



Pain-related fear, catastrophizing and pain in the recovery from a fracture

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ABSTRACT

Background and aims: Pain-related fear and catastrophizing are prominently related to acute and persistent back pain, but little is known about their role in pain and function after a fracture. Since fractures have a clear etiology and time point they are of special interest for studying the process of recovery. Moreover, fracture injuries are interesting in their own right since patients frequently do not recover fully from them and relatively little is known about the psychological aspects. We speculated that catastrophizing and fear-avoidance beliefs might be associated with more pain and poorer recovery after an acute, painful fracture injury.

Methods: To this end we conducted a prospective cohort study recruiting 70 patients with fractures of the wrist or the ankle. Participants completed standardized assessments of fear, pain, catastrophizing, degree of self-rated recovery, mobility and strength within 24 h of injury, and at 3- and 9-month follow-ups. Participants were also categorized as having high or low levels of fear-avoidance beliefs by comparing their scores on the first two assessments with the median from the general population. To consolidate the data the categorizations from the two assessments were combined and patients could therefore have consistently high, consistently low, increasing, or decreasing levels.

Results: Results indicated that levels of fear-avoidance beliefs and catastrophizing were fairly low on average. At the first assessment 69% of the patients expected a full recovery within 6 months, but in fact only 29% were fully recovered at the 9-month follow-up. Similarly, comparisons between the affected and non-affected limb showed that 71% of those with a wrist fracture and 58% with an ankle fracture were not fully recovered on grip strength and heel-rise measures. Those classified as having consistently high or increasing levels of fear-avoidance beliefs had a substantially increased risk of more intense future pain (adjusted OR = 3.21). Moreover, those classified as having consistently high or increasing levels of catastrophizing had an increased risk for a less than full recovery of strength by almost six-fold (adjusted OR = 5.87).

Conclusions and implications: This is the first investigation to our knowledge where the results clearly suggest that fear and catastrophizing, especially when the level increases, may be important determinants of recovery after an acute, painful, fracture injury. These results support the fear-avoidance model and suggest that psychological factors need to be considered in the recovery process after a fracture.

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1. Introduction

Despite seemingly successful medical treatment, poor recovery and pain after a fracture is surprisingly common. Only 30–75% of patients regain pre-fracture levels of physical function during the coming year and just as many have pain (Kaukonen et al., 1988; Mossey et al., 1989; Ponzer et al., 1999). The healing of fractures requires immobilization and after fixation there is a period of regaining strength and mobility in the affected joints. Distal radius fractures of the wrist account for 20% of all fractures (Toh and Jupiter, 1994; O'Neill et al., 2001), but complications occur in more than one-third of the patients (Atkins et al., 1990; Lagerström et al., 1998). Fractures of the ankle account for one-tenth of all fractures and delayed recovery is also frequent (Nilsson, 1969; Jensen et al., 1998). When patients fail to gain full recovery the probability increases that the patient will suffer more pain, frustration and disability. Because fractures have a clear initiation they are excellent for studying the development of long-term problems following an acute injury.

Psychological factors have been linked to the recovery process after a fracture, as well as to the development of persistent pain problems. Anxiety is a common feature of fractures (Kennedy et al., 2004) and it is linked to a host of psychological factors including worry and attention that may influence pain perception (Asmundson et al., 2004). Indeed, anxiety has been directly linked to post-fracture pain levels (Jelicic and Kempen, 1999; Falch et al., 2003).

A cognitive behavioral model of how persistent problems develop is the fear-avoidance model (Vlaeyen and Linton, 2000). The basic tenet is that a vicious circle may develop if the pain results in catastrophizing and fear since these are associated with hypervigilance, and avoidance of movement. While these processes may be adaptive in the acute stage (Leeuw et al., 2007), they paradoxically may prolong recovery. There is an evidence to support the model for chronic low back pain (Vlaeyen and Linton, 2000; Leeuw et al., 2007) but there is a paucity of studies concerning how catastrophizing and fear may affect acute pain. Fractures offer a unique opportunity to study this model.

In a prospective study, fear predicted disability 6 months after an acute back pain episode (Swinkels-Meewisse et al., 2006). Similarly, another study of 44 patients seeking care for acute low back pain showed that an increasing level of fear and catastrophizing during the initial two weeks' period was related to poorer recovery 12 months later (Sieben et al., 2002). One reason may be that patients who expect a quick recovery but who do not experience it then become more worried (Sieben et al., 2002; Rachman and Arntz, 1991). Thus, pain-related fear and catastrophizing in the acute phase may be important for future pain perception and recovery, but little is known about the process particularly in disorders other than low back pain.

The purpose of this study was to investigate the role of pain-related fear and catastrophizing during the acute phase on long-term recovery from a fracture. We predicted that high or increasing levels of fear and catastrophizing would be related to more pain and less recovery at follow-up.

2. Methods

2.1. Design

A prospective cohort design was employed with assessment within 24 h of injury (T1), at 3 (T2) and 9 months (T3) post injury. While obtaining measures before the injury was not possible, we obtained ratings within 24 h of the injury and we employed questionnaires to assess fear and catastrophizing that can be compared

to the general population (e.g. MFABQ and the PCS below) and we also compared the mobility and strength of the affected limb with the non-affected one. Although there is variation between people concerning the degree to which their dominant and non-dominant limbs will have the same mobility and strength, it is generally a good proxy (Peolsson et al., 2001) although conservative when the 10% difference rule is employed (Petersen et al., 1989).

2.2. Participants

Consecutive patients seeking care for a fracture of the distal radius or the ankle were invited to participate. Additional criteria were being 18–70 years of age and not having multiple fractures or dementia. All patients gave their informed consent. In all 79 patients were recruited, but 9 dropped out. These 9 subjects differed from the subjects completing the study regarding age (older, mean age 63.2) and sex (more females, 8 women and 1 man). The completers comprised 56 women and 14 men with a mean age of 53.9 years (SD = 12.2; range 18–70 years of age) who had a confirmed fracture of the distal radius ($n = 57$) or the ankle ($n = 13$). Forty-four of the subjects reported that they were employed, 18 were retired, 5 were students and 3 were unemployed or on parental leave.

The Research Ethics Committee at Örebro University Hospital approved the study.

2.3. Assessments

2.3.1. Pain-related fear and catastrophizing

Fear-avoidance beliefs were measured with a modified form (MFABQ) of the Fear-Avoidance Beliefs Questionnaire (FABQ) which has good reliability and validity (Waddell et al., 1993) and in a pilot test the MFABQ correlated highly with the full FABQ ($n = 36$; $r = 0.97$). Four items were selected from the factor that deals with the relationship between physical activity and pain to form the modified version (MFABQ), and which has previously been successfully employed (Linton et al., 2000; Buer and Linton, 2002). Participants were asked to rate items in relation to their own prior experiences of pain and the items concerned the beliefs that:

1. Pain is caused by physical activity;
2. Physical activity makes one's pain worse;
3. Physical activity might be harmful;
4. One should not do physical activities which (might) make one's pain worse.

Consistent with the FABQ, the items were answered on a verbal (Likert type) seven-point scale (0–6, sum score 0–24), from “strongly disagree” to “strongly agree”, higher sum score indicate stronger fear-avoidance beliefs.

Catastrophizing was measured by The Pain Catastrophizing Scale (Sullivan et al., 1995; Severijns et al., 2002) which is a self-report scale that consists of 13 items, with a five-point scale (0–4, sum score 0–52), from “not at all” to “all the time”.

2.3.2. Pain and expected recovery

Self-ratings of current pain and expected recovery were assessed at T1–T3. A Numeric Rating Scale (NRS) 0–10 was used to rate pain, where 0 meant “no pain” and 10 meant “unbearable pain”. Similarly, patients estimated their risk of having problems from the fracture for more than an additional 6 months in percent of recovery compared to pre-fracture status (e.g. 100% recovered or 50% recovered) at T1 and T2 (expected recovery) as well as actual recovery at T3.

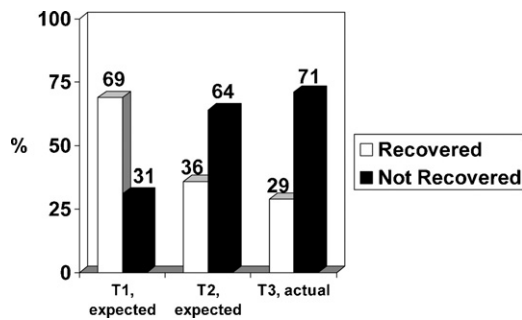


Fig. 1. An overview of the percentage of patients rating expected and actual recovery at T1–T3.

2.3.3. Mobility and strength

Mobility of the wrist or ankle and strength was assessed at the 9-month follow-up. Mobility was measured in the affected area (wrist/ankle) using a 310 mm double arm plastic goniometer with a half-circle protractor scale from 0° to 180° with 1° increments (KEBO Care®, Sweden). This was done in 6 directions, flexion, extension, radialflexion, ulnarflexion, pronation and supination for the wrist and in 2 directions for the ankle, flexion and extension. The reliability of goniometer mobility measures has been debated, but the device is accurate enough to detect changes and differences between left and right sides, which was the purpose of this study (Hogrefe, 1990; Sölveborn and Olerud, 1996).

Handgrip strength was measured using the JAMAR® hand dynamometer (Sammons® Preston, Bolingbrook, IL, USA) which registers the maximal momentary strength (Lagerström et al., 1998; Peolsson et al., 2001). It has been found to be a reliable method which is recommended for clinical use (Peolsson et al., 2001). For the patients with a fracture of the ankle, a standardized standing heel-rise test was employed (Svantesson et al., 1998).

3. Statistical analyses

The analyses were made with the SPSS (version 11.0) statistical software program. Because of some skewed distributions, non-parametric statistics were used. Since the hypothesis was that high or increasing levels of fear and catastrophizing would lead to poorer recovery, patients were classified into groups. To obtain a cut-off for categorization, the median ($M=9$) on the MFABQ in the general population in Sweden was employed (Buer and Linton, 2002). Participant's scores at T1 and T2 were cast against this cut-off and categorized on both T1 and T2 and then combined. Consequently, participants could have the same level (consistently high or consistently low) or different levels (increasing, alternatively decreasing) between T1 and T2 resulting in four profiles (High T1–High T2, consistently high; Low T1–Low T2, consistently low; Low T1– High T2, increasing; High T1–Low T2, decreasing). In a further step to consolidate the data for analyses of either those patients having a high score on the MFABQ at both T1 and T2 or who had an increasing level between T1 and T2 were classified as High. Likewise, either those who had a low score at both time points or who had a decrease from high to low were classified as Low. A similar procedure was done

Table 2

The median (md), minimum–maximum, of the sum scores for the Modified Fear-Avoidance Beliefs Questionnaire (MFABQ) and the Pain Catastrophizing Scale (PCS) at injury (T1) and at the two follow-ups (T2, T3).

	T1, md (min–max)	T2, md (min–max)	T3, md (min–max)
Fear-avoidance beliefs (MFABQ 0–24)	7 (0–24)	6 (0–17)	5 (0–20)
Catastrophizing (PCS 0–52)	10 (0–36)	8 (0–42)	7 (0–41)

for the catastrophizing scores on the PCS. Here the median from the general population was 11 (Buer and Linton, 2002) and similar groups were formed as for fear-avoidance beliefs above. Thus, those with high scores could then be compared with those having low scores and odds ratios calculated concerning the prospective relationship to outcome at T3.

In addition to self-ratings of recovery, patients were also classified as “recovered” or “not recovered” based on the objective assessments of mobility and strength. Since pre-fracture measurements were not possible, we used the intra-individual difference between the injured and the uninjured side as a proxy for comparison. If the ratio between the injured side and the uninjured side was $\leq 10\%$ the case was classified as Recovered and if the difference was $>10\%$ as Not Recovered.

Logistic regression analyses were performed in order to calculate odds ratios which are reported with 90% confidence intervals as an estimate of risk. Because this is an exploratory study examining the possible role of fear and catastrophizing we choose the 90% since the study group is heterogeneous and the sample size is limited.

4. Results

4.1. Recovery

Ratings of current pain and worry showed a decreasing tendency from T1 to T3 which probably reflects the healing process. The level of pain had a median of 4 (range = 0–8) at T1 and a median of 1 at T2 (range = 0–8) as well as at T3 (range = 0–6). Worry was assessed to a median of 2 (range 0–10) at T1 and a median of 0 at T2 (range = 0–5) and T3 (range = 0–5). The number of patients reporting no pain or no worry increased from T1 to T3 from 4% to 46% and from 30% to 57%, respectively.

Fig. 1 illustrates the results of the self-ratings of recovery. While 69% of the patients rated that they expected to be fully recovered within six months at T1, this rate decreased by about half to 36% at T2. However, the proportion of patients who actually rated themselves as fully recovered at T3 was just 29%. Thus, although most patients expected full recovery within 6 months at injury less than one-third actually experienced this outcome.

The patients were also asked to estimate the risk of having problems from the fracture more than 6 months after the accident on a NRS (0, no risk–10, extreme risk). The results showed that more than 50% of the patients rated the risk as 2 or less at T1 while at T2 it increased to 3.

Table 1

The number and percentage of patients having discrepancies of $>10\%$ between the injured and uninjured sides, classified as recovered/unrecovered (classified as recovered/unrecovered). Shown at the 9 months follow-up (T3) and by location of the fracture.

	Wrist fracture ($n=56$)		Ankle fracture ($n=12$)	
	Unrecovered, n (%)	Recovered, n (%)	Unrecovered, n (%)	Recovered, n (%)
Mobility	25 (45)	31 (55)	4 (33)	9 (66)
Grip strength/heel rise	40 (71)	16 (29)	7 (58)	5 (42)

Table 3

The classification of profiles at injury (T1) and at 3 months (T2) for fear and avoidance beliefs and catastrophizing. A combined classification was then formed for a low profile and a high profile.

Classification		MFABQ, n (%)	PCS, n (%)	Total for profiles (%)
Time point				
T1 (injury)	T2 (3 month)			
L	L	32 (54)	34 (56)	Consistently low Decreasing Low = 71%
H	L	10 (17)	9 (15)	
L	H	11 (19)	5 (8)	Increasing Consistently high High = 29%
H	H	6 (10)	13 (21)	

MFABQ; cut-off for classification is 9 points; PCS; cut-off for classification is 11 points.

Table 4

Results of the logistic regression analyses showing unadjusted and adjusted odds ratios and confidence intervals for categorized fear-avoidance beliefs at injury (T1–T2) in relation to self-rated pain intensity, recovery, and objectively measured mobility and strength at the 9-month follow-up (T3).

	n	OR	90% CI	OR ^a	90% CI ^a
Pain	58	3.41	1.17–9.97	3.21	1.03–9.89
Recovery	58	0.76	0.28–2.08	0.71	0.25–1.99
Mobility	59	0.34	0.13–0.95	0.37	0.13–1.02
Handgrip strength/heel rise	58	0.67	0.24–1.86	0.69	0.25–1.92

^a Adjusted for age and gender.

Recovery rates at follow-up (T3), as measured by mobility and strength, are shown in Table 1. For the patients with wrist fractures, 45% were not fully recovered, i.e. displayed a difference >10% in mobility between sides, while for the patients with ankle fractures, 33% were not fully recovered. Similarly, 71% of those with a wrist fracture and 58% with an ankle fracture were not fully recovered with regard to grip strength and the heel-rise measures, respectively.

4.2. Fear-avoidance beliefs and catastrophizing

Median scores and range for the MFABQ and the PCS are shown in Table 2. The correlation coefficient between fear-avoidance beliefs and catastrophizing was 0.36 (Spearman's rho).

4.3. Prospective effect of fear and catastrophizing on outcome

In order to test the idea that high levels or increasing levels of fear and catastrophizing are related to outcome, participants were classified according to the criteria described above. Table 3 shows the distribution of participants with high or low levels of fear at T1 and T2. As may be seen in the table, the proportion of patients having a low level of fear at both T1 and T2 was 54% while for catastrophizing it was 56%. The proportion having a low profile at T2 (profiles: T1 low–T2 low or T1 high–T2 low) was 71% for both fear (MFABQ) and catastrophizing (PCS). Consequently, 29%

Table 5

Results of the logistic regression analyses showing the unadjusted and adjusted odds ratios and confidence intervals for categorized catastrophizing levels (PCS) at injury (T1–T2) in relation to self-rated pain intensity, recovery, and objectively measured mobility and strength at the 9-month follow-up (T3).

	n	OR	90% CI	OR ^a	90% CI ^a
Pain	60	1.92	0.73–5.09	1.92	0.63–5.83
Recovery	60	2.25	0.70–7.30	2.52	0.74–8.58
Mobility	60	1.51	0.60–3.84	1.88	0.70–5.07
Handgrip strength/heel rise	59	5.12	1.34–19.58	5.87	1.45–23.73

^a Adjusted for age and gender.

of the participants had a high profile at T2 (T1 low–T2 high; T1 high–T2 high) for both fear and catastrophizing. These high-level vs low-level categorizations were used in the regression analyses as predictor variables, whereas the outcome variables were subjective ratings of pain and recovery as well as the more objective measures of mobility and strength.

Odds ratios adjusted and unadjusted for age and sex were calculated in order to examine the prospective relationship between fear (MFABQ) and catastrophizing (PCS) with future outcome and the results are displayed in Tables 4 and 5. The analyses show that higher fear-avoidance beliefs increased the risk for pain with an adjusted odds ratio of 3.21 and a 90% confidence interval above unity. However, high fear was not significantly related to future self-rated recovery, mobility or strength. For catastrophizing there was a significant relationship only for strength. High levels of catastrophizing increased the risk for a less than full recovery concerning strength with an odds ratio of 5.87 and a 90% confidence interval above unity.

5. Discussion

This is the first investigation to our knowledge of the role of pain-related catastrophizing and fear in the recovery from a fracture. Our results show that higher than average scores, or increasing scores, on pain-related fear and catastrophizing are associated with future pain and recovery levels as measured by questionnaires and muscle strength. Indeed, higher levels increased the risk of having more intense pain by three-fold and the risk of having poorer recovery in terms of muscle strength by six-fold. These findings are in line with other research concerning back pain and support the fear-avoidance model (Leeuw et al., 2007; Vlaeyen et al., 1995; Lohnberg, 2007; Vangronsveld et al., 2007).

This effect may be related to expectations since the vast majority of patients, at the time of injury, expected a full recovery within six months, but less than a third actually achieved this. Indeed, expectations of a full recovery dropped by about half from T1 to T2 and self-reported recovery was slower than anticipated for many. Indeed, participants seemed to adjust their expectations to the reality of the recovery process. This change in expectation might influence fear and catastrophizing but our previous research suggests that fear and catastrophizing may well drive expectations (Boersma and Linton, 2006). A mechanism may be that when expectations are not realized then this results in increases in fear and catastrophizing that in turn hinder recovery. This finding and the interpretation are in line with Sieben (Sieben et al., 2002) where increases in fear in patients seeking care for an acute back pain episode were also related to actual recovery.

On average, fear-avoidance beliefs and catastrophizing showed moderate levels and decreased over time as would be anticipated during healing. However, given the results above, this may create a “false sense” of proper recovery for health care professionals which might lead to a failure to identify patients risking a poor recovery. Our findings suggest that it is important to monitor pain-related fear and catastrophizing during the first weeks of the recovery process. Further, psychologically oriented interventions might then be helpful in order to prevent complications and poor recovery. Because patient expectations are not in line with the usual course of recovery, one method might be to provide specific information tailored to those at risk, e.g. about the natural course of recovery (Linton et al., 2007). Further, since fear and catastrophizing are known to be related to avoidance of movement a program of exposure exercises may be worthwhile (Vlaeyen and Linton, 2000; Leeuw et al., 2007; Lohnberg, 2007).

There are some methodological idiosyncrasies which should be kept in mind when interpreting these results. First, the size of

population restricts the analyses that may be conducted and potentially the generalization of the findings. With a very large sample it would have been possible to conduct analyses using specific fracture locations, age groups, gender, and risk profiles. Nevertheless, our sample is sufficient to study the main question, i.e. the role of fear and catastrophizing in recovery. Second, the time frame for measurement might have been different, e.g. with several assessments at shorter intervals which would have allowed for a more detailed analysis.

6. Conclusions and implications

Our results show that fear and catastrophizing may be instrumental in the process of recovery after a fracture and suggest that early identification and preventive interventions might enhance recovery. Future studies will need to replicate, generalize, and test more specific hypotheses.

Conflicts of interests

The authors have not declared any conflicts of interests related to this study.

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