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Disability and depression after orthopaedic trauma

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ABSTRACT

Introduction: Musculoskeletal injury is a common cause of impairment (pathophysiology), but the correlation of impairment with pain intensity and magnitude of disability is limited. Psychosocial factors explain a large proportion of the variance in disability for various orthopaedic pathologies.

The aim of this study is to prospectively assess the relationship between psychological factors and magnitude of disability in a sample of orthopaedic trauma patients in The Netherlands.

Material and methods: One hundred and one adult patients between 1 and 2 months after one or more fractures, tendon or ligament injuries were enrolled. Four eligible patients refused to participate. Thirty-five women and 30 men with an average age of 50 years (range, 22–92 years) completed the follow-up evaluation between 5 and 8 months after their injury and their data was analyzed. The patients completed a measure of disability (the Short Musculoskeletal Function Assessment-Netherlands, SMFA-NL), the Dutch Centre for Epidemiologic Study of Depression-scale (CES-D), the Dutch Impact of Event Scale (SVL), and the Dutch Pain Catastrophizing Scale (PCS) at the time of enrollment and again 5–8 months after injury.

Results: There were moderate correlations between symptoms of depression (CES-D, $r = 0.48$, $p < 0.001$) and symptoms of PTSD (SVL, $r = 0.35$, $p = 0.004$) at enrollment and magnitude of disability 5–8 months after trauma. Catastrophic thinking (PCS) at enrollment and magnitude of disability 5–8 months after trauma showed a small correlation (PCS, $r = 0.26$, $p = 0.034$). The Pain Catastrophizing Scale (Beta = 0.29; $p = 0.049$), surgery (Beta = 0.26; $p = 0.034$), additional surgery (Beta = 0.26; $p = 0.019$) and other pain conditions (Beta = 0.31; $p = 0.009$) were the significant predictors in the final model (adjusted R-squared = 0.35; $p < 0.001$) for greater disability 5–8 months after trauma.

Discussion and conclusions: In The Netherlands, symptoms of depression measured 1–2 months after musculoskeletal trauma correlate with disability 5–8 months after this trauma. The psychological aspects of recovery from musculoskeletal injury merit greater attention.

Level of evidence: Level II, Prognostic study.

Introduction

Musculoskeletal injury is a common cause of impairment (pathophysiology), but the correlation of impairment with pain intensity and magnitude of disability is limited [1]. Psychosocial factors explain a large proportion of the variance in disability for various orthopaedic pathologies [2]. For instance, catastrophic thinking (the tendency to magnify pain, feel helpless when faced with pain, and ruminate on the pain experience), pain anxiety (cognitive and physiological anxiety when experiencing pain, as well as avoidance of activities that cause pain), and symptoms of depression tend to account for more of the variation in magnitude of disability and pain intensity than measure of musculoskeletal pathology and impairment for many conditions [3].

Given the moderate to strong correlation between psychological factors and musculoskeletal disability [4,5], it is surprising that they are not routinely addressed in the care of patients recovering from orthopaedic trauma. To date, we know that depressive symptoms are common after trauma, and they correlate with disability [6]; Post Traumatic Stress Disorder (PTSD) is common after orthopaedic trauma [7,8]; and patients who develop PTSD after trauma have more depressive symptoms within days of the injury [9]. A previous study in the United States found that symptoms of depression 1–2

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months after 1 or more fractures correlate with magnitude of disability 5–8 months after injury [23]. Since psychosocial factors are culturally mediated [10] we were curious if the conclusions drawn from that study would also apply in a cohort of orthopaedic trauma patients in The Netherlands. If prospective studies consistently demonstrate longitudinal relationships between psychological factors measured early on in recovery and greater pain intensity and magnitude of disability during the late stage of recovery, the next step would be an intervention to try to ameliorate this.

The aim of this study is to prospectively assess the relationship between psychological factors (depression and PTSD), coping strategies (pain catastrophizing and pain anxiety), pain intensity (measured on an ordinal scale), and magnitude of disability in a sample of orthopaedic trauma patients in The Netherlands. Our primary null-hypothesis is that symptoms of depression, PTSD, and catastrophic thinking measured 1–2 months after musculoskeletal trauma do not correlate with disability 5–8 months after injury. In addition we addressed the prevalence of an estimated diagnosis of major depression and PTSD, at enrollment and final evaluation, and changes in magnitude of disability, symptoms of depression, and symptoms of PTSD between enrollment and final evaluation.

Materials and methods

Patients

Adult patients visiting the outpatient office of the orthopaedic trauma service within 1 or 2 months after 1 or more fractures, tendon or ligament injuries were invited to participate in this prospective IRB-approved study. The timeframe of 1–2 months was used in prior studies and based on our experience that recovery is well established (e.g. taking little or no pain medication, bearing weight, making progress with exercises) in most patients by this time. The patients were enrolled by an independent researcher not involved in the patients' care after providing written informed consent.

We excluded patients with major medical comorbidity expected to worsen in the next 6 months, comorbid chronic pain condition, use of pain medication or antidepressant medication with a change in regimen after trauma, psychosis, bipolar disorder, or active substance dependence or other factors that could interfere with informed consent processes and treatment and we excluded comorbid brain injury, spinal cord injury, and mental retardation.

Among 118 screened patients 104 were enrolled, 4 patients declined and 10 did not meet inclusion criteria (3 with cognitive

Table 1
Patient demographics.

Parameter	Cohort ($n=101$)	Responders ($n=65$)	Non-responders ($n=36$)	p-value*
Age, median (IQR), range, *y*	45 (28–62), 18–92	48 (39–63), 22–92	36 (23–49), 18–78	0.003+
Injury Severity Score, median (IQR), Range	4.0 (4–9), 1–13	8.0 (4–9), 1–9	4.0 (4–9), 1–13	0.06+
Gender				
Male, No. (%)	51 (51)	30 (46)	21 (58)	
Female, No. (%)	50 (50)	35 (54)	15 (42)	0.24o
Surgery				
Yes, No. (%)	56 (56)	32 (49)	13 (36)	
No, No. (%)	45 (45)	33 (51)	23 (64)	0.20o
Additional surgery				
Yes, No. (%)	1 (1.0)	1 (1.5)	0 (0)	
No, No. (%)	100 (99)	64 (98)	36 (100)	1.0^
Other pain conditions				
Yes, No. (%)	13 (13)	8 (12)	5 (14)	
No, No. (%)	87 (86)	56 (86)	31 (86)	1.0^
Missing, No. (%)	1 (1.0)	1 (1.5)	0 (0)	
Marital status				
Single, No. (%)	34 (34)	17 (26)	17 (47)	
Living with partner, No. (%)	15 (15)	8 (12)	7 (19)	
Married, No. (%)	44 (44)	34 (52)	10 (28)	0.06^
Separated/Divorced, No. (%)	5 (5.0)	3 (4.6)	2 (5.6)	
Widowed, No. (%)	3 (3.0)	3 (4.6)	0 (0)	
Education				
Educated beyond high school, No. (%)	82 (81)	52 (80)	30 (83)	
Not educated beyond high school, No. (%)	18 (18)	12 (18)	6 (17)	1.0^
Missing, No. (%)	1 (1.0)	1 (1.5)	0 (0)	
Working status				
Full-time, No. (%)	43 (43)	26 (40)	17 (47)	
Part-time, No. (%)	28 (28)	19 (29)	9 (25)	
Homemaker, No. (%)	6 (5.9)	4 (6.2)	2 (5.6)	
Retired, No. (%)	14 (14)	10 (15)	4 (11)	0.99^
Unemployed not possible to work, No. (%)	3 (3.0)	2 (3.1)	1 (2.8)	
Unemployed possible to work, No. (%)	5 (5.0)	3 (4.6)	2 (5.6)	
Currently on sick leave, No. (%)	2 (2.0)	1 (1.5)	1 (2.8)	
Health outcomes				
SMFA-FI, median (IQR), Range	35 (22–49), 2.9–86	38 (26–49), 2.9–86	33 (19–48), 4.4–63	0.44+
SMFA-BI, median (IQR), Range	40 (25–52), 0–98	42 (27–52), 4.2–98	34 (15–49), 0–92	0.14+
SMFA-Total, median (IQR), Range	37 (22–49), 3.3–89	38 (27–49), 3.3–89	32 (21–48), 3.3–71	0.35+
SVL, median (IQR), range	8.0 (2.0–21), 0–106	10 (4.0–21), 0–106	6.0 (1.0–22), 0–62	0.67+
PCS, median (IQR), range	8.0 (2.0–12), 0–38	9.0 (4.0–13), 0–38	4.5 (0.5–9), 0–27	0.009+
CES-D, median (IQR), range	8.0 (3.0–13), 0–33	8.0 (3.0–13), 0–29	7.0 (3.0–10), 0–33	0.23+
Pain, median (IQR), range	3.0 (2.0–6.0), 0–9	3.0 (2.0–5.0), 0–9	2.0 (0.5–6), 0–8	0.22+

* Comparing, responders vs. non-responders.
\+ Mann–Whitney *U*-test.
o Chi-square test.
^ Fisher's exact test.

impairment, 3 with chronic pain due to rheumatoid arthritis, 1 patient with a mental condition, 1 patient with a change in opioid regimen, 2 did not speak Dutch). Three patients were excluded from the study because they did not complete the enrollment questionnaires.

One hundred and one patients completed demographics, injury characteristics and questionnaires at the time of enrollment and 65 patients repeated them between 5 and 8 months after injury. This timeframe was considered appropriate since this is the time it is believed most patients have returned to their daily routine. To obtain this follow-up information we sent an e-mail with instructions and an internet link to the Research Electronic Data Capture (REDCap) survey containing the questionnaires. Patients that did not complete the study were younger, had less severe injuries, and had more effective coping strategies (pain catastrophizing and pain anxiety) (Table 1). To account for the potential influence of missing values we performed a sensitivity analysis comparing the correlations of our main outcomes of responders with non-responders at baseline. No significant differences between the correlations of the responders and non-responders were found.

There were 30 men and 35 women with an average age of 50 years (with a range of 22–92 years). Patients tended to be employed, married, and educated beyond high school. Eight patients had pre-existing pain conditions (back, neck, shoulder, thigh, ankle, ribs and headache) (Table 1).

Measures

Several questionnaires were completed at 1–2 months and 5–8 months after the musculoskeletal trauma. The Dutch Short Musculoskeletal Function Assessment questionnaire (SMFA-NL) is a measure of musculoskeletal disability [11–13]. The questionnaire can be applied as 1 comprehensive score (SMFA-Total) or it may be divided in 2 parts, the Function Index (FI) and the Bother Index (BI). The function index assesses the patients' functional performance; the bother index measures the degree to which patients are bothered by their performance in several functional areas [14].

Table 2
Bivariate analysis: disability 5–8 months post trauma ($n = 65$).

		CES-D 1–2 months	PCS 1-2 months	Pain 1–2 months	SVL 1–2 months	CES-D 5–8 months	PCS 5–8 months	Pain 5–8 months	SVL 5–8 months
SMFA: FI 5–8 months	Spearman's rank correlation	0.47	0.27	0.41	0.35	0.74	0.60	0.37	0.63
	Sig. (2-tailed)	<0.001	0.03	<0.001	0.004	<0.001	<0.001	0.002	<0.001
SMFA: BI 5–8 months	Spearman's rank correlation	0.46	0.26	0.40	0.33	0.76	0.61	0.47	0.59
	Sig. (2-tailed)	<0.001	0.04	0.001	0.008	<0.001	<0.001	<0.001	<0.001
SMFA: total 5–8 months	Spearman's rank correlation	0.48	0.26	0.41	0.35	0.76	0.60	0.41	0.62
	Sig. (2-tailed)	<0.001	0.034	<0.001	0.004	<0.001	<0.001	<0.001	<0.001

Sensitivity analysis

Bivariate analysis: disability 1–2 months post trauma ($n = 101$)

		CES-D 1–2 months	PCS 1–2 months	Pain 1–2 months	SVL 1–2 months
SMFA: FI 1–2 months	Spearman's rank correlation	0.45	0.33	0.32	0.43
	Sig. (2-tailed)	<0.001	<0.001	0.0011	<0.001
SMFA: BI 1–2 months	Spearman's rank correlation	0.52	0.39	0.39	0.43
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001
SMFA: total 1–2 months	Spearman's rank correlation	0.49	0.34	0.33	0.44
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001

Bivariate analysis: disability 1–2 months post trauma ($n = 65$)

		CES-D 1–2 months	PCS 1–2 months	Pain 1–2 months	SVL 1–2 months
SMFA: FI 1–2 months	Spearman's rank correlation	0.45	0.30	0.37	0.51
	Sig. (2-tailed)	<0.001	0.015	0.0026	<0.001
SMFA: BI 1–2 months	Spearman's rank correlation	0.56	0.34	0.45	0.52
	Sig. (2-tailed)	<0.001	0.0026	<0.001	<0.001
SMFA: total 1–2 months	Spearman's rank correlation	0.50	0.29	0.36	0.51
	Sig. (2-tailed)	<0.001	0.019	0.0032	<0.001

Bivariate analysis: disability 1–2 months post trauma ($n = 36$)

		CES-D 1–2 months	PCS 1–2 months	Pain 1–2 months	SVL 1–2 months
SMFA: FI 1–2 months	Spearman's rank correlation	0.48	0.41	0.31	0.29
	Sig. (2-tailed)	0.003	0.01	0.06	0.08
SMFA: BI 1–2 months	Spearman's rank correlation	0.46	0.44	0.36	0.29
	Sig. (2-tailed)	0.005	0.007	0.03	0.09
SMFA: total 1–2 months	Spearman's rank correlation	0.49	0.43	0.33	0.29
	Sig. (2-tailed)	0.003	0.009	0.05	0.08

Table 3
Bivariate statistical analysis ($n = 65$).

	SMFA: total 1–2 months		SMFA: total 5–8 months	
	Correlation	*p*-value	Correlation	*p*-value
Spearman's rank correlation				
Age	0.23	0.06	0.031	0.81
Injury Severity Score	0.26	0.04	0.070	0.58
	Median (IQR)	*p*-value	Median (IQR)	*p*-value
Mann–Whitney *U* test				
Surgery				
Yes	43 (31–55)		17 (4.9–37)	
No	30 (21–42)	0.02	7.1 (2.7–18)	0.02
Sex				
Male	33 (21–42)		8.4 (3.3–20)	
Female	43 (29–56)	0.05	14 (3.3–33)	0.29
Other pain conditions				
Yes	44 (33–62)		24 (4.3–42)	
No	37 (24–49)	0.21	9.8 (3.5–24)	0.25
Education beyond high school				
Yes	36 (22–48)		9.7 (3.3–24)	
No	43 (34–51)	0.20	13 (6.5–30)	0.54
Kruskal–Wallis one-way analysis				
Marital status				
Single	39 (24–49)		14 (7.1–30)	
Living with partner	24 (12–35)		4.1 (2.2–14)	
Married	38 (29–49)	0.28	13 (3.8–30)	0.31
Separated/Divorced	51 (30–69)		1.1 (0–39)	
Widowed	40 (29–59)		11 (5.4–16)	
Working status				
Full-time	33 (25–42)		8.2 (3.2–30)	
Part-time	42 (29–52)		9.8 (3.2–39)	
Homemaker	45 (19–62)		20 (5.8–33)	
Retired	44 (35–53)	0.67	13 (3.8–22)	0.78
Unemployed not possible to work	42 (39–45)		16 (15–46)	
Unemployed possible to work	14 (9.8–55)		7.1 (0.5–14)	
Currently on sick leave	49 (49–49)		45 (45–45)	

For the measurement of depressive symptoms we used the Dutch Centre for Epidemiologic Study of Depression-scale (CES-D) which has proved to be a valid and reliable tool to measure depressive symptoms [15,16]. For the measurement of symptoms of PTSD we used the validated Dutch Translation of the Impact of Event Scale; the "Schokverwerkingslijst (SVL)" [17,18]. The validated Dutch Pain Catastrophizing Scale was used to assess catastrophic thinking in response to pain [19,20]. Pain was measured with an ordinal pain scale ranging from 0 (no pain) to 10 (worst pain ever).

The severity of the injury was determined during the time of enrollment using the Injury Severity Score (ISS). Only musculoskeletal ISS scores were used for this study [21,22].

Statistical analysis

An a priori power analysis revealed that 85 patients would provide 80% power to detect a moderate correlation ($r = 0.3$) of depression with disability, with an alpha of 0.05. To account for loss of 15%, our enrollment goal was 100 patients.

Normality of questionnaires was tested with the Shapiro–Wilk test. We decided to use non-parametric tests since the majority of the questionnaires were not normally distributed.

We used a Mann–Whitney *U*-test in bivariate analysis for continuous variables and a Chi-square or Fisher's exact test when applicable for categorical variables. For the determination of correlations we used Spearman's rank correlation. To compare paired groups with continuous data we used Wilcoxon signed-rank sum test. Kruskal–Wallis one-way analysis was used to detect differences in the distribution between multiple groups with continuous data. All possible influencing explanatory variables were entered in a multiple linear regression model.

Results

There were moderate correlations between symptoms of depression (CES-D) and symptoms of PTSD (SVL) at enrollment and magnitude of disability 5–8 months after trauma. Catastrophic thinking (PCS) at enrollment and magnitude of disability 5–8 months after trauma showed a small correlation (Table 2). Sex and the Injury Severity Score (ISS) correlated with disability at enrollment, but not at the final evaluation. Patients treated operatively had greater disability at enrollment and at final evaluation (Table 3). All potentially influencing factors were entered in a multiple linear regression model looking for predicting factors of disability 5–8 months after injury (measured with the SMFA-Total). Marital status and work status were the only potential confounding variables not entered into the final model because of collinearity in the model, no differences in bivariate analysis and limited clinical interest as a potential confounder.

The Pain Catastrophizing Scale (Beta = 0.29; $p = 0.049$), surgery (Beta = 0.26; $p = 0.034$), additional surgery (Beta = 0.26; $p = 0.019$) and other pain conditions (Beta = 0.31; $p = 0.009$) were the significant predictors in the final model (adjusted R-squared = 0.35; $p < 0.001$) for greater disability 5–8 months after trauma (Table 5).

Table 4
Outcome measures ($n = 65$).

Questionnaires	1–2 months	5–8 months	*p*-value
Wilcoxon signed rank sum test			
SMFA-FI, median (IQR), range	38 (26–49), 2.9–86	11 (2.9–27), 0–76	<0.001
SMFA-BI, median (IQR), range	42 (27–52), 4.2–98	15 (4.2–27), 0–75	<0.001
SMFA-Total, median (IQR), range	38 (27–49), 3.3–89	9.8 (3.3–28), 0–76	<0.001
SVL, median (IQR), range	10 (4.0–21), 0–106	6.0 (1.0–17), 0–74	0.05
PCS, median (IQR), range	9.0 (4.0–13), 0–38	5.0 (2.0–14), 0–39	0.21
CES-D, median (IQR), range	8.0 (3.0–13), 0–29	14 (12–17), 6.0–60	<0.001
Pain, median (IQR), range	3.0 (2.0–5.0), 0–9	2.0 (1.0–6.0), 0–10	0.33
SVL			
≥33, No. (%)	10 (15)	10 (15)	
<33, No. (%)	55 (85)	55 (85)	
CES-D			
≥16, No. (%)	13 (20)	22 (34)	
<16, No. (%)	52 (80)	43 (66)	

Table 5
Multivariable model for predicting disability.

Parameter	Coef.	Beta	SE	*p*-value	95% CI		$n=65$ Adj. R^2
CES-D	0.51	0.22	0.30	0.099	−0.10	1.1	0.35
SVL	0.032	0.036	0.14	0.83	−0.26	0.32	
PCS	0.64	0.29	0.32	**0.05**	0.0030	1.3	
ISS	0.12	0.021	0.71	0.87	−1.3	1.6	
Male	−7.3	−0.21	3.9	0.062	−15	0.40	
Age	−0.17	−0.17	0.12	0.17	−0.41	0.076	
Surgery	8.8	0.26	4.0	**0.03**	0.70	17	
Additional surgery[a]	36	0.26	15	**0.02**	6.2	67	
Other pain conditions: yes	16	0.31	5.9	**0.01**	4.3	28	
Other pain conditions: unknown	−23	−0.17	15	0.13	−54	6.8	
Educated beyond high school: yes	−3.1	−0.072	4.8	0.52	−13	6.6	
Educated beyond high school: unknown	−20	−0.15	15	0.18	−51	9.9	

In model: CES-D, SVL, PCS, ISS, male, age, surgery, additional surgery, other pain conditions: yes & unknown, educated beyond high school: yes & unknown.
[a] Based on a single individual.

One to two months after injury 20% of the patients met the threshold for an estimated diagnosis of depression (16 points or greater on the CES-D questionnaire) (21) and 15% met the threshold for an estimated diagnosis of PTSD (33 or higher on the SVL) (22). Five to 8 months after injury, the percentage was identical for PTSD but the prevalence of an estimated diagnosis of depression had increased to 34% (Table 4).

Between enrollment and final evaluation, the median total SMFA score decreased from 38 to 11, the median CES-D score increased from 8.0 to 14, and the median SVL, PCS, and pain intensity were comparable (10–.0, 9.0–5.0, and 3.0–2.0 respectively) (Table 4).

Discussion and conclusions

In The Netherlands, symptoms of depression measured 1–2 months after musculoskeletal trauma correlate with disability 5–8 months after this trauma, just as they do in the United States [23]. Disability at 5–8 months also correlated with symptoms of PTSD and catastrophic thinking. Although excluding the variables depression, symptoms of PTSD and catastrophic thinking from the final multiple linear model would result in a large decrease in the total predicting value of the model (adjusted R-squared of 0.15 versus 0.35), we were unable to show an obvious significant effect of the individual variables when accounting for confounders. This might be explained by the lower than anticipated sample size. The correlation between disability and psychological distress is consistent in musculoskeletal research [2,3,24]. Indeed, the proportion of patients with an estimated diagnosis of major depression rose from one-fifth at enrollment to one-third at final evaluation. Given the correlation of disability and depression, it is notable that disability decreased and depression increased over time. We speculate that, notwithstanding the decrease in physical impairment and disability with recovery, patients may struggle to restart their lives in the aftermath of skeletal trauma which might lead to an increase in symptoms of depression. The rates of estimated diagnoses of depression and PTSD are higher than the rates reported in the general population (depression: 3–20%; PTSD: 4–10%) [25–27] and higher than in an outpatient medical population (depression: 2–12%; PTSD: 8–16%) [28,29].

This study should be interpreted in the light of its limitations. We used thresholds on questionnaires rather than psychiatric evaluation to estimate diagnoses of depression and PTSD. The findings regarding PTSD at enrollment should be interpreted in light of the fact that this diagnosis requires persistence of symptoms for 1 month or more after trauma. We demonstrated correlation, but cannot comment on causation. We lost more patients than anticipated—we probably should have anticipated this in a trauma population.

Stress reactions are expected after trauma, but studies in different cultures have consistently demonstrated that greater psychological distress early on in recovery portends a worse outcome later. Optimal mood and coping strategies can help patients adapt to impairment and get through the counterintuitive aspects of recovery such as stretching exercises and return to vocation and avocation.

The weight of evidence to date, suggests that surgeons should screen for psychological distress and ineffective coping strategies either using brief questionnaires or with empathetic verbal inquiry (e.g. "Which part of recovery has been more difficult: the physical or the emotional?"). Cognitive behavioural therapy (CBT) is an effective, evidence-based treatment that can be initiated if suboptimal mood or coping strategies are identified. Health systems could be better designed to support such interdisciplinary care of patients with musculoskeletal injury. Even surgeons that want to help their patients with the emotional aspects of recovery do not always have a good place to send patients that are interested in this kind of support.

Future studies should address the effect of screening and intervention early on in the recovery process on pain intensity, disability, and return to work later on in recovery. Innovations in the techniques and technology for repairing fractures and avoiding adverse events have slowed in recent years. While these aspects of care always deserve our attention and efforts, it is possible that the best opportunities for improved health after musculoskeletal injury are innovations in our cognitive and emotional care of the injured patient.

Conflict of interest statement

Each author certifies that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Ethical approval

The work has been approved by the appropriate ethical committees related to the institution(s) in which it was performed and subjects gave informed consent to the work. A copy of the letter from our ethical committee approving this study is available.

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References

[1] Waddell G, Main CJ. Assessment of severity in low-back disorders. Spine (Phila Pa 1976) 1984;9:204–8.
[2] Ring D, Guss D, Malhotra L, Jupiter JB. Idiopathic arm pain. J Bone Joint Surg Am 2004;86-A:1387–91.
[3] Ring D, Kadzielski J, Malhotra L, Lee SG, Jupiter JB. Psychological factors associated with idiopathic arm pain. J Bone Joint Surg Am 2005;87:374–80.
[4] Pincus T, Burton AK, Vogel S, Field AP. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. Spine (Phila Pa 1976) 2002;27:E109–20.
[5] Vranceanu AM, Ring D. Value of psychological evaluation of the hand surgical patient. J Hand Surg Am 2008;33:985–7.
[6] Crichlow RJ, Andres PL, Morrison SM, Haley SM, Vrahas MS. Depression in orthopaedic trauma patients. Prevalence and severity. J Bone Joint Surg Am 2006;88:1927–33.
[7] Glynn SM, Asarnow JR, Asarnow R, Shetty V, Elliot-Brown K, Black E, et al. The development of acute post-traumatic stress disorder after orofacial injury: a prospective study in a large 265 urban hospital. J Oral Maxillofac Surg 2003;61:785–92.
[8] McCarthy ML, MacKenzie EJ, Edwin D, Bosse MJ, Castillo RC, Starr A. Psychological distress associated with severe lower-limb injury. J Bone Joint Surg Am 2003;85-A:1689–97.
[9] Nyberg E, Stieglitz RD, Frommberger U, Berger M. [Psychological disorders after severe occupational accidents]. Versicherungsmedizin 2003;55:76–81.
[10] Nisbett RE, Miyamoto Y. The influence of culture: holistic versus analytic perception. Trends Cogn Sci 2005;9:467–73.
[11] Engelberg R, Martin DP, Agel J, Obremsky W, Coronado G, Swiontkowski MF. Musculoskeletal function assessment instrument: criterion and construct validity. J Orthop Res 1996;14:182–92.
[12] Engelberg R, Martin DP, Agel J, Swiontkowski MF. Musculoskeletal function assessment: reference values for patient and non-patient samples. J Orthop Res 1999;17:101–9.
[13] Reininga IH, el Moumni M, Bulstra SK, Olthof MG, Wendt KW, Stevens M. Cross-cultural adaptation of the Dutch short musculoskeletal function assessment questionnaire (SMFA-NL): internal consistency, validity, repeatability and responsiveness. Injury 2011;43:726–33.
[14] Swiontkowski MF, Engelberg R, Martin DP, Agel J. Short musculoskeletal function assessment questionnaire: validity, reliability, and responsiveness. J Bone Joint Surg Am 1999;81:1245–60.
[15] Cuijpers P, Smit F, Willemse G. Predicting the onset of major depression in subjects with subthreshold depression in primary care: a prospective study. Acta Psychiatr Scand 2005;111:133–8.
[16] Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1977;385–401.
[17] Horowitz M, Wilner N, Alvarez W. Impact of event scale: a measure of subjective stress. Psychosom Med 1979;41:209–18.
[18] van der Ploeg E, Mooren TT, Kleber RJ, van der Velden PG, Brom D. Construct validation of the Dutch version of the impact of event scale. Psychol Assess 2004;16:16–26.
[19] Severeijns R, van den Hout MA, Vlaeyen JW, Picavet HS. Pain catastrophizing and general health status in a large Dutch community sample. Pain 2002;99:367–76.
[20] Sullivan M, Bishop S, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess 1995;524–32.
[21] Baker SP, O'Neill B, Haddon Jr W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974;14:187–96.
[22] Greenspan L, McLellan BA, Greig H. Abbreviated injury scale and injury severity score: a scoring chart. J Trauma 1985;25:60–4.
[23] Vranceanu AM, Bachoura A, Weening A, Vrahas M, Smith RM, Ring D. Psychological factors predict disability and pain intensity after skeletal trauma. J Bone Joint Surg Am 2014;96:e20.
[24] 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;88:1983–8.
[25] Kessler RC, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). JAMA 2003;289:3095–105.
[26] Oliver JM, Simmons ME. Affective disorders and depression as measured by the diagnostic interview schedule and the beck depression inventory in an unselected adult population. J Clin Psychol 1985;41:469–77.
[27] Wilhelm K, Mitchell P, Slade T, Brownhill S, Andrews G. Prevalence and correlates of DSM-IV major depression in an Australian national survey. J Affect Disord 2003;75:155–62.
[28] Barry KL, Fleming MF, Manwell LB, Copeland LA, Appel S. Prevalence of and factors associated with current and lifetime depression in older adult primary care patients. Fam Med 1998;30:366–71.
[29] Mundi E, Baum A. Medical disorders as a cause of psychological trauma and posttraumatic stress disorder. Curr Opin Psychiatry 2004;17:2.