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The Implications of Chronic Pain Models for Rehabilitation of Distal Radius Fracture

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Short Title: Rehabilitation of the Distal Radius Fracture

Abstract

Distal radius fracture (DRF) is a common injury usually resulting from a fall. Most patients recover following DRF with no residual pain or disability, however a small subset of patients continue to experience pain and disability even one year after the injury. Currently, there are no practice guidelines for early identification and treatment of patients who are potentially at greater risk of developing these adverse outcomes. As a result, physiotherapy management of patients following DRF does not incorporate screening of these at-risk patients. The objective of this paper is to apply constructs from learned helplessness and cognitive-behavioral models of chronic pain in assessing psychosocial risk profile of patients following DRF. We have also integrated some of the key tenets derived from personal and life-style factors in assessing this risk profile. These guidelines are proposed to categorize patients into higher or lower psychosocial risk profile for developing chronic pain and disability following DRF. Moreover, we outline the theoretically driven model depicting the RACE approach towards the management of patients following DRF. The model suggests that patients with minimal psychosocial risk factors are managed based on their injury profile and those with higher psychosocial risk are treated with risk-based RACE approach. Physiotherapists can start with these theoretical frameworks to inform their practice. Since this approach is theoretically driven at best, high quality studies can

be designed to compare the RACE approach to standard therapy in mitigating the risk of chronic pain and disability in patients with greater risk of these adverse outcomes following DRF.

<u>INTRODUCTION</u>

Chronic pain is defined as "pain which lasts beyond the expected point of tissue healing, longer than 3 months duration", [1] and is commonly associated with musculoskeletal disorders. The overall prevalence of chronic musculoskeletal pain is increasing (27% in private household and 38% in long-term care homes) [2, 3]. The economic burden resulting from chronic musculoskeletal pain is substantial and likely to increase with the aging population [4, 5]. Chronic pain arising from musculoskeletal conditions such as back pain and fibromyalgia is commonly studied and is known to fit with a biopsychosocial framework [6, 7]. While theoretical frameworks have been discussed in these chronic musculoskeletal conditions, application of these frameworks to managing acute hand injury like a fracture has received little attention.

The focus of this paper is on chronic musculoskeletal pain, arising following hand injury using the example of a distal radius fracture (DRF). DRF is a common injury first described by an Irish surgeon Abraham Colles in 1814, hence it is often labelled as Colles fracture [8]. In developed countries, the incidence of DRF and other wrist fractures is > 39/10000 persons/year (Hodsman, Leslie, Tsang, and Gamble, 2008; van Staa, Dennison, Leufkens, and Cooper, 2001) [9, 10]. Furthermore, rates of DRF are gradually increasing in developed countries [11, 12].

Acute pain resulting from DRF serves as a warning sign indicating tissue injury. However chronic pain serves no purpose, does not necessarily reflect tissue injury, and is a liability to the

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body [2, 13]. Pain during fracture healing and remodelling can warn the patients when they are overly stressing the compromised fracture site. Ideally, DRF heals in anatomic position within 6 weeks and patients are able to resume motion of the affected wrist and hand. Even allowing for bone remodelling, it can be inferred that normal resumption of pain-free activities would be expected by three months.

However, a number of immediate and long-term complications [14] and residual disability are known to occur following DRF. Chronic pain and difficulties with occupational and household work are common and mostly observed in older adults (seven times greater than patients < 65 years of age) even one year after the DRF [15, 16]. The incidence of persistent pain and its characterization following DRF is quite variable. Our longitudinal data illustrates that 20% of individuals with a DRF still have moderate pain (and 8% severe or very severe pain) 3-months after a DRF [17]. The incidence of severe or very severe pain remains at 8% at 6-months and drops to 5% at 1-year [17]. Since those in moderate pain at 3-months may still be transitioning due to fracture healing, it seems inappropriate to classify them as having chronic pain at that time point.

Persistent severe pain and autonomic dysfunction can be caused by Complex regional pain syndrome type I (CRPS I) [18], a known complication following DRF [14]. However there is inconsistency in the literature regarding the rate of CRPS I following DRF, where some studies report incidence of CRPS I in the ranges of 15-28 % [19-21] and others report incidence of 1% [22]. Variations in incidence may partially relate to a lack of consistent diagnosis. Given the controversy in the diagnosis of CRPS, researchers have focused on measuring pain intensity as an adverse outcome, rather than the diagnosis of CRPS in clinical studies [23, 24]. Hence, for the purposes of this paper chronic pain will be considered as persistent pain beyond 6-months period rather than classifying it into CRPS or non-CRPS pain.

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A number of studies have identified predictors of poor functional status and chronic pain following DRF. These studies have determined that financial compensation [25], age, income level, and socioeconomic status [26] are the key predictors of chronic pain and functional status following DRF. Moore et al (2008) [15] found older adults were more vulnerable for developing chronic pain following DRF; whereas others report that older patients have less functional disability even when a poor reduction is achieved [27]. This inconsistency is likely because prognosis studies are usually case series or retrospective cohort in nature. The variables being examined are dependent on availability and not derived from any theoretical framework.

To date the literature has largely focused on the biomedical aspects of the problem in the assessment and treatment of patients following DRF [23, 24]. In the light of emerging evidence that the psychological factors could influence the self-reported pain and disability [28, 29], the potential role of psychological factors in development of chronic pain following DRF needs to be explored. Therfore, we selected predominant psychological models and discuss their application to DRF with an emphasis on how they might inform physical therapy management of DRF.

Prior to exploring how these psychological models might inform DRF management, the current evidence around the physical therapy management of DRF needs to be explored. A systematic review of physiotherapy following DRF found weak evidence to support physical therapy over exercises given by surgeon, and also for specific modalities including ultrasound, pneumatic compression devices, and continuous passive motion [30]. It has also been suggested that "in-house" (clinic-based) physical therapy exercises may not be needed for undisplaced casted DRF [31]. These reviews also highlight that the primary focus in DRF rehabilitation has been on correcting physical impairments (oedema, loss of motion/strength/hand function). Since a small subset of patients experience chronic pain and disability following DRF [15, 16, 25], there is a need to

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identify patients at risk early in the rehabilitation process and determine if altered rehabilitation pathways can prevent these adverse outcomes.

A discussion of all the theoretical models of chronic pain is beyond the scope of this paper. Rather, we have selected two models from psychology literature that have been used extensively in the field of chronic pain, but not discussed in relation to patients with DRF. The objective of this paper is to discuss the learned helplessness model and the cognitive-behavioural model of chronic pain and how they apply to DRF rehabilitation. Specifically, we want to identify potential predictors of chronic pain arising from these theoretical frameworks and discuss implications of these models in rehabilitation of patients who are believed to be at-risk of developing chronic pain following DRF. Related constructs from socio-economic and self-efficacy literature are also integrated in this discussion.

LEARNED HELPLESSNESS MODEL

The learned helplessness model was first described by Seligman (1972) [32] and then reformulated in 1978 [33]. The model argues that when individuals are unable to overcome a challenging situation, they develop helplessness behaviour. The generality and chronicity of an individuals' helplessness is influenced by the causal attribution these individuals make for the helplessness [33]. If they determine that a given situation is universally uncontrollable, i.e. nobody can change the outcome despite their efforts; then they do not blame themselves for their lack of ability to change the outcome of that situation. Conversely, if they attribute the cause of their helplessness to be their own internal factors, where others can alter the outcome with necessary efforts, the self-blame is greater and eventually gives rise to three-fold deficits in their behaviour. Subcomponents of this helplessness have been described as below:

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   I.   Cognitive – holding a belief that the outcomes are uncontrollable despite efforts to overcome the situation [33].

  II.   Motivational – decreased motivation to initiate responses to control the situation. This is because the individual believes that the adverse outcome is inevitable and his actions will not alter it [33].

 III.   Emotional – learning that the outcomes are uncontrollable leads to depression and lack of self-confidence [33].

Previous studies have explored the relationship between the learned helplessness and chronic musculoskeletal pain. These studies have indicated that the helplessness influences chronic pain behaviour in patients with fibromyalgia, rheumatic conditions, and certain other chronic conditions [34-39]. Samwel et al (2006) [36] also suggested that clinicians involved in the treatment of patients with chronic pain should always examine if learned helplessness is influencing this behaviour before formulating a treatment plan.

Other studies have linked helplessness behaviour to lower self-dignity and disrupted identity. Individuals suffering from helplessness behaviour tend to have poor socio-economic status and quality of life in addition to depressive behaviour [40, 41]. Thus the literature suggests that there may be both generic and (pain) specific aspects to learned helplessness.

Learned helplessness can develop during response to injury like DRF, but is also modulated by prior experiences with painful conditions. In particular, if patients were unable to successfully manage their pain or control the outcome of a previous health problem, they may be "preset" in a mode of learned helplessness. When confronted with a new injury, such as DRF, their injury response may be governed by previously developed learned helplessness. Patients with chronic musculoskeletal pain demonstrate depressive behaviour, withdrawal, and

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motivational deficits [42-44]. This is congruent with the learned helplessness model and would lead to reduced engagement in rehabilitation. Since lack of adherence to hand therapy can lead to poor outcomes following DRF [45], therapist may need to assess learned helplessness as a potential barrier to rehabilitation and be prepared to appropriately manage it.

<div align="center">**COGNITIVE-BEHAVIOURAL MODEL OF CHRONIC PAIN**</div>

The cognitive-behavioural model of chronic pain proposes that patients' negative beliefs and poor coping behaviours are central to the development and maintenance of chronic pain [44, 46, 47]. Patients with pain are engaged in continuous process of interpreting the information related to their pain. Their interpretation and reaction to the injury predicts the behavioural coping and emotional state of the individual [44, 46, 47]. It has been suggested that negative cognitive behaviours following an injury could lead to catastrophic pain and chronicity [44, 46, 47]. A number of factors such as reacting negatively to the physical injury, avoiding usual activities due to fear of aggravating pain, decreased self-efficacy, and lack of initiative in handling the problem can lead to psychological distress and maintenance of the painful state. It is has been believed that pain behaviours such as verbal reporting of intense pain, limping while walking, and avoiding daily activities are associated with poor coping skills [48]. In patients with hand injuries, these behaviours might include holding the affected hand with the unaffected hand for support, avoiding movement, jerky/dyskinetic movement, and exaggerated pain complaints during therapy. Being overly reliant on protective devices and orthotics might also suggest this behaviour pattern.

The model also proposes that factors such as attention from spouse, health care providers, and financial compensation can become motivators of the pain behaviours as they reinforce the learned helplessness [47, 49, 50]. Financial compensation has already been observed as a predictor of chronic pain in patients with DRF [25]. The attention from spouse and health care providers in

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influencing chronic pain behaviours in patients with DRF has not been examined, but the therapists may be able to observe the behaviour of "overprotective" spouses/family in the clinic. It has been suggested that patients with chronic pain are afraid of causing further damage to their injury and warrant further examination and alternative treatments for relieving pain [48]. This can be particularly important following a fracture where patients may not fully understand whether the bone is healed or there is a risk of repeat fracture. Since, most wrist fractures arise from a fall this can exacerbate the fear of re-injury. Therapists can play an important role in reducing fear avoidance of movement by providing appropriate explanation of the injury, healing process and guidelines for safe activity [48, 51]. In some cases, fall prevention programs that include physical and cognitive elements may be needed to reduce anxiety. Graded activity programs that incorporate principles of cognitive behavioural therapy may assist patients demonstrating fear avoidance behaviours to resume more normal activity.

Negative cognitive processes can lead to a decline in self-efficacy which contributes to, and is exacerbated by passive pain coping strategies. When patients expect pain control will be accomplished by external factors, they develop inactive attitudes towards controlling their pain. Overreliance on modalities and passive mobilization may exacerbate this problem. Conversely, we also know that adequate pain control is important since uncontrolled pain can be the instigator for adverse psychological and physiological processes that becomes a vicious circle and lead to chronic pain [48]. Mitigation of negative cognitive processes can include strategies of activating patients, empowering them and using cognitive processes (contemplation) to alter their perceptions and coping skills to be more favourable for pain control. By using more active pain relief approaches and providing techniques/interventions which allow self-management of pain, it is possible to manage pain without adversely affecting self-efficacy or creating passive strategies

in patients with DRF. A qualitative studies indicated that compensatory behaviours are common after DRF [52]. During the healing phase of DRF, this may be both necessary and appropriate. However, maintained compensation will be contrary to full recovery. We know that grip strength is markedly reduced following immobilization [53]. Lack of engagement in rehabilitation and active functional use of the hand could lead to ongoing strength impairments that reinforce reduced activity levels. Studies support that the graded functional activity is effective in recovery following DRF [24].

In summary, the cognitive-behavioural model suggests that pain related beliefs and behaviours held by the patient can lead to either helpful or unhelpful coping strategies. Negative perceptions can be identified by therapists based on observation of patients beliefs/attitudes or behaviours and should be considered as risk for developing chronic pain. Conversely, positive attitude and thinking, viewing pain as a manageable problem, adopting a pro-active approach by patients in pain management can reduce pain intensity and should be considered as potential therapeutic agent [46-48].

RELATED CONSTRUCTS FROM OTHER MODELS OF CHRONIC PAIN

The focus of this paper was using two psychological models as foundation for discussing prognostic variables that might be considered during management of DRF. However, these potential predictors should be considered in light of other factors that might be potential risks for developing chronic pain following DRF. Individuals who live in poor socio-economic conditions [26, 54, 55] or are as well as those who are manual workers [56] are more likely to exhibit chronicity of pain. Self-efficacy and perceived pain control are often termed as a predictors of pain and functional status in patients with different chronic musculoskeletal conditions and should be considered while managing patients with DRF [57-59].

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Physical aspects of the injury including its severity, treatment complications and pre-exisitng health are also potenial mediators. We know that the extent of initial displacement [60] and inadequate reduction [27] contribute to higher pain and disability outocomes following DRF, hence these factors should be considered while treating patients with DRF. Moreover, individuals with commorbidities experience greater chronicity of pain in different body areas. In particular, those suffering from diabetes [61], obesity [62, 63], and hypertension [64] exhibit greater musculoskeletal pain. These patients may have pre-existing health-related negative cognitions or already developed substantial learned helplessness behaviours that would govern their response to an acute injury like DRF. Additionally, personal and life-style factors such as reduced physical activity and smoking are known to impact chronic pain behaviour [65, 66]. Those who suffer from other illnesses, have had sedentary life-style, and have history of smoking are at greater risk of developing chronic pain following DRF. These factors should also be explored while assessing patients for rehabilitation following DRF.

CLINICAL IMPLICATIONS FOR PHYSICAL THERAPISTS FOR ASSESSMENT AND TREATEMENT IN REHABILITATION OF PATIENTS WITH DRF

It is apparent from the existing literature that there is small but clinically relevant subset of patients who experience profound pain and disability following DRF. The incidence rate of these adverse outcomes is 5-8% even after necessary physical therapy interventions. Current assessment and treatment practices for patients with DRF primarily focus on physical aspect of impairment [23, 24]. Based on the discussion of the some important constructs from two psychologically-based models of chronic pain and their potential application in managing patients with DRF, it is worthwhile to incorporate psychologically-based risk-reduction and management techniques into the DRF rehabilitation. Firstly, this risk-reduction approach should screen

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patients who are believed to be at-risk of developing chronic pain and disability based on the assessment guidelines derived from the theoretical constructs discussed earlier. Secondly, risk profile should be created for individual patient and customized treatment programs should be employed in the management of such patients.

One of this study authors (JMD) has recommended that an important part of rehabilitation is to *"Assist Patients in Dealing With Their Injury Using Appropriate Coping Mechanisms and Avoidance of Patterns That Increase the Risk of developing Chronic Pain/Disability Syndromes"* [67]. However, that paper did not describe how to do so. The application of models discussed in this paper and evidence about risk factors can provide strategies on how to assess risk factors during patient assessment (interview questions listed in Table 1). At present, there are no qualitative studies defining the specific negative cognitions associated with DRF, prognostic cohort studies that specifically define the role of learned helplessness or other specific negative cognitions, or intervention studies that compare cognitive-behavioural physical therapy with standard therapy in DRF patients. However, this work has been performed in other musculoskeletal conditions like back and neck pain and it is suggested that this approach is effective [68-71]. While high quality studies are needed to enhance the understanding of what type and extent of negative behaviours affect outcomes following DRF, it is possible to extrapolate the findings from other musculoskeletal conditions and apply the theoretically-based suggestions contained in this paper to construct an approach for assessing and treating DRF in higher risk patients versus a low-risk patients.

<u>**Assessment Implications**</u>

As outlined earlier, the purpose of the initial assessment should be to screen the patients at-risk of chronic pain following DRF. The therapist can determine psychosocial risk factors from

an intake interview. Interview should include specific questions that would identify response to previous injuries, attitudes/beliefs about pain, and the patients' perceived control to identify potential negative cognition of 'helplessness'. Prior negative experiences can contribute to a poor outcome of long-term pain and disability [33, 35, 36]. The helplessness subscale of the RAI can be used to examine the helplessness behaviour by self-report [72]. Although not used for DRF in the past, it has been used successfully in patients with other musculoskeletal conditions [34, 73]. The "Yellow flags" are reports of unexpectedly high levels of pain, inability to control pain, and experiences with healthcare professionals who were "not able to control their pain". Patients with concurrent chronic pain conditions such as fibromyalgia, low back pain, neck pain, and headaches may have established positive or negative response patterns that are "pre-wired" and it will be useful for the therapist to identify any helplessness issues resulting from their inability to control these conditions as prognostic for response to a DRF.

Cognitive variables such as negative beliefs about the cause, prognosis, poor coping skills, and catastrophizing of the injury are negative cognitions that may play a role in the development of chronic pain in patients following DRF [44, 48]. These factors should be identified early in the management of DRF patients. Negative cognitions may manifest during interviews or be evident by responses on questionnaires like the Patient Rated Wrist/Hand Evaluation (PRWHE) and the Illness Perception Questionnaire (IPQ). The PRWHE has a pain scale that asks about pain intensity/frequency and Usual Activities Scale which asks functional impairments compared to their pre-injury activity [74]. Higher baseline pain scores on the PRWHE predict long-term outcomes and also identify patients who were unsuccessful in returning to work [16]. The IPQ offers quantitative measurement of patients' beliefs about five domains of their injury: the cause of the injury, symptoms of the injury, consequences of the injury, time-frame for which the injury

will last, and their ability or health care professional's ability to control the outcome of the injury [75, 76]. The IPQ can quantitatively measure the constructs of helplessness and cognitive-behavioural response to DRF and can serve as a useful screening measure to identify these predictors of chronic pain in patients following DRF. The IPQ has been useful in assessing similar constructs in patients with rheumatoid arthritis [77], chronic fatigue syndrome [78], diabetes, [79] and chronic obstructive pulmonary disease [80].

Given the association between chronic pain and comorbidities [61-64], it is important to have an accurate medical history of the patients presenting to physiotherapy department for rehabilitation following DRF. Many clinics have established intake mechanisms such as existing assessment forms or linkage to medical records that address comorbid conditions. If this is not available, the Comorbidity Index (CI) can be used for this purpose [81]. Physical activity level and smoking history should also be screened, as they often predict chronic pain [65, 66].

Patient-Specific Functional Scale (PSFS) can be used to identify the activities that are compromised as a result of the DRF and assess the level of impairment with those activities [82, 83]. This will provide insight into how impaired the person views himself and identifies tasks that may become the focus for activity-based treatment.

Table 1 provides examples of how prognosis questions of different domains can be incorporated into assessment in order to determine the risk profile of patients for developing chronic pain following DRF. Patients at high risk of chronic pain should be managed according to their risk profile, whereas those at low risk may be managed according to their injury profile.

Treatment Implications

Patients should be managed based on their prognosis for recovery. All patients should be informed that DRF has a high rate of recovery and normally results in minimal permanent

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disablement. They should be told that the pain resulting from a DRF is transient and usually manageable with minor intervention. This will benefit both high-risk and low-risk patients by reducing their anxiety at the outset.

Some patients may not require extensive rehabilitation following a DRF. Patients who fall into a low risk group from the psychosocial perspective and the physical perspective may be do well on a home-based exercise program with advice to contact physical therapists if should they have any difficulty [24]. A positive psychosocial profile is a patient with high-self efficacy, minimal fear of pain/movement (within safety parameters) and positive goals and expectations around resumption of activity. Therapists should consciously evaluate these attitudes and behaviours during assessment and promote them through treatment approaches. Helplessness, lack of self-efficacy/problem-solving, fear of movement, catastrophizing, or other psychosocial barriers might suggest that closer supervision and a more psychologically based approach is needed. Graded imagery, graded meaningful activity combined with cognitive evaluation of capability/response, mirror therapy, patient-centered goal setting/treatment planning and group-based activity programs are examples of treatment choices that may benefit patients who need greater integration of psychosocial and physical rehabilitation. The main objective is to promote self-efficacy and independence in daily activities and not focus on pain. Similar approaches have been successful in patients with other musculoskeletal conditions [37, 84].

Health care providers should use consistent and clear language while communicating with their patients. This has positive impact on patients' recovery by reducing their negative cognition regarding the injury [85]. Patients' perception that their injury is unexplained contributes to catastrophizing their illness and injury [51]. Patients should be encouraged to ask questions so that unique concerns are identified and addressed. The dynamics of client-caregiver relationship can

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be constructively influenced by positive communication [85]. Home-based exercise programs and patient educational materials should address both physical and psychological aspects of injury recovery. Having the education materials made more personalized can also combat learned helplessness. Studies have also shown that conveying information on prognosis and treatment benefits improves exercise adherence in patients with chronic pain [86].

Focusing on specific, relevant and achievable goals allows patients to increase their self-efficacy and physical activity simultaneously. This might mean helping elderly patients' efforts to use their affected hand while eating or dressing or injured workers to strengthen their arm in carrying objects related to their work. Similarly, younger patients may have sport or endurance related goals. In a study examining personal recovery choice pathways, patients and clinicians exhibited much more divergence in preferences [87], indicating that the person's life context was a potent determinant on the perspectives of disability and not well represented by the clinicians. Therefore, patients should have opportunity to exert this perspective throughout the rehabilitation process. This includes allowing patients to choose important activities in therapy and at home that meet physical goals, set personal functional goals, customize their own treatment plan, share decisions about progressing treatment and reviewing their own progress though specific (patient-based and impairment-based) data can empower them to assume greater control and actively participate in their own rehabilitation. A cohort study of patients followed 1 year after rehabilitation for spinal disorders found that a personal goal achievement score provided the greatest patient satisfaction.[88] Similarly, a patient-oriented hand therapy program was shown to produce better scores on self-reported outcome, less pain, and higher patient satisfaction than a standard hand program [89].

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Figure 1 illustrates an integrated rehabilitation model for patients following DRF. It incorporates a prognosis-based approach, where high-risk individuals would receive a biopsychosocial approach to rehabilitation and low risk patients would receive advice and home program. The components of the model are: 1) **R**educing pain (without encouraging helplessness), 2) **A**ctivating (graded and meaningful activity), 3) **C**ognitive techniques to facilitate positive attitudes/behaviours and mitigate negative ones during therapy/recovery), and 4) **E**mpowering (increasing self-efficacy and control to facilitate ownership and competency around self management). We have given this model a short name derived from these components - RACE.

OUTCOME EVALUATION

Constant monitoring of pain and disability can facilitate early identification of pain/disability experiences that are excessive or fail to resolve. Patients may feel being in control of their injury if they can monitor their progress. Measuring their symptoms through self-report (PRWHE) and physical parameters (strength, motion, hand volume) on a shared progress flow sheet can serve as start point for setting goals and discussing what these indicators suggest about their progress. Overly aggressive activity will cause swelling and loss of motion measured through hand volume or joint range of motion. Insufficient activity will show dampened improvements in both impairment and functional measures. The PRWHE has separate scales for tracking pain, standard tasks, and usual tasks, which may allow for discrete discussions and goal setting. The use of PSFS where patient select their own problematic functional activities is a simple way to incorporate patient-based goal setting into treatment and outcome evaluation. Patients may benefit from a personal log that allows them to monitor their outcomes and opinions about therapy for ongoing reflection and discussion.

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FUTURE DIRECTIONS

Therapy needs after DRF may range from a home program to intensive. Clinical prediction rules that identify subgroups have not been developed. However, we know that 5 to 10% of people develop chronic pain following DRF and this represents a substantial burden. We also know that both psychosocial and physical risk factors are implicated and thus have sufficient basis to use existing theory and evidence to assessment and treatment approaches. However, there is a need for more high quality prognostic studies that identify risk factors derived from broader theoretical models rather than a biomedical framework. Future prognostic and effectiveness research should include measures that evaluate biological, neurophysiological, and psychological variables during recovery to build more specific and evidence-based models of how to optimize recovery following DRF. Subsequently, randomized trials that compare prognosis-based treatment versus standardized treatment and trials might be conducted to provide more meaningful information on therapy roles and effects.

CONCLUSION

Chronic pain occurs in a small subset of patients following DRF but leads to profound disablement. A biopsychosocial approach to rehabilitation is needed but is not currently a standard practice. This paper discussed two psychological models of chronic musculoskeletal pain: the learned helplessness model and the cognitive-behavioural model and their application in the rehabilitation of DRF. A prognosis-based (RACE approach to DRF was suggested, where patients with minimal psychosocial risk factors are managed based on their injury profile and those with higher risk have a risk-based treatment program. This program will reduce the pain stimulus, engage patients in meaningful graded activities, use cognitive interaction to optimize positive thoughts and behaviours, and empower them to be in control in managing their recovery.

REFERENCE LIST

(1) Strong J. Chronic Pain Problems. *Pain: a Textbook for Therapists*. 1 ed. London: Churchill Livingstone; 2002. 397-410.

(2) Ramage-Morin PL. Chronic pain in Canadian seniors. *Health Rep* 2008;19(1):37-52.

(3) Fox PL, Raina P, Jadad AR. Prevalence and treatment of pain in older adults in nursing homes and other long-term care institutions: a systematic review. *CMAJ* 1999;160(3):329-333.

(4) D'Astolfo CJ, Humphreys BK. A record review of reported musculoskeletal pain in an Ontario long term care facility. *BMC Geriatr* 2006;6:5.

(5) Podichetty VK, Mazanec DJ, Biscup RS. Chronic non-malignant musculoskeletal pain in older adults: clinical issues and opioid intervention. *Postgrad Med J* 2003;79(937):627-633.

(6) Weiner BK. Spine update: the biopsychosocial model and spine care. *Spine (Phila Pa 1976)* 2008;33(2):219-223.

(7) Masi AT, White KP, Pilcher JJ. Person-centered approach to care, teaching, and research in fibromyalgia syndrome: justification from biopsychosocial perspectives in populations. *Semin Arthritis Rheum* 2002;32(2):71-93.

(8) Colles A. On the fracture of the carpal extremity of the radius. Edinb Med Surg J. 1814;10:181. *Clin Orthop Relat Res* 2006;445:5-7.

(9) Hodsman AB, Leslie WD, Tsang JF, Gamble GD. 10-year probability of recurrent fractures following wrist and other osteoporotic fractures in a large clinical cohort: an analysis from the Manitoba Bone Density Program. *Arch Intern Med* 2008;168(20):2261-2267.

(10) van Staa TP, Dennison EM, Leufkens HG, Cooper C. Epidemiology of fractures in England and Wales. *Bone* 2001;29(6):517-522.

(11) Thompson PW, Taylor J, Dawson A. The annual incidence and seasonal variation of fractures of the distal radius in men and women over 25 years in Dorset, UK. *Injury* 2004;35(5):462-466.

(12) Larsen CF, Lauritsen J. Epidemiology of acute wrist trauma. *Int J Epidemiol* 1993;22(5):911-916.

(13) Moseley GL. A pain neuromatrix approach to patients with chronic pain. *Man Ther* 2003;8(3):130-140.

(14) McKay SD, MacDermid JC, Roth JH, Richards RS. Assessment of complications of distal radius fractures and development of a complication checklist. *J Hand Surg [Am]* 2001;26(5):916-922.

(15) Moore CM, Leonardi-Bee J. The prevalence of pain and disability one year post fracture of the distal radius in a UK population: a cross sectional survey. *BMC Musculoskelet Disord* 2008;9:129.

(16) MacDermid JC, Roth JH, McMurtry R. Predictors of time lost from work following a distal radius fracture. *J Occup Rehabil* 2007;17(1):47-62.

(17) MacDermid JC, Roth JH, Richards RS. Pain and disability reported in the year following a distal radius fracture: a cohort study. *BMC Musculoskelet Disord* 2003;4:24.

(18) Merskey H. Logic, truth and language in concepts of pain. *Qual Life Res* 1994;3 Suppl 1:S69-S76.

(19) Field J, Atkins RM. Algodystrophy is an early complication of Colles' fracture. What are the implications? *J Hand Surg Br* 1997;22(2):178-182.

(20) Bickerstaff DR, Kanis JA. Algodystrophy: an under-recognized complication of minor trauma. *Br J Rheumatol* 1994;33(3):240-248.

(21) Atkins RM, Duckworth T, Kanis JA. Algodystrophy following Colles' fracture. *J Hand Surg Br* 1989;14(2):161-164.

(22) Dijkstra PU, Groothoff JW, ten Duis HJ, Geertzen JH. Incidence of complex regional pain syndrome type I after fractures of the distal radius. *Eur J Pain* 2003;7(5):457-462.

(23) Kay S, McMahon M, Stiller K. An advice and exercise program has some benefits over natural recovery after distal radius fracture: a randomised trial. *Aust J Physiother* 2008;54(4):253-259.

(24) Maciel JS, Taylor NF, McIlveen C. A randomised clinical trial of activity-focussed physiotherapy on patients with distal radius fractures. *Arch Orthop Trauma Surg* 2005;125(8):515-520.

(25) Grewal R, MacDermid JC, Pope J, Chesworth BM. Baseline predictors of pain and disability one year following extra-articular distal radius fractures. *Hand (N Y)* 2007;2(3):104-111.

(26) Chung KC, Kotsis SV, Kim HM. Predictors of functional outcomes after surgical treatment of distal radius fractures. *J Hand Surg Am* 2007;32(1):76-83.

(27) Grewal R, MacDermid JC. The risk of adverse outcomes in extra-articular distal radius fractures is increased with malalignment in patients of all ages but mitigated in older patients. *J Hand Surg [Am]* 2007;32(7):962-970.

(28) Watson J, Ring D. Influence of psychological factors on grip strength. *J Hand Surg Am* 2008;33(10):1791-1795.

(29) Ring D, Kadzielski J, Fabian L, Zurakowski D, Malhotra LR, Jupiter JB. Self-reported upper extremity health status correlates with depression. *J Bone Joint Surg Am* 2006;88(9):1983-1988.

(30) Handoll HH, Madhok R, Howe TE. Rehabilitation for distal radial fractures in adults. *Cochrane Database Syst Rev* 2002;(2):CD003324.

(31) Wakefield AE, McQueen MM. The role of physiotherapy and clinical predictors of outcome after fracture of the distal radius. *J Bone Joint Surg Br* 2000;82(7):972-976.

(32) Seligman ME. Learned helplessness. *Annu Rev Med* 1972;23:407-412.

(33) Abramson LY, Seligman ME, Teasdale JD. Learned helplessness in humans: critique and reformulation. *J Abnorm Psychol* 1978;87(1):49-74.

(34) Palomino RA, Nicassio PM, Greenberg MA, Medina EP, Jr. Helplessness and loss as mediators between pain and depressive symptoms in fibromyalgia. *Pain* 2007;129(1-2):185-194.

(35) Samwel HJ, Kraaimaat FW, Crul BJ, Evers AW. The role of fear-avoidance and helplessness in explaining functional disability in chronic pain: a prospective study. *Int J Behav Med* 2007;14(4):237-241.

(36) Samwel HJ, Evers AW, Crul BJ, Kraaimaat FW. The role of helplessness, fear of pain, and passive pain-coping in chronic pain patients. *Clin J Pain* 2006;22(3):245-251.

(37) Hommel KA, Wagner JL, Chaney JM, White MM, Mullins LL. Perceived importance of activities of daily living and arthritis helplessness in rheumatoid arthritis; a prospective investigation. *J Psychosom Res* 2004;57(2):159-164.

(38) Tayer WG, Nicassio PM, Weisman MH, Schuman C, Daly J. Disease status predicts fatigue in systemic lupus erythematosus. *J Rheumatol* 2001;28(9):1999-2007.

(39) Smith TW, Christensen AJ, Peck JR, Ward JR. Cognitive distortion, helplessness, and depressed mood in rheumatoid arthritis: a four-year longitudinal analysis. *Health Psychol* 1994;13(3):213-217.

(40) Aujoulat I, Luminet O, Deccache A. The perspective of patients on their experience of powerlessness. *Qual Health Res* 2007;17(6):772-785.

(41) Waschbusch DA, Sellers DP, LeBlanc M, Kelley ML. Helpless attributions and depression in adolescents: the roles of anxiety, event valence, and demographics. *J Adolesc* 2003;26(2):169-183.

(42) Crombez G, Eccleston C, Van Hamme G, De Vlieger P. Attempting to solve the problem of pain: a questionnaire study in acute and chronic pain patients. *Pain* 2008;137(3):556-563.

(43) Molton IR, Jensen MP, Nielson W, Cardenas D, Ehde DM. A preliminary evaluation of the motivational model of pain self-management in persons with spinal cord injury-related pain. *J Pain* 2008;9(7):606-612.

(44) Turk DC, Okifuji A. Chronic Pain. *Chronic Physical Disorders : Behavioral Medicine's Perspective*.Cornwall, UK: John Wiley & Sons, Ltd.; 2008. 165-190.

(45) Lyngcoln A, Taylor N, Pizzari T, Baskus K. The relationship between adherence to hand therapy and short-term outcome after distal radius fracture. *J Hand Ther* 2005;18(1):2-8.

(46) Nicholas M, Sharp TJ. Cognitive-behavioral programs: theory and application. *Int Anesthesiol Clin* 1997;35(2):155-170.

(47) Turk DC, Rudy TE. Cognitive factors and persistent pain: A glimpse into pandora's box. *Cognitive Therapy and Research* 1992;16(2):99-122.

(48) Sharp TJ. Chronic pain: a reformulation of the cognitive-behavioural model. *Behav Res Ther* 2001;39(7):787-800.

(49) Boothby JL, Thorn BE, Overduin LY, Ward LC. Catastrophizing and perceived partner responses to pain. *Pain* 2004;109(3):500-506.

(50) Block AR, Kremer EF, Gaylor M. Behavioral treatment of chronic pain: the spouse as a discriminative cue for pain behavior. *Pain* 1980;9(2):243-252.

(51) Kouyanou K, Pither CE, Rabe-Hesketh S, Wessely S. A comparative study of iatrogenesis, medication abuse, and psychiatric morbidity in chronic pain patients with and without medically explained symptoms. *Pain* 1998;76(3):417-426.

(52) Bialocerkowski AE. Difficulties associated with wrist disorders--a qualitative study. *Clin Rehabil* 2002;16(4):429-440.

(53) MacDermid JC, Richards RS, Roth JH. Distal radius fracture: a prospective outcome study of 275 patients. *J Hand Ther* 2001;14(2):154-169.

(54) Davies KA, Silman AJ, Macfarlane GJ et al. The association between neighbourhood socio-economic status and the onset of chronic widespread pain: results from the EPIFUND study. *Eur J Pain* 2009;13(6):635-640.

(55) Macfarlane GJ, Norrie G, Atherton K, Power C, Jones GT. The influence of socio-economic status on the reporting of regional and widespread musculoskeletal pain: results from the 1958 British Birth Cohort Study. *Ann Rheum Dis* 2008.

(56) Saastamoinen P, Leino-Arjas P, Laaksonen M, Lahelma E. Socio-economic differences in the prevalence of acute, chronic and disabling chronic pain among ageing employees. *Pain* 2005;114(3):364-371.

(57) Mannerkorpi K, Svantesson U, Broberg C. Relationships between performance-based tests and patients' ratings of activity limitations, self-efficacy, and pain in fibromyalgia. *Arch Phys Med Rehabil* 2006;87(2):259-264.

(58) Rudy TE, Lieber SJ, Boston JR, Gourley LM, Baysal E. Psychosocial predictors of physical performance in disabled individuals with chronic pain. *Clin J Pain* 2003;19(1):18-30.

(59) Lackner JM, Carosella AM. The relative influence of perceived pain control, anxiety, and functional self efficacy on spinal function among patients with chronic low back pain. *Spine (Phila Pa 1976)* 1999;24(21):2254-2260.

(60) MacDermid JC, Donner A, Richards RS, Roth JH. Patient versus injury factors as predictors of pain and disability six months after a distal radius fracture. *J Clin Epidemiol* 2002;55(9):849-854.

(61) Hoff OM, Midthjell K, Zwart JA, Hagen K. The association between diabetes mellitus, glucose, and chronic musculoskeletal complaints. Results from the Nord-Trondelag Health Study. *BMC Musculoskelet Disord* 2008;9(1):160.

(62) McCarthy LH, Bigal ME, Katz M, Derby C, Lipton RB. Chronic Pain and Obesity in Elderly People: Results from the Einstein Aging Study. *J Am Geriatr Soc* 2008.

(63) Hitt HC, McMillen RC, Thornton-Neaves T, Koch K, Cosby AG. Comorbidity of obesity and pain in a general population: results from the Southern Pain Prevalence Study. *J Pain* 2007;8(5):430-436.

(64) Bruehl S, Chung OY, Jirjis JN, Biridepalli S. Prevalence of clinical hypertension in patients with chronic pain compared to nonpain general medical patients. *Clin J Pain* 2005;21(2):147-153.

(65) Weingarten TN, Moeschler SM, Ptaszynski AE, Hooten WM, Beebe TJ, Warner DO. An assessment of the association between smoking status, pain intensity, and functional interference in patients with chronic pain. *Pain Physician* 2008;11(5):643-653.

(66) Holth HS, Werpen HK, Zwart JA, Hagen K. Physical inactivity is associated with chronic musculoskeletal complaints 11 years later: Results from the Nord-Trondelag Health Study. *BMC Musculoskelet Disord* 2008;9(1):159.

(67) MacDermid JC. Hand therapy management of intra-articular fractures with open reduction and pi plate fixation: a therapist's perspective. *Tech Hand Up Extrem Surg* 2004;8(4):219-223.

(68) den Boer JJ, Oostendorp RA, Beems T, Munneke M, Oerlemans M, Evers AW. A systematic review of bio-psychosocial risk factors for an unfavourable outcome after lumbar disc surgery. *Eur Spine J* 2006;15(5):527-536.

(69) Gohner W, Schlicht W. Preventing chronic back pain: evaluation of a theory-based cognitive-behavioural training programme for patients with subacute back pain. *Patient Educ Couns* 2006;64(1-3):87-95.

(70) Busch H. Appraisal and coping processes among chronic low back pain patients. *Scand J Caring Sci* 2005;19(4):396-402.

(71) Michaelson P, Sjolander P, Johansson H. Factors predicting pain reduction in chronic back and neck pain after multimodal treatment. *Clin J Pain* 2004;20(6):447-454.

(72) DeVellis RF, Callahan LF. A brief measure of helplessness in rheumatic disease: the helplessness subscale of the Rheumatology Attitudes Index. *J Rheumatol* 1993;20(5):866-869.

(73) Thumboo J, Fong KY, Chan SP et al. The Rheumatology Attitudes Index and its helplessness subscale are valid and reliable measures of learned helplessness in Asian patients with systemic lupus erythematosus. *J Rheumatol* 1999;26(7):1512-1517.

(74) MacDermid JC, Turgeon T, Richards RS, Beadle M, Roth JH. Patient rating of wrist pain and disability: a reliable and valid measurement tool. *J Orthop Trauma* 1998;12(8):577-586.

(75) Moss-Morris R, Weinman J, Petrie K, Horne R, Cameron L, Buick D. The Revised Illness Perception Questionnaire (IPQ-R). *Psychology & Health* 2002;17(1):1-16.

(76) Weinman J, Petrie K, Moss-Morris R, Horne R. The illness perception questionnaire: A new method for assessing the cognitive representation of illness. *Psychology & Health* 1996;11(3):431-445.

(77) Murphy H, Dickens C, Creed F, Bernstein R. Depression, illness perception and coping in rheumatoid arthritis. *J Psychosom Res* 1999;46(2):155-164.

(78) Heijmans MJ. Coping and adaptive outcome in chronic fatigue syndrome: importance of illness cognitions. *J Psychosom Res* 1998;45(1 Spec No):39-51.

(79) Griva K, Myers LB, Newman S. Illness perceptions and self efficacy beliefs in adolescents and young adults with insulin dependent diabetes mellitus. *Psychology & Health* 2000;15(6):733-750.

(80) Scharloo M, Kaptein AA, Weinman JA, Willems LN, Rooijmans HG. Physical and psychological correlates of functioning in patients with chronic obstructive pulmonary disease. *J Asthma* 2000;37(1):17-29.

(81) Sangha O, Stucki G, Liang MH, Fossel AH, Katz JN. The Self-Administered Comorbidity Questionnaire: a new method to assess comorbidity for clinical and health services research. *Arthritis Rheum* 2003;49(2):156-163.

(82) Westaway MD, Stratford PW, Binkley JM. The patient-specific functional scale: validation of its use in persons with neck dysfunction. *J Orthop Sports Phys Ther* 1998;27(5):331-338.

(83) Chatman AB, Hyams SP, Neel JM et al. The Patient-Specific Functional Scale: measurement properties in patients with knee dysfunction. *Phys Ther* 1997;77(8):820-829.

(84) Geraets JJ, Goossens ME, de Bruijn CP et al. A behavioural treatment for chronic shoulder complaints: concepts, development, and study design. *Aust J Physiother* 2004;50(1):33-38.

(85) Cedraschi C, Nordin M, Nachemson AL, Vischer TL. Health care providers should use a common language in relation to low back pain patients. *Baillieres Clin Rheumatol* 1998;12(1):1-15.

(86) Medina-Mirapeix F, Escolar-Reina P, Gascon-Canovas JJ, Montilla-Herrador J, Collins SM. Personal characteristics influencing patients' adherence to home exercise during chronic pain: a qualitative study. *J Rehabil Med* 2009;41(5):347-352.

(87) Stineman MG, Rist PM, Kurichi JE, Maislin G. Disability meanings according to patients and clinicians: imagined recovery choice pathways. *Qual Life Res* 2009;18(3):389-398.

(88) Hazard RG, Spratt KF, McDonough CM et al. The impact of personal functional goal achievement on patient satisfaction with progress one year following completion of a functional restoration program for chronic disabling spinal disorders. *Spine (Phila Pa 1976)* 2009;34(25):2797-2802.

(89) Harth A, Germann G, Jester A. Evaluating the effectiveness of a patient-oriented hand rehabilitation programme. *J Hand Surg Eur Vol* 2008;33(6):771-778.

The Implications of Chronic Pain Models for Rehabilitation of Distal Radius Fracture

Table 1 - Application of Discussed Concepts to Assess Risk Profile of Patients with Distal Radius Fracture

Construct assessed	Interview Questions	Self-report Measures
Learned Helplessness	• Have you had a previous injury? How well were you able to manage your pain with that injury? • In your personal view, how easy is it to manage your health?	Learned Helplessness subscale of the Rheumatology Attitudes Index. Discriminative scores for helplessness behaviour not available in patients with DRF, however in patients with fibromyalgia helplessness score was 18 [72].
Cognitive-Behavioural	• Do you have any concerns about risks or how you will recover from this injury? If yes, what are they? • What does the pain feel like? (looking for overly emotional or catastrophizing descriptors) • Do you rely on yourself or your caregiver to decide on what is best for managing your health?	The Illness Perception Questionnaire (IPQ). The IPQ has been used to predict pain-related disability over a time period in patients with musculoskeletal complaints [75].
Wrist pain and functions following DRF	• What increases/decreases your wrist pain? • How much does the pain affect your daily	Patient rated wrist evaluation (PRWE). Differential scores for high pain not defined but the baseline PRWE was 48 in patients who did not take time off from work and 68 in patients not returning to work after 17 weeks [16]. It

	functions and your work?	can be obtained at http://www.srs-mcmaster.ca/ResearchResourcesnbsp/Musculoskeletal/UpperLimbNeck/tabid/2723/Default.aspx
Past medical History and Comorbidities	• Do you have other medical conditions? Do they affect your activity level and functions?	Katz comorbidity Index. The details regarding the impact of musculoskeletal conditions such as back pain and arthritis, as well as other comorbid conditions like diabetes, hypertension, and depression on patient's health can be obtained by this scale [81].
Previous musculoskeletal injuries, treatment received for the injuries, and the outcome achieved	• How long did it take to recover from your previous injury? What things helped you recover? Did medical professionals provide enough support in reducing your pain and disability?	
Chronic pain in other areas such as back pain, neck pain, arthritis, headache, fibromyalgia	• How bad is your pain in XX area? What increases/decreases your pain?	
Activity level prior to DRF	What activities did you do before your injury? • Did you stop doing those? • Do you play any sport or have any active hobbies? • Did you exercise regularly before this injury?	Patient Specific Functional Scale (PSFS). The PSFS identifies the activities that are affected by the injury and are meaningful to the patient and examines the level of difficulty experienced in those activities [82]. The minimal detectable change (MDC90) for the PSFS is 2 points, so the decrease in the PSFS score of > 2 points indicates improvement in the functional status of the patient.
Smoking habits	How many cigarettes do you smoke in a day?	

The Implications of Chronic Pain Models for Rehabilitation of Distal Radius Fracture

Figure 1. This figure illustrates the treatment approaches based on the risk profile for patients with distal radius fracture. The RACE approach is recommended for patients believed to be at higher risk of chronic pain following DRF. The patients in lower risk profile can be treated with conventional physiotherapy approach.