Part VIII: Discussion & Summary
Discussion

The purpose of this thesis is to clarify the role of psychological factors in upper extremity illness behavior. Most patient and health care provider misconceptions about upper extremity illness can be understood in terms of the normal human response to symptoms, pain in particular. Misinterpretations are usually over interpretations related to the heuristics that have evolved to enhance human survival (i.e. the shortcuts that our mind takes to try to keep us out of trouble).

A tendency to misinterpret or over interpret symptoms is part inherent (genetic) and part circumstantial. This tendency can be measured reliably and validly with questionnaires. These psychological measurements are consistently important predictors of symptom intensity and magnitude of disability in upper extremity conditions.

This thesis is divided into 8 Parts and 17 Chapters. The Chapters in this thesis give an overview of the importance of psychological factors in upper extremity illness behavior. The tendency to misinterpret or over interpret symptoms can be reliably measured. However, most of these questionnaires are long and burdensome for the patient and this thesis presents shortened versions of those questionnaires. The Chapters discussing the influence of patient language show that specific words and phrases can be an indication of misinterpretation of symptoms. The physician should empathetically explain that this is a normal human response, and invite the patient to remain curious about other ways to interpret the symptoms. Humans are programmed to respond to hurt as if it was always harm. But we override this system for things like sports, exercises, and spicy foods. We also filter the signals for things like backache and headache. We can invite patients to use these same coping strategies for any musculoskeletal pain, whether puzzling and nonspecific or related to discrete pathophysiology.

Historical misconceptions

Misinterpretations by doctors

An incomplete appreciation of the degree to which misinterpretation or over interpretation of bodily symptoms affects disability in hand and upper extremity illness can affect a provider’s recommendations. For instance, when discretionary surgery is seen as the primary source of hope for improving health and wellbeing, the patient may subject themselves to unnecessary risks and inconveniences. Misinterpretations are human and have happened frequently throughout history.

For example, the conception and treatment of migraine has changed considerably since ancient times. During the Roman Empire, Aretaeus treated patients with headaches by bleeding them. Not only the cubital vein, but the arteries on the head and the nose were sites to extract blood. When that failed, a hot iron could be used to cauterize the skin of the head to get rid of the migraines. This treatment was still used in the 10th century AD. Abucalcasis, physician to King Al-Hakam III of Spain, advised that if the hot iron did not work, to incise the temples of the patient and to insert peeled garlic in the temple. In the same time period, doctor Ali ibn Isa advised patients to wear a dead mole on the head to get rid of the headaches. These treatments seem risky, disfiguring, and downright silly to us now, but were based on the same misconceptions to which humans remain susceptible in modern times.

In the Middle Ages doctors thought that a person could contract the black death by just looking at a patient who had the disease. We now know that the Yersinia pestis bacteria causes this disease. In the 19th century, even after scientific evidence demonstrated that washing hands would reduce infections, some doctors refused to wash their hands.
Misinterpretation by patients

The misconceptions of the patient can also affect health. For instance, when a patient with a fracture of the distal radius decides not to move their fingers because they feel pain and react protectively, it can result in stiffness. History also provides noteworthy examples of misinterpretations.

In Ancient Greece, oracles were an important source of advice, Delphi being one of the most famous. When King Croesus of Lydia consulted the oracle to ask whether or not he should invade the mighty Persian Empire, the oracle told him that when he crossed the river Halys (which separated Lydia from the Persian empire), a mighty empire would fall. Croesus misinterpreted the oracle, thinking that this would mean the fall of the Persian Empire. He crossed the river and was defeated by the Persians.

Stalin misinterpreted German intentions in Poland during World War II. In 1939, Stalin and Hitler signed the Molotov–Ribbentrop Pact to prevent hostilities between the two countries, despite being ideologically opposed. This also sealed the fate of Poland, which was invaded on September 1st, 1939. After the invasion of the German army, the Soviet forces invaded Poland as well, and the country was divided. In 1941, even when there were signs of massive troops building up close to the border with the Soviet State, Stalin did not believe an invasion by Hitler was imminent, since they signed the Pact. Stalin might have thought this was just a show of might of the German army. When the German Wehrmacht and Waffen-SS did invade the Soviet Union on June 22nd, 1941, Stalin did not coherently act for a week while being in his dacha (second home) outside Moscow.

Misinterpretation of language can also have consequences; a patient can misinterpret an explanation by a doctor or misunderstand medical language. In astronomy, the myth of a civilization on Mars was fed by a misinterpretation. In 1877, the Italian astronomer Schiaparelli detected “canali” on Mars. This was translated into English as “canals”, instead of “channel”, as Schiaparelli had meant. The astronomer Percival Lowell read this and also thought he found the canals on the planet. Since canals are traditionally built in civilized communities, this misinterpretation led to a fascination with the planet. Lowell wrote books which built up the myth of a civilization on Mars and the canals were never found.

The cover of this thesis refers to a misconception about lobsters, a New England delicacy. Not only are lobsters on the menu of many restaurants, but they are also commonly found in tourist shops throughout New England. Lobsters are caught in a trap. A lobster trap lies on the bottom of the ocean and a buoy marks its location. The bait is at the end of the trap so the lobster needs to go through the entrance with a funnel in order to eat the bait. For centuries, New Englanders and fishermen thought that lobsters were trapped in a lobster trap because once in, they couldn’t get out. That makes sense: lobsters are scavengers, there is bait in the trap and because the lobster is so big with its huge claws, it cannot get out of the funnel-shaped trap. However, scientists concluded, by using video cameras, that lobsters can get out of the trap. The lobsters that are caught, are simply in the trap when a fisherman retrieves the lobster pot. The lobster misconception demonstrates the importance of testing even the most logical assumptions.
Discussion of the chapters

Influence of psychological factors on illness behavior in the recovery after traumatic conditions

Chapters 2, 3 and 4 deal with the influence of psychological factors on illness behavior in recovery after a fracture of the distal radius. Chapter 2 demonstrates that grip strength is determined by many factors. Pain anxiety was the only predictor of grip strength among patients recovering from a distal radius fracture. Chapter 3 presents literature showing that there is no difference in functional outcome after a distal radius fracture when exercises are started early or late or whether exercises are done at home or under supervision of an occupational therapist. The importance of the health care provider in the recovery after this fracture is also discussed: health care professionals should get patients in the healthy stretch mindset. Even when patients feel pain when doing their exercises, they should stretch, which can be counterintuitive. The health care provider should coach the patients. Chapter 4 investigates the influence of motion on disability as measured with individual questions of the Disabilities of Arm, Shoulder and Hand questionnaire (DASH). We selected 9 questions from the DASH and only 1 was influenced by motion; but 5 by measures of misinterpretation of bodily symptoms (mainly overinterpretation of nociception and symptoms of depression). The findings in these three Chapters provide evidence that health care providers should take notice of psychological factors when evaluating disability after a distal radius fracture. This is in line with other studies, showing that factors other than motion (impairment) are important. Even grip strength, used as an objective evaluation of functional improvement, is influenced by psychological factors. This influence was small and indicates that grip strength is influenced by many factors.

Chapter 5 and 6 focus on patients with finger injuries. Chapter 5 demonstrates that pain and workers’ compensation were more important predictors of DASH and Short-Form 36 (SF-36) (general health) than burnout or job satisfaction. More than half of the variation in disability was determined by these two factors, but the variation in SF-36 which could be explained by the models was smaller. The scores in the SF-36 and DASH were only slightly worse than normal values in the United States. The demonstrated importance of workers compensation on disability is in concordance with other studies. Chapter 6 expands the findings in Chapter 5 by investigating the predictors of time off work. Depression was the most important predictor of variation in disability, pain and time off work. Disability improved over time in patients with finger tip injuries. Chapter 6 found a DASH score of 35, just after the injury and a score of 17 after a month; Chapter 5 found a DASH score of 12 after 6 months, which is slightly higher than United States normal scores. Future studies can replicate our findings with more patients and with a different follow-up interval. We have seen that the DASH score improved to almost normal values after fingertip injuries. It is important to get sufficient follow-up data; we had lower follow-up rates than we anticipated with this relative short time frame, although this is encountered frequently in prospective studies. Another idea is to repeat these studies in patients with other fractures of the hand.

One might argue that the effect of misinterpretations of bodily symptoms on disability will decrease over time or this effect is only observed in the United States. Chapter 17 presents evidence that both are not true. Even after a follow-up of 21 years, over interpretation of nociception (pain catastrophizing) was a predictor of disability in a cohort of Dutch patients. In this population the average disability score was low, even lower than the United States normal score. Chapters 5, 6 and 17 demonstrate that average disability levels improved over time, but the effect of psychological factors on disability remains.
The findings in Chapters 3, 4, 5, 6 and 17 are not only applicable to traumatic hand conditions; the findings that disability is influenced more by misinterpretation of symptoms than impairment has also been demonstrated in other orthopaedic conditions. Some factors in the process of recovery cannot be altered, such as workers’ compensation, but symptoms of depression, overinterpretation of nociception (pain catastrophizing) and health anxiety can be influenced. If a surgeon pays attention to this biopsychological paradigm of recovery after hand injuries, the surgeon is better able to explain the bodily reactions the patient has. This will make it easier to get the patient in the healthy stretch attitude and the patient needs to understand that their recovery is on track. When the physician recognizes psychological distress, the patient can be referred to a psychologist. Cognitive Behavioral Therapy (CBT) executed by a psychologist, proved effective for depression, heightened illness concern, low back pain, medically unexplained symptoms. Treatment with CBT also reduced pain and disability in patients with nonspecific pain. CBT was affirmed to be effective in reducing disability and catastrophizing in patients with chronic pain and in improvement of Post Traumatic Stress Disorder (PTSD). When a surgeon keeps this treatment option in mind this will benefit a subset of patients which score high on specific psychological measures to measure these over interpretations of symptoms. CBT reduces psychological distress and further research can be done to evaluate the effect on disability after traumatic injuries. The department of Orthopaedic Hand and Upper Extremity Surgery is currently conducting a study where the effects of CBT in traumatic patients are evaluated.

Effect of patient language and informed shared decision making on disability

Previous studies found that patient word choice can reveal coping strategies and correlates with satisfaction. Patients in more distress give signals to the doctor in the form of psychological and social expressions. Chapter 7 studies patient language in a cohort of patients with traumatic and non-traumatic disorders of the upper extremity. Medical encounters were audio taped and a partial transcript was made in order to answer the study questions. In agreement with other studies, we found that patient language influenced disability, pain, pain catastrophizing (misinterpretation of nociception) and depression. Chapter 8 builds on the findings of Chapter 7 by using the partial transcript to construct a phrases and feelings questionnaire. We found that both questionnaires correlated with disability. Higher score on the Phrases questionnaire (what patients would say about their illness) was the most important predictor of higher levels of disability. This study showed the importance of patient language, which is in agreement with studies with oncologic patients and patients suffering from low back pain. When patients give cues as an indication of psychological distress such as misinterpretation of symptoms, health care providers do not always respond adequately to the cues. The individual questions and the phrases questionnaires as presented in Chapter 8 can be used to detect psychological distress. Both Chapter 7 and 8 provide evidence that patient language correlates with disability. This implicates that health care providers should pay attention to patient language. The Chapters studied 61 and 83 patients respectively, and the patients were enrolled from the practice of 3 different surgeons from one practice. The aim of Chapter 7 and 8 was not to validate a new questionnaire but to investigate the importance of patient language on disability. Future studies can try to replicate our findings with more patients and from the practice of more surgeons.

The process of informed shared decision (ISDM) is when the informed patient and the doctor make a decision together; and this process can improve patient satisfaction and patient compliance. In Chapter 9, the finding that hand surgeons have a moderate level of ISDM, is presented. Heightened illness concern proved an important predictor of satisfaction.
and ISDM. Depression and catastrophic thinking were the most important predictors of disability. Literature suggested that when patients have a more active role in the encounter, they are more satisfied with their visit. We also found an effect of ISDM on satisfaction (the element Identify choice). However, when also depression, illness concern and catastrophic thinking were measured these had a larger influence on satisfaction than ISDM. ISDM did correlate with disability, but was not included in the best models of prediction. The findings that the tendency to misinterpret or overinterpret bodily signals are important predictors of disability is in agreement with literature. A limitation of Chapter 9 is that only non-traumatic patients participated in the study. Traumatic patients were excluded on purpose, since patients with traumatic injuries might prefer a more paternalistic approach.

Chapter 9 indicates that ISDM has a role in satisfaction and especially the element Identify choice is important. The elements Establish role of decision making and Information preference of the ISDM show room for improvement, consistent with the study of Braddock and colleagues. One way to improve the information on choices is to use decision aids. These tools give additional information about the diagnoses and treatment options to the patients and were successfully used in low back pain. Surgeons are positive about their use in joint replacement. With the use of decision aids, patients can be better informed about the disease and the possible treatment options. This can result in higher scores of ISDM. The Orthopaedic Hand and Upper Extremity Service is currently working on studies to measure the effect of decision aids and future studies are necessary to prove the effectiveness of these tools in orthopaedic surgery.

Another aspect of Chapter 9 merits further study. Surgeons scored lower on ISDM in patients suffering from non-specific arm pain. In addition, when patients had higher levels of illness concern the ISDM score was lower. Patients with heightened illness concern or nonspecific conditions can be treated by a psychologist with coaching and CBT. A psychologist can give patients with non-specific complaints a better understanding of their symptoms, so they can better cope with their disease. Future studies can investigate whether the level of ISDM and patient satisfaction is higher if patients with higher levels of psychological distress are seen by a psychologist before visiting a surgeon.

Measuring misinterpretation of symptoms in the orthopaedic practice

Factors other than motionsuch as pain, pain catastrophizing and heightened illness concern correlate with disability and is an indirect measure of psychology. Pain can be assessed with one question, such as an ordinal pain scale or Visual Analogue Scale, but psychological assessment of direct measures usually requires long questionnaires. An example is the Pain Catastrophizing Scale which contains 13 questions, or the 18 item Short Health Anxiety Inventory (SHAI).

The aim of Chapters 10-16 is threefold. The first aim is to describe the development and validation of shorter questionnaires of the PCS and SHAI. The second aim is to validate commonly used questionnaires in patients with hand and upper extremity disorders for phone and web-based administration. The third aim is to determine whether psychological factors have a role in not-returning of a mailing survey, not-completing a questionnaire or not returning to scheduled follow-up. Chapter 10, 11 and 13 describe the creation, validation and phone validation of abbreviated versions of the Pain Catastrophizing Scale (PCS) and Short Health Anxiety Inventory (SHAI) questionnaires. Chapter 10 and 11 illustrate the validation and creation of the PCS-4 and SHAI-5. The PCS and SHAI mediate disability, pain and satisfaction in patients with upper extremity illness. In order to choose the questions, the methodology of the study of McCracken and Dhinnga was used. We found
differences in the correlations of the short and long version of the questionnaire with disability, pain and self-rating of health, which can be anticipated when using this methodology \(^\text{59}\). The lower values of internal consistency, which were found for the abbreviated questionnaire, are also expected \(^\text{59}\). The QuickDASH score was higher than the DASH score, which is in agreement with the study of Gummeson and colleagues \(^\text{60}\). Chapter 12 shows that there are small differences in scores of SHAI \(^\text{50}\) and pain, when pen and paper were compared to web-based administration. This is consistent with literature; some studies found no differences in outcome scores when online and pen and paper completion were compared \(^\text{61-65}\), whereas other studies found small differences \(^\text{66-69}\). The differences we found, were small, and are probably not clinically relevant.

Chapter 13 concludes that scores for disability and pain are unequal when telephone administration was compared to pen and paper, which is consistent with findings in previous studies \(^\text{70-72}\). We found worse scores for disability and pain in phone administration, in contrast to other studies where better scores were obtained with phone evaluation \(^\text{70-72}\). These chapters demonstrate that there are small differences in the scores, based on the method of administration, which are probably not clinically significant and form no objection to use in most research questions. Using shorter questionnaire will improve administration efficiency because it is faster to complete. It also, more importantly, reduces time burden on study subjects. These shortened questionnaires can be implemented in a busy orthopaedic practice to detect psychological distress. Web and telephone questionnaires may also be eventually implemented in standard care. Patients complete questionnaires before the visit with a surgeon. Future studies can also investigate whether questionnaires administered over the phone or online can replace certain follow-up visits to a health care provider to measure differences in disability.

In Chapter 12 the PCS-6 and SHAI-6 were used, which is a different abbreviated version of the shortened version described in Chapter 10, 11, and 13. The shortened versions used in Chapter 12 were a preliminary attempt to abbreviate the PCS \(^\text{49}\) and SHAI \(^\text{50}\) questionnaire. Chapter 12 focuses on differences when web and paper administration were compared. Besides the PCS \(^\text{49}\) and SHAI \(^\text{50}\) questionnaires, also the QuickDASH \(^\text{73}\), Patient Health Questionnaire-2 (PHQ-2) \(^\text{74}\) and pain were compared. The final version of the PCS \(^\text{49}\) and SHAI \(^\text{50}\) contained 4 and 5 items of the 6 questions presented in Chapter 12. Even though we did not investigate differences in PCS-4 and SHAI-5 in pen and web-based questions, the principle is the same that there are small differences in different formats of administration. Part VI shows that psychological factors mediate completion of questionnaires and have a role in return of a mailed survey. Age was associated with not returning to a scheduled follow-up after a distal radius fracture (Chapter 14). Since younger age was the only predictor of not returning to the scheduled follow-up, convenience might have caused this difference. This is in agreement with the study of Solberg and colleagues \(^\text{75}\). Not returning after a fracture is not per se an indication of worse outcome; patients that did not follow-up after a metacarpal fracture had the same outcomes as those that did return for a follow-up visit \(^\text{76}\). The department of Orthopaedic Hand and Upper Extremity Surgery conducts momentarily a study on optional follow-up in hand fractures.

Chapter 15 reports that male sex, age and pain are the factors which are associated with non-responding to a mailed survey. The findings that there are differences in patients who do and do not return questionnaires is in line with literature \(^\text{77-80}\). Missing data occurs frequently in research \(^\text{81-83}\) and in line with the findings in Chapter 15 the department of Orthopaedic Hand and Upper Extremity Surgery conducts currently a study in which differences in follow-up rate are evaluated. In this study, patients receive different methods of follow-up. Chapter 15
had a follow-up rate of 34% after one mailing, which is a lower than the average response rate in medical research and future studies can focus on how to get the best follow-up rates after sending out a survey. Chapter 15 shows that specific variables can determine whether patients return a mailed questionnaire or not.

Catastrophic thinking and age are predictors of not completing a questionnaire (Chapter 16). In addition to a differences in age and PCS, there were also differences in years of education, depression and pain anxiety. Since both age and PCS are continuous variables, the odds of not completing the questionnaire increase with 4% per year of older age or 4% per point higher on the PCS. Younger age is a predictor for not returning to a scheduled follow-up and sending back a mailed survey. Older patients also leave more questions blank in questionnaires, which is consistent with other studies. The finding that catastrophic thinking is a predictor for leaving questions blank is a new finding. These three chapters indicate that there are differences in patients that do complete surveys, send back mailings and come back for a follow-up and those that do not, this is an important finding for research.

Future directions
This thesis shows that psychological factors have a role in illness behavior in patients with traumatic and non-traumatic diseases of the upper extremity. Mood and coping strategies are important mediators of the variations in disability, time off work, informed shared decision making and satisfaction with the doctor for a given pathology.

Physicians can detect over interpretation or misinterpretation by picking up on specific phrases patients use and by screening for these tendencies with questionnaires in research or as part of standard care.

A new development in patient reported outcomes is the Item Response Theory (IRT) as part of Computerized Adaptive Testing (CAT). When questions are administered with this technique, the answer of the previous question will determine which question is selected next, which makes it possible to obtain an accurate score with a minimal number of questions. The National Institute of Health funds the Patient-Reported Outcomes Measurement Information System (PROMIS) initiative, which is free to use. Future studies can use this technology to measure disability, pain interference and depression.

When the CAT technology is not available or not preferred by the patients, short form questionnaires can also be used to reduce the questionnaire burden. There are a number of short-form questionnaires available to measure depression, health anxiety, pain catastrophizing and disability. Our department worked on the development of other shorter questionnaires such as the Pain Self-Efficacy Questionnaire.

Questionnaires can be administered over the phone or online, which makes research more efficient. Web-based questionnaires have a couple advantages over traditional pen-and-paper administration. Online questionnaires have the option to make questions obligatory to answer so there is no (or less) missing data. This thesis showed that specific patient factors and misinterpretation of nociception are associated with increased odds for not completing a questionnaire.

If doctors have more information on the tendencies of misinterpretation or overinterpretation of symptoms in the patients they treat, it provides an opportunity to help patients understand that not all symptoms and disability are caused by pathophysiology and impairment. Each questionnaire measures a particular aspect of misinterpretation of symptoms, explains a part of the patient’s disability, and provides another option for improved health.

Misinterpretations are shortcuts the human mind has developed to help us survive. The
A healthcare provider can use the analogy of the smoke alarm in the kitchen to lessen any discomfort or stigma associated with misinterpretations. Cooking a greasy meal will set off a well-functioning alarm. It’s up to us to interpret when there is truly a problem and continue cooking. When we feel pain, it sets off our “pain alarm”. We feel protective and prepare for the worst. It’s up to us to interpret when the pain is expected and does not indicate trouble and continue with the painful activity.

We feel that there are many different ways to implement the findings of this thesis. First of all, the surgeon should be more aware of the influence of misinterpretations on illness behavior, time off work, shared decision making, and satisfaction. Second, depression and post-traumatic stress disorder are encountered frequently after a musculoskeletal trauma, and this thesis shows the importance of effective coping strategies and optimal mood on lessening symptoms and disability after trauma. Finally, when a healthcare provider senses or measures tendencies to misinterpret symptoms, techniques based on cognitive behavioral therapy are important. Start with empathy, use analogies to help patients understand their situation without feeling any shame about it, and coach them through simple stepwise ways to gain confidence and reinterpret symptoms. Patients that have insight into their difficulties changing mindset can be offered a workbook or one-on-one coaching with a psychologist.

Summary of the chapters

Part II: Impairment versus disability after a fracture of the distal radius

Chapter 2: Determinants of Grip Strength in Healthy Subjects compared to that in Patients Recovering from a Distal Radius Fracture

Grip strength is often used as a measure of functional recovery after a fracture of the distal radius. Grip strength is partly voluntary and the study of Watson and Ring found that depression had a small influence on grip strength in a variety of upper extremity diagnoses. The aim of this chapter is to assess the influence of psychological factors on grip strength in the recovery of a fracture of the distal radius. Fifty patients recovering from a conservatively treated distal radius fracture and 50 healthy individuals completed questionnaires and grip strength was measured. The patients were enrolled approximately 6 weeks after their fracture. The questionnaires consisted of the Pain Anxiety Symptoms Score (PASS), Negative Pain Thoughts Questionnaire (NPTQ), Disabilities of the Arm, Shoulder and Hand (DASH), Center of Epidemiologic Studies-Depression questionnaire (CES-D), and the Pain Catastrophizing Scale (PCS).

Grip strength in the group of patients recovering from a distal radius fracture was 55% of the uninjured side. Depression, PASS and dominant limb grip correlated with grip strength, but only PASS was retained in the multivariable regression model and determined 9% of the variation in grip strength. The best model for disability contained NPTQ, age and sex and determined 31% of the variation in disability. In healthy individuals, Body Mass Index and sex were the only factors correlating with absolute grip strength, and DASH only correlated with grip strength.

In conclusion, grip strength is complex and determined by many factors. The models presented in this chapter only explain a small portion of the variability in grip strength. Physical make-up is key in healthy individuals but in the process of fracture recovery psychological factors are important.
Chapter 3: Recovery after Fracture of the Distal Radius

Patients with a fracture of the distal radius usually have good functional recovery. Six months after conservative treatment, function was restored to 75-97% of flexion and extension and rotation to 87-97% of normal values after conservative treatment; and these numbers were 67-93% and 78-100% respectively, after operative treatment. A patient reported outcome measure is used frequently to measure disability after this fracture. Studies consistently found that factors other than motion are important predictors of disability such as pain, workers’ compensation, age and income.

Complex Regional Pain Syndrome (CRPS) is sometimes diagnosed after distal radius fractures. The diagnostic criteria are subjective and imprecise, and CRPS is usually diagnosed when no other explanation for the symptoms can be found. The incidence varies between 1% and 37%. The development of ecchymosis and pain is expected after this fracture, and when a patient is protective concerning hand and finger motion, the hand will get more stiff. We advocate not using a medical diagnosis (CRPS), which might make patients passive and overly focused on medical treatments. Descriptive terms such as disproportionate pain and disability are more accurate and helpful.

Patients should move their hands to resolve edema. It’s an active process that depends on the patient. Studies indicate that manual edema mobilization techniques are ineffective. Active exercises might feel unsafe but are they essential in the process of recovery. When patients have heightened levels of catastrophic thinking (e.g. if I feel pain when doing exercises, this means this is harmful), can cause patients to overprotect their arm. The healthcare provider can help patients strive for a healthy stretch mindset, which is more accurate and helpful. Patients that have difficulty changing mindset and have insight into their difficulties might be interested in working with a psychologist.

Numerous studies showed that there is no difference in final motion after a distal radius fracture when exercises are started late or early after volar plating, pinning, external fixator or a cast. We advocate that patients should first stretch to get finger and forearm motion back, and then start on wrist flexion and extension exercises. Recent studies showed that formal occupational therapy does not result in better outcomes than home exercises. This overview of literature indicates that, just as in other diseases of the upper extremity, psychological factors are important in the process of recovery. There is a role for cognitive behavioral therapy in the recovery of distal radius fractures, since this treatment can address misconceptions about pain and anxiety. The health care provider should guide and coach the patient in the recovery.

Chapter 4: Correlation between Perceived Disability and Objective Physical Impairment after Distal Radius Fractures

In patients with elbow fractures, motion was an important predictor of disability in individual questions in the Disabilities of Arm, Shoulder and Hand questionnaire (DASH). However, pain was a better predictor than motion. The aim of Chapter 4 was to find if the findings in the elbow were also true for a fracture of the wrist. We chose 9 questions in the DASH. These were [1] “Open a tight or new jar”, [2] “Write”, [3] “Prepare a meal”, [4] “Make a bed”, [5] “Change a light bulb overhead”, [6] “Wash or blow dry your hair”, [7] “Wash your back”, [8] “Put on a pullover sweater”, [9] “Use a knife to cut food”.

Motion was restored to 74% flexion and 85% extension. Only 11 patients had incomplete forearm rotation after 3 months. Patients completed the Pain Anxiety Symptoms Score (PASS) for pain anxiety, Pain Catastrophizing Scale (PCS) for misconceptions of nociception,
Center of Epidemiologic Studies-Depression questionnaire (CES-D) \(^{94}\) to measure depression and a pain score. Only “Open a tight or new jar” was associated with motion (wrist flexion). Wrist flexion and PCS accounted for 33% of the variation in the question. Disability in writing was determined by PCS and limb dominance (R-squared 0.33); difficulties with preparing a meal by pain, CES-D and PCS (R-squared 0.20). Making a bed was predicted by pain and CES-D (explaining 14% of the variation in the question); changing a light bulb was associated with age, pain and fracture type (R-squared 0.23).

CES-D and PCS, were the most important predictors of 5 questions, motion in 1 question. There were no models for 4 questions. We found that psychological factors were more important in mediating variation in the questions than motion in patients recovering from a fracture of the distal radius.

Part III: Finger injuries and the influence of psychological factors

**Chapter 5: The Influence of Job Satisfaction, Burnout, Pain and Workers’ Compensation Status on Disability after Finger Injuries**

Burnout is a common reason to be out of work in European countries \(^{123, 124}\) and is a predictor of disability. Job satisfaction proved a predictor of pain and disability \(^{125}\). This Chapter sought to find if workers’ compensation, pain, job satisfaction or burnout were the most important predictors of disability. Patients completed the Shirom-Melamed Burnout Measure \(^{126}\) to measure burnout and the Job Descriptive Index \(^{127}\) for job satisfaction at enrollment. The Disabilities of Arm Shoulder and Hand (DASH) \(^{10}\), pain and Short Form-36 (SF-36) \(^{14}\) were assessed at the follow-up.

A total of 93 patients were enrolled in the study and 51 patients completed the follow-up. After 6 months, the DASH score was 12, the SF-36 Mental Component Score (MCS) was 49 and SF-36 Physical Component Score (PCS) was 48. The mean pain score was 2.1. Pain and workers’ compensation determined 52% of the variation in disability, but pain was the most important individual predictor. Pain accounted for 14% of the SF-36 PCS and workers’ compensation determined 11% of the variation in the SF-36 MCS. Workers’ compensation and pain were more important predictors than job satisfaction or burnout in disability after finger injuries.

**Chapter 6. Determinants of Disability one Month after Fingertip Injuries**

Hand and finger injuries are common and disability after hand injuries correlates with injury severity \(^{128, 129}\). Studies evaluating the relation of disability with psychological factors after a finger injury are scarce. This Chapter describes the determinants of disability in 82 patients with a fracture, amputation or laceration of the fingertip. Patients completed questionnaires to measure disability (short form of the Disabilities of the Arm, Shoulder and Hand [QuickDASH])\(^{10, 73}\), symptoms of depression (Patient Health Questionnaire-9, [PHQ-9]) \(^{130}\), pain and coping (Pain-Self Efficacy Questionnaire [PSEQ]) \(^{131}\).

QuickDASH and psychological questionnaires improved significantly from enrollment to the second evaluation one month later. Depression, time after injury and injury mechanism determined 54% of the variation in disability. Depression was the most influential factor in disability and was also a predictor of pain and time off work. Variation in range of motion was predicted by the time since injury.
Part IV: The influence of psychological factors in encounters with hand surgeons

Chapter 7: Correspondence of Patient Word Choice with Psychologic Factors in Patients with Upper Extremity Illness

Language of the doctor is very important, but also the language of patients is critical. Patient language can reflect illness behavior. The aim of Chapter 7 is to find out if patient language correlates with psychological factors, pain and disability. Sixty-one patients were seen by two hand surgeons and the encounters were audio taped. A partial transcript was made, and the expressions of the patients were categorized by consensus. These phrases categories were: (1) “Find it and fix it”; (2) “It’s serious”; (3) “Something is wrong”; (4) “I can’t”; (5) “Protective mindset”; and (6) “Deemphasis (hoping)”. Patients completed a pain scale and questionnaires to measure disability (Disabilities of Arm, Shoulder and Hand, [DASH]) 10, catastrophic thinking (Pain Catastrophizing Scale [PCS]) 49, depression (Patient Health Questionnaire-9 [PHQ-9]) 130 and illness concern (Whiteley Index) 132.

Patients who expressed phrases in the category “I can’t”, which put emphasis on the impact of symptoms on activities, had higher Whiteley Index, PCS, DASH and pain score. Using phrases in the categories “It’s serious” (severity of their condition) was associated with higher pain scores and “Protective mindset” (avoidance of symptoms) with less depressive symptoms. Patient expressions can help the health care provider to detect psychological distress.

Chapter 8: The Correlation of Phrases and Feelings about Patient’s Upper Extremity Illness with Disability

The previous Chapter showed the importance of specific patterns in patient language with respect to disability, pain and catastrophic thinking. The most influential phrases and feelings from Chapter 7 were listed to create a phrases and feelings questionnaire. The purpose of Chapter 8 was not to validate the questionnaires but to show that patient language influences disability. The phrases-questionnaire contained the following questions: 1) “I’m dropping things”, 2) “I’m feeling weak”, 3) “My hand gets numb”, 4) “I have excruciating pain”, 5) “I have a high threshold for pain”, 6) “The pain is unbearable”, 7) “I can’t even do simple things”, 8) “It’s moving along my arm” and 9) “There’s swelling”. The feelings questionnaire consisted of the following statements: a) “I don’t trust my arm”, b) “I can’t depend on my arm”, c) “It feels like something serious”, d) “If we don’t do something it will only get worse”, and e) “When I feel pain, I’m causing more damage”. The questionnaires were completed by 83 patients with a variety of upper extremity diagnoses who also completed the QuickDASH 73, the shortened version of the Disabilities of Arm, Shoulder and Hand for disability, the Pain Self-Efficacy Questionnaire, PSEQ, for coping 131 and an ordinal pain scale. There was a large correlation between the phrases and feelings, and both questionnaires correlated with QuickDASH. The most important predictors of QuickDASH included phrases, PSEQ, had treatment before and differences by working status. Phrases was the most important predictor. This Chapter demonstrates that patient language mediates disability.

Chapter 9 Informed Shared Decision Making and Patient Satisfaction

When patients have a more active role in the encounter with their doctor, they are more satisfied. The aim of Chapter 9 is to measure the magnitude of the informed shared decision making (ISDM) in a hand surgery practice and to assess the influence of ISDM on satisfaction and disability (Disabilities of Arm, Shoulder and Hand, DASH) in a non-traumatic sample of patients. Surgeons were not familiar with the scoring system of the ISDM. All encounters

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were audio taped and the amount of ISDM was scored by 2 independent research assistants, not involved in the clinical care of the patient. The following 8 elements of ISDM were scored: Identify choice; Establish role of decision-making; Information preference; Present evidence; Ascertain ideas, concerns and expectations; Develop partnership; Negotiate decisions; and Agree on action plan. The subjects completed the Princess Margaret Hospital Satisfaction with Doctor Questionnaire (PMH-PSQ-MD) 133 to measure satisfaction with their doctor, Disabilities of Arm, Shoulder and Hand (DASH) 10 for disability, Pain Catastrophizing Scale, PCS 49, for catastrophic thinking, Whiteley Index 132 for heightened illness concern, patient self rating of health, a pain scale and the Patient Health Questionnaire-9, PHQ-9 130, for symptoms of depression.

A total of 130 patients were enrolled and the level of ISDM in the hand clinic was moderate. The healthcare providers had the lowest scores for the ISDM elements Establish role of decision making and Information preference. A lower score on the Whiteley Index and differences by working status (unemployed unable to work compared to full-time), were the most important predictors of variation in the ISDM score (determined 11% of the variation). PMH-PSQ-MD was associated with lower Whiteley Index, female sex, specific diagnosis and the element Identify choice of the ISDM. This model determined 22% of the variation in the satisfaction score. DASH was associated with catastrophic thinking, depression, female sex and specific diagnosis (determining 55% of the variation in disability score). Depression and catastrophic thinking were the most important predictors of the DASH.

Part V: Questionnaires to measure disability and psychological factors

Chapter 10: Creation of the Abbreviated Measures of the PCS and SHAI: the PCS-4 and SHAI-5

Pain catastrophizing and heightened illness concern both correlate with pain and disability 2,53-56. The Pain Catastrophizing Scale (PCS) 49 and Short Health Anxiety Inventory (SHAI) 50 can be used to measure levels of catastrophizing and health anxiety. The PCS has 13 and the SHAI 18 questions. If a surgeon would like to use questionnaires in a busy clinic, it is important that these are short to limit burden on the patients. Chapter 10 describes the creation of a 4-question version of the PCS, the PCS-4 and a 5-question version of the SHAI, the SHAI-5. A total of 164 patients completed the PCS 49, the SHAI 50, the Disabilities of Arm, Shoulder and Hand (DASH) 10, the Patient Health Questionnaire-9, PHQ-9 130 and an ordinal pain scale.

Inter-item correlation analyses were conducted and questions (3) “It’s terrible and I think it’s never going to get any better”; (6) “I become afraid that the pain may get worse”; (8) “I anxiously want the pain to go away”; (11) “I keep thinking about how badly I want the pain to stop”; remained in the PCS. Questions (2) “I notice aches and pains…”; (3) “…..aware of bodily sensation or changes”; (12) “I ….think I have a serious illness”; (15) “If I had a serious illness I would…”; (17) “A serious illness would ruin…..aspects of my life”; remained in the SHAI.

Both short questionnaires showed adequate internal consistency (α=0.87 and α=0.67, respectively) and had a comparable correlation with the DASH, PHQ-9 and pain scale. Chapter 10 shows the development of a 4 item PCS and a 5 item SHAI which will reduce the necessary time to complete the questionnaire.
Chapter 11: Abbreviated Psychological Questionnaires are valid in Patients with Hand Conditions

Completing questionnaires can be burdensome for patients, but can be helpful for orthopaedic surgeons to get an idea of the psychological status of the patient. It is essential not only to show that the abbreviated versions of the questionnaires have a good internal consistency, as was shown in Chapter 10, but the questionnaires should also be validated. Chapter 11 showed that the 4 and 13 item version of the Pain Catastrophizing Scale (PCS-4 and PCS-13)\textsuperscript{49}, the 5 and 18 item version of the Short Health Anxiety Inventory (SHAI-5 and SHAI-18)\textsuperscript{50} had a large correlation with each other. In addition, a regression analysis showed that the same models were formed for the outcome measures when the short or long version of the questionnaires were used as explanatory variables. PCS-4 and PCS-13 were both in the best model for Disabilities of Arm, Shoulder and Hand (DASH)\textsuperscript{10}, the short version of the DASH, QuickDASH\textsuperscript{73} and pain. SHAI-18 and SHAI-4 were in the best models for patient self-rating of health. These findings established the validity of the abbreviated version of the PCS and SHAI questionnaire.

Chapter 12: The Comparison of Paper- and Web-based Questionnaires in Patients with Hand and Upper Extremity Illness

Most questionnaires are validated for pen and paper administration, but modern developments make web-based questionnaire administration possible. This is more efficient, since there is no need for second entry in a database. It is important to know if there are differences in outcome scores when data is obtained with different methods of administration for the interpretations of the findings. Some studies found no differences\textsuperscript{61-65} when different forms of questionnaire completion were compared. The aim of Chapter 12 is to detect differences when web-based administration is compared to pen and paper. Patients completed the short form of the Disabilities of the Arm, Shoulder and Hand (QuickDASH)\textsuperscript{73}, an ordinal pain scale, the Patient Health Questionnaire-2 (PHQ-2)\textsuperscript{74}, abbreviated version of the Short Health Anxiety Inventory (SHAI-6)\textsuperscript{50} and abbreviated version of the Pain Catastrophizing Scale (PSC-6)\textsuperscript{49}. A total of 99 patients completed questionnaires in both formats after each other at the day of enrollment. The order in which the questionnaires were completed changed after every 5 patients.

There were small differences in the SHAI score and pain, but not in QuickDASH, PHQ and PCS. Although the differences were statistically significant, they are probably not clinically relevant. Questionnaires can also be administered in web-based format.

Chapter 13: Validation of Phone Administration of Short-Form Disability and Psychology Questionnaires

In addition to administration in a web-based environment, there might also be differences in outcome scores when pen and paper administration is compared to phone administration. Our group developed the PCS-4\textsuperscript{49} and SHAI-5\textsuperscript{50}, the short versions of the Short Health Anxiety Inventory and the Pain Catastrophizing Scale (Chapter 10). The objective of Chapter 13 is to investigate differences between the two methods of administration in those 2 questionnaires, and the Patient Health Questionnaire-2 (PHQ-2)\textsuperscript{74}, short form of the Disabilities of Arm, Shoulder and Hand (QuickDASH)\textsuperscript{73} and a pain scale. A total of 157 patients completed questionnaires in the office at the day of enrollment and 135 patients completed the same questionnaires over the phone the next day. Non-completers were younger, but there were no other differences.

There were small differences in QuickDASH and pain, but not in PCS, SHAI or PHQ-
2. All follow-up scores correlated highly (r=0.77-0.86) with the initial scores. The level of agreement as measured with the Intraclass Correlation Coefficient was high (0.76-0.92). Shorter questionnaires are valid to be administered over the phone.

Part VI: Factors influencing return to follow-up or mailing response

Chapter 14: Predictors of Return after Cast Removal in Patients with a Nonoperatively Treated Distal Radius Fracture
Not all patients who are scheduled for a follow-up appointment with their surgeon return to the clinic. Studies assessing predictors of not returning to a follow-up visit are scarce. In Chapter 15 a cohort of 37 patients with a distal radius fracture, treated with a cast, were scheduled for a clinical follow-up. A total of 11 patients did not return and the only predictor for returning to the clinic was older age. The Disabilities of Arm, Shoulder and Hand (DASH) score was 36, and the best predictor of DASH was Pain Catastrophizing Scale (PCS). PCS predicted 8.9% of the variation in disability. Older age is the only variable associated with a return visit.

Chapter 15: Factors Associated with Survey Response in a Hand Surgery Clinic
A lower follow-up rate in research is connected to less valid data. The purpose of Chapter 14 is to investigate predictors of not returning a mailed questionnaire. We sent 104 patients the Disabilities of Arm, Shoulder and Hand (DASH) questionnaire and a satisfaction scale with their visit to our clinic, 6 month after their visit. At the time of enrollment in clinic, the participants completed the Patient Health Questionnaire-9 (PHQ-9), Pain Catastrophizing Scale (PCS), Short Health Anxiety Inventory (SHAI) and a pain scale. Thirty-five patients returned the questionnaires (34%). Patients were satisfied with their visit (satisfaction score of 8.7) and had a mean DASH score of 9.6. Patients that did not return the mailing, were younger, had higher levels of pain catastrophizing, and were predominantly male. Male sex (Odds Ratio of 2.6), pain (OR 1.3) and younger age (OR 0.97) were predictors of not returning a questionnaire by mail.

Chapter 16: Factors Associated with Incomplete DASH Questionnaires
In clinical research, missing answers in questionnaires or other missing data are common. The Disabilities of Arm, Shoulder and Hand (DASH) questionnaire is often used in upper extremity research. Chapter 16 tried to find differences between patients that completed the DASH questionnaire and those that did not. In a sample of convenience, consisting of 1204 patients, as part of 8 prospective studies, 31% of patients did not complete all questions in the DASH. The cohort of patients also completed a pain scale, Pain Anxiety Symptoms Score (PASS) for pain anxiety, Pain Catastrophizing Scale (PCS), for pain catastrophizing, and the Center of Epidemiologic Studies-Depression questionnaire (CES-D) for depression. Patients that did not complete the DASH were older, had less years of education, and had higher levels of depression, catastrophic thinking and pain anxiety. In models of prediction, age and PCS were predictors of not completing the DASH questionnaire.
Part VII: The importance of psychological factors in the long term outcomes

Chapter 17: Long Term Outcomes after Fractures of Both Bones of the Forearm
Several years after fractures of both bones of the forearm, disability correlated with pain and with impairment. Chapter 17 evaluates the disability of patients 21 years after this fracture. There were 36 skeletally mature patients and 35 skeletally immature patients at the time of injury. Patients completed the Pain Catastrophizing Scale (PCS) to measure catastrophic thinking, Center of Epidemiologic Studies-Depression questionnaire (CES-D) for depression and the Disabilities of Arm, Shoulder and Hand (DASH) questionnaire for disability. Function was measured and a radiograph was obtained. Patients that were skeletally immature at the time of injury had better motion, although differences were small. The average DASH score was 8 and the best predictors of disability were PCS, grip strength and pain, determining 56% of the variation in DASH. A model with pain alone determined 40% of the variation in DASH. Depression correlated with disability, but was not retained in the best model. Pain and psychological factors, were the most important predictors of disability in a cohort of patients evaluated 21 years after a fracture.
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