Complex Regional Pain Syndrome (CRPS) because implication of the sympathetic nervous system was contributing to overutilization of costly and ineffective stellate ganglion blocks and other treatments.\(^{28,29}\) Two Cochrane reviews on spinal cord stimulation and local anaesthetic sympathetic blockade in the treatment of CRPS I concluded that there is not enough evidence to support the use of either treatment.\(^{29,30}\) The diagnostic criteria currently available for CRPS are subjective and imprecise. The lack of a plausible explanation for the signs and symptoms associated with CRPS is one of the diagnostic criteria for this condition. Therefore, it can be argued that the diagnosis of CRPS is never appropriate after a fracture of the distal radius. A fracture of the distal radius is associated with ecchymosis and swelling in the hand that leads to stiffness and pain if the patient is too protective to exercise the hand and use it for daily activities.

The reported prevalence of disproportionate pain and disability among patients recovering from a fracture of the distal radius varies widely, between 1\% and 37\% in published series,\(^{31-37}\) perhaps in part because it is poorly defined, subjective, and unverifiable. Along these lines, it is difficult to interpret the trials suggesting that Vitamin C limits the occurrence of CRPS given that the diagnosis is subjective and variably defined, and the only published trials were performed by advocates of Vitamin C.\(^{36,38}\) A recent trial by McQueen and colleagues\(^{39}\) showed no benefit with Vitamin C.

In general, physicians ascribe disproportionate pain and disability to a poorly understood pathophysiological process currently labeled CRPS, while psychologists emphasize the importance of psychological factors (catastrophic thinking in particular) and illness behavior (e.g. pain avoidance).\(^{28}\) Use of the term CRPS places emphasis on an elusive and possibly mythical pathophysiological process, leads to medical and surgical treatments that, to date, are at best wishful thinking and at worst harmful, and distracts the patient and the provider from effective treatments such as cognitive behavior therapy.\(^{28}\) In our opinion, until we have a better understanding of this illness, it should be referred to descriptively as disproportionate pain and disability rather than using specific biomedical terms, and it should be treated with an evidence-based approach based on cognitive behavior therapy.
Techniques for Reducing Impairment:

**Edema:**
The most important thing a patient can do to reduce swelling is to use the hand as normally as possible. Use of the hand for light daily tasks (writing, typing, washing, etc.) is safe and should be encouraged. Patients often ask “should I squeeze a ball”, which we believe reflects the tendency to feel passive about recovery (“the ball will heal my hand”). We counter with: “I want you to squeeze your hand into a tight ball, over and over again, as much as you can”. We demonstrate the blanching that occurs when the hand is squeezed into a tight fist and use the analogy of squeezing out a sponge. The same is true for opening the hand into rigid extension, which is also encouraged: “tight open, tight fist”. Elevation is also useful, but difficult to maintain if one is using the hand for daily tasks. The role of passive treatments such as massage, wrapping or gloves is debatable and passive approaches should be used with caution in order to optimize the patient’s active role in their own recovery (self-efficacy).

Tessman and Schmidt found better absolute reduction in swelling measured with volume displacement with gloves compared to elastic bandages in a very small randomized trial. Härén and colleagues compared Manual Lymph Drainage as described by Voddor (12 patients) with usual exercises (14 patients) after fracture of the distal radius treated with an external fixator. The investigators documented significantly less edema measured volumetrically shortly after removal of the fixator, but no differences at later time points. A randomized trial comparing modified manual edema mobilization to standard technique in 30 patients that had plates, external fixator or cast fixation of the distal radius showed no differences in edema, pain or motion.

**Motion:**
Finger and forearm motion exercises are started immediately after injury or treatment, with finger motion taking priority. The easiest finger exercise for patients to understand is a composite fist with self-assist using the other hand, which also addresses edema. There is value to keeping it simple. Using the other hand to push and stretch the injured hand can be counterintuitive and typically feels unsafe to start, because pain can trigger protection and preparation for the worst (catastrophic thinking). It’s important to normalize this and show empathy by discussing this normal human response: “It probably feels like the wrong thing to do”; “Patients often tell me it feels like they will pop the sutures or dislodge the plate. Is that how it feels?”; “Exercises after fracture or surgery are counterintuitive”. Providers should emphasize that patients need to get the arm moving themselves in order to limit passive attitudes towards recovery.

The key is to help patients change from a “protective” to that of a “healthy stretch” mindset, which is not an easy talk to accomplish. Regularly performing finger and forearm exercises enables the patients to experience a return of motion to the hand, making the process feel more natural and allowing the patients to make the transition themselves. It is important for the provider to empathize, teach, and be patient, while avoiding words or actions that might reinforce a protective mindset. For instance, the common phrases “work to pain, but not beyond” or “don’t over do it” are unhelpful for patients who are struggling to control their catastrophic thinking. The phrase “no pain, no gain” is not helpful because it implies that the patient is “a wimp” or should be ashamed, when in fact their protectiveness is entirely normal and expected.

Analogies can help make complex concepts understandable and, like stories, often communicate counterintuitive concepts more effectively. The “smoke alarm in the kitchen”
analogy is useful to help normalize a protective response to pain. The pain is like smoke or grease created during cooking. It sets the alarm off, but it is not a fire. Most fire alarms while cooking the kitchen are false alarms, but this does not mean that the alarm is broken. It is actually working perfectly and just as it is designed. Patients need to realize that humans are programmed and evolved to respond protectively to pain and to prepare for the worst, so we should not be surprised or ashamed to feel that painful exercises are the wrong thing to do and might cause harm.

Patients will find it very convincing that the pain alarm is a true alarm. Human intelligence collects all the things that prove our theory (rationalization, pattern forming) while tending to disregard the evidence that our theory may be incorrect. That’s how the magician fools us, through our intelligence and our strengths, not through the weaknesses of our brain. Just like it may seem very convincing that the lady in the box is sawed in half, it can seem convincing that stretching exercises will cause harm—again, given the way our brain works that is to be expected. This phenomenon is nothing to be ashamed of, but it is necessary to be prepared for it. Patients will ask, “Should I ignore the pain?” and the answer would be, “No. You have to be prepared for how the pain will make you feel protective and prepare for the worse and how convincing it will be that the exercises are not a good idea”. Psychologists call this act a preparation of mindfulness. Patients need to be very mindful of how their body works and be prepared for the counterintuitive nature of the recovery process. They should be prepared to manage the alarm, (open the window or disconnect the alarm) and keep stretching (keep cooking).

As stated earlier, the goal is to get into a healthy stretch mindset. We know that when we stretch or do yoga that the discomfort we feel is healthy. We know that we are not stretching properly until we feel the discomfort. Once patients “filter” the alarm as we do with workouts, sports, and yoga, they will be able to do much more effective stretches and feel they are healthy. This change in mindset takes time and each patient must reach this mindset in his or her own way and at his or her own pace. The health provider should understand how long this process can take (months), and encourage the patient that everything will work out—there is no rush.

With non-bridging external fixators and internal plate and screw fixation it is safe to initiate wrist flexion and extension exercises as soon as possible; however, when patients are in pain and wrist motion exercises are particularly counterintuitive early on. There is now very good evidence that final wrist motion does not depend on early initiation of wrist stretches.

Lozano-Calderon and colleagues \(^\text{12}\), in a randomized trial including 60 patients, compared the initiation of wrist stretches 2 weeks after volar plate fixation with initiation after 6 weeks. They found no differences in pain, Gartland and Werley score, Mayo Wrist score and range of motion 3 and 6 months after fracture \(^\text{12}\). Two studies also documented similar findings in patients treated with percutaneous pinning \(^\text{45, 46}\).

McQueen \(^\text{13}\) compared non-bridging fixators with external fixators in a randomized trial with 60 patients. After 1 year, flexion and grip strength were significantly better in the non-bridging group (87% vs 69% of the uninjured side), but extension was not, findings consistent with the greater residual dorsal angulation of the fracture in the bridging fixator group \(^\text{13}\). Atroschi and colleagues \(^\text{47}\) randomized 38 patients to bridging or non-bridging external fixation and found no differences in pain, DASH, grip strength or range of motion. Krishnan and colleagues \(^\text{48}\) randomized 60 patients to bridging or non-bridging external fixation, and found no differences in grip strength and pain, but the group treated with bridging external fixation had more flexion (60° vs 50°) and radial deviation. In another study, McQueen and colleagues \(^\text{4}\), in a study including 120 patients, compared open reduction internal fixation, casting, early
motion after external fixator and late motion after treatment with external fixation and found no significant differences in outcome. Jenkins and colleagues \(^49\) randomized 106 adults to bridging or non-bridging external fixator and noted that the patients in the non-bridging patients had more grip strength but motion comparable to that in patients in the bridging group. Franck and colleagues \(^50\) randomized 40 patients treated with Kirschner wires (K-wires) to non-bridging external fixators and found significantly better ulnar deviation in the external fixation group, but no other differences in outcome measures.

Wilcke and colleagues \(^16\) randomized 63 patients to volar plating or bridging external fixation. After a year, disability was the same, but the patients in the plating group had significantly better (but probably not clinically relevant) extension (94% vs 85% of the uninjured side), supination (99% vs 89%) and pronation (99% vs 92%) \(^16\).

Davis and Buchanan \(^51\) compared early motion with late motion in patients treated with a cast. After 1 week of treatment with a cast, 55 patients were randomized to 3 weeks additional casting or tubigrip \(^51\). The patients in the tubigrip group had better Gartland and Werley score, but all other outcome measures were comparable \(^51\). Two other similar studies had the same findings \(^10, 52\). Dias and colleagues \(^53\) randomized 97 patients with nondisplaced fractures to conventional casting for 5 weeks or crepe bandage, and 90 patients with displaced fractures to casting or modified casting (where a strap could be loosened volarly so motion was possible). For the patients in the nondisplaced group, outcomes were comparable, but the patients with displaced fractures treated with a modified cast had more grip strength (76% vs 58%) than the patients with a conventional cast \(^53\). Abbaszadegan and colleagues \(^54\) randomized 68 patients to 4 weeks of plaster cast or elastic bandage, and found better grip strength (78%-94%), arc of wrist flexion and extension (89% vs 98%) and radial and ulnar deviation in the group treated with a bandage.

We prefer to see full finger and forearm motion before we initiate wrist flexion and extension exercises. Patients and therapists often emphasize strengthening exercises, but strength returns with normal use and strengthening exercises should not be initiated until motion is well-established in order to avoid distracting the patients from the more important stretching exercises. Scar massage might help reduce adhesions of the skin to the tendons of the tendons \(^55\). There is no evidence that other scar treatments are effective. When patients are not gaining satisfactory function, dynamic or progressive splinting is sometimes considered \(^40, 56\) although these are passive treatments and there is no evidence that they are more effective than active-self assisted stretching. We prefer to help patients get comfortable with exercises in which they use objects such as a table top to create a fulcrum for getting a better stretch of the wrist capsule.

**Formal Physical or Occupational Therapy**

It’s not infrequent for a patient with a fracture of the distal radius to inquire, “will I need therapy?” at the first office visit. Again, we think this reflects the tendency of many patients to take a passive role in their recovery. Our answer is, “You will need to do lots of stretching exercises to get yourself recovered”. We emphasize that our role and that of a therapist is teaching, coaching, and camaraderie.

In a retrospective study, Oskarsson and colleagues \(^57\) documented that the 40 patients that requested physiotherapy had less motion and weaker grip 35 weeks after fracture than 70 patients that did not. Lyngcoln and colleagues \(^58\) found that adherence to the prescribed regimen of physiotherapy correlated with less pain but not greater motion. Taylor and Bennell concluded that there were no differences in range of motion when 30 patients were randomized
to passive mobilization or to sham passive mobilization (soft tissue massage) in addition to normal treatment.

Souer and colleagues randomized 46 patients to formal occupational therapy and 48 to independent exercises after volar plating. After 6 months the group randomized to independent exercises had better motion, although the differences were small. Among a group treated with volar plating, Krischak and colleagues randomized 23 patients to home exercises and 23 to formal physiotherapy. The patients assigned to home exercises had better grip strength and motion and less disability than the patients randomized to formal therapy. Another study found no differences between exercises/advice and formal physiotherapy in 42 patients treated with cast or K-wires. In a group treated with K-wires or a cast, Kay and colleagues randomized 28 patient to formal physiotherapy and 28 to independent exercises. After 6 weeks, the group treated with physiotherapy had less pain, but all other outcomes were comparable with outcomes in the other group. Another study by Kay and colleagues found that patients randomized to passive mobilization techniques in addition to physiotherapy and home exercises had slightly more flexion, but no differences in motion, pain or grip strength.

Among patients treated nonoperatively, Christensen and colleagues found no differences in exercise instructions or exercise instructions and formal occupational therapy. In a very small, randomized trial (9 patients per group), Watt and colleagues found formal physiotherapy to be better than independent exercises in patients treated with a cast. Pasila and colleagues found no differences between patients rehabilitating with home exercises and those with physiotherapy. Wakefield and McQueen randomized 96 older patients (87 women, mean age 72 years) to formal physiotherapy or home exercises. Among the 66 patients who were analyzed, the patients randomized to physiotherapy had more range of wrist motion; all other results were comparable. Gronlund and colleagues compared 17 patients undergoing early occupational therapy with 23 patients with usual care and found no difference in results at 3 months. Bache and colleagues, in an older group of 98 patients (mean age of 69 years) compared formal physiotherapy with home exercises and found that after 12 weeks, supination was better in the home exercises group, but other motions, pain or grip strength were comparable.

**Techniques for Reducing Disability**

Studies have shown that depressive symptoms and posttraumatic stress disorder are common after orthopaedic trauma. In patients recovering from a fracture of the distal radius, Gong and colleagues found that symptoms of depression correlated with pain and disability, but not operative or nonoperative treatment.

Coping strategies, symptoms of depression, catastrophic thinking, heightened illness concern, cultural factors, circumstantial sources of stress, and social factors (such as secondary gain) are all very responsive to treatment with techniques based in cognitive behavioral therapy. Cognitive behavioral therapy in its simplest form is learning to distinguish thought from fact. The cognitive errors and pain avoidant behavior to which humans are prone during injury or illness can be come fixed or habitual, particularly among patients accustomed to trusting their “gut feelings”.

Occupational and physical therapists have some formal training in psychology, and can develop these aspects of their expertise. All health providers need to work on effective communication skills, empathy in particular, and avoid using words and concepts that reinforce catastrophic thinking. In the future, psychologists, or at least cognitive and behavioral treatments, will likely be part of the treatment regimen for patients recovering from fracture.
of the distal radius. For now, health care providers should learn from the experts about the cognitive and emotional aspects of human illness behavior and try to incorporate the treatment strategies that are firmly based on evidence.

For example, patients with disproportionate pain and disability tend to present their hand as if it is separate from them, almost as if they brought it in to drop off for repair and pick up later. This dissociation and passivity are part of the normal human protective response to injury and pain, just taken a bit too far. Mirror therapy is a behavioral treatment that helps patients reincorporate their hand and arm as an integral part of themselves, which gets them back on track for recovery.73-78

Perhaps the most common cognitive error (misconception) in a hand surgeon’s office is: “these fingers won’t bend until the swelling is gone”. With enough empathy and coaching, a physician can get the patient to make a full fist within a few minutes. Seeing that the patient’s gut feeling was inaccurate can be empowering but it can also be very uncomfortable, so this should not be attempted until the physician is sure the patient is ready. Intuitive people do not particularly like magic shows, it is difficult for an intuitive person to experience such a divide between their thoughts (the woman is sawed in half) and the fact that it’s just sleight of hand when they are used to trusting their thoughts. Physicians need to be patient and see the patient every week or so initially if necessary (in practice this is rarely necessary but can be helpful when patients find exercises particularly counterintuitive).

We have noticed that patients tend to “turn the corner” in achieving the “health stretch” mindset as they begin to use the hand for things that are important to them. AT this stage, patients are finally convinced that they will recover and that the pain alarm is a false alarm. It can be very beneficial to encourage patients to try things that are important to them. Advise them that “it will definitely hurt, but it is definitely safe”. Just plant that seed without trying to convince and give them a week or two to try to get up the courage to go against their gut feeling.

Summary
Disability after a distal radius fracture is determined as much or more by mindset and circumstances than by pathophysiology or impairment. Active, self-assisted exercises are the most important part of the recovery process and healthcare providers’ role is primarily empathy and coaching patients through the normal protective response to pain and injury. Our job is guide patients towards the healthy stretch mindset, using empathy and encouraging them to return to activities that are important to them. The stretches themselves are straightforward, but they will not be done well until the patient is ready to fully participate in the recovery process.
References


