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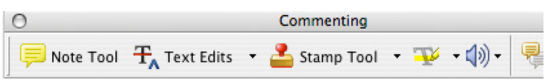

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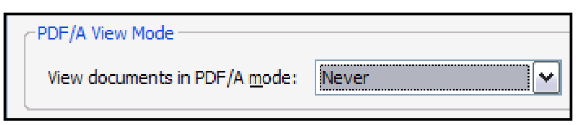

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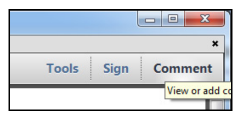

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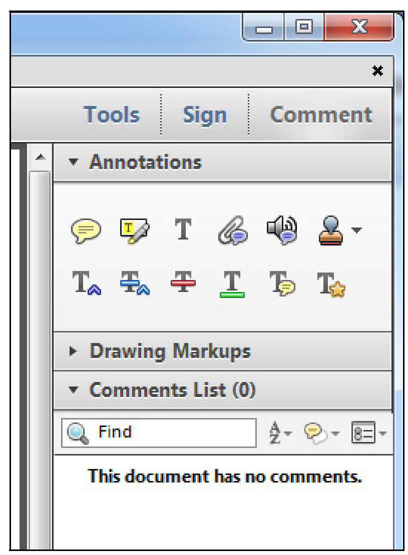

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Psychosocial factors affecting variation in patient-reported outcomes after elbow fractures

Prakash Jayakumar, MBBS, BSc (Hons), MRCS (Eng), FMSEM, DPhil[a,*], Teun Teunis, MD, PhD[b], Ana-Maria Vranceanu, PhD[c], Meredith Grogan Moore[d], Mark Williams, PhD, MCSP[e], Sarah Lamb, MSc, MA, MCSP, DPhil[a], David Ring, MD, PhD[c], Stephen Gwilym, DPhil, FRCS (Orth)[a]

[a]Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Oxford, UK
[b]University Medical Center Utrecht, Utrecht, The Netherlands
[c]Department of Psychiatry, Massachusetts General Hospital and Harvard Medical School, Boston, MA, USA
[d]Department of Surgery and Perioperative Care, Dell Medical School, University of Texas at Austin, Austin, TX, USA
[e]Department of Sport, Health Sciences and Social Work, Oxford Brookes University, Headington Campus, Oxford, UK

Background: The purpose of this study was to identify factors associated with limitations in function measured by patient-reported outcome measures (PROMs) 6-9 months after elbow fractures in adults from a range of demographic, injury, psychological, and social variables measured within a week and 2-4 weeks after injury.

Methods: We enrolled 191 adult patients sustaining an isolated elbow fracture and invited them to complete PROMs at their initial visit to the orthopedic outpatient clinic (within a maximum of 1 week after fracture), between 2 and 4 weeks, and between 6 and 9 months after injury; 183 patients completed the final assessment. Bivariate analysis was performed, followed by multivariable regression analysis accounting for multicollinearity. This was evaluated using partial R^2, correlation matrices, and variable inflation factor assessment.

Results: There was a correlation between multiple variables within a week of injury and 2-4 weeks after injury with PROMs 6-9 months after injury in bivariate analysis. Kinesiophobia measured within a week of injury and self-efficacy measured at 2-4 weeks were the strongest predictors of limitations 6-9 months after injury in multivariable regression. Regression models accounted for substantial variance in all PROMs at both time points.

Conclusions: Developing effective coping strategies to overcome fears related to movement and reinjury and finding ways of persevering with activity despite pain within a month of injury may enhance recovery after elbow fractures. Heightened fears around movement and suboptimal coping ability are modifiable using evidence-based behavioral treatments.

This work was performed at Oxford University Hospitals and Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences.
The South Yorkshire Research Ethics Committee approved this study (IRAS No. 16/YH/0017).

*Reprints requests: Prakash Jayakumar, MBBS, BSc (Hons), MRCS (Eng), FMSEM, DPhil, Nuffield Orthopaedic Centre, Windmill Road, Headington, Oxford OX3 7HE, United Kingdom.
E-mail address: pjx007@gmail.com (P. Jayakumar).

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Level of evidence: Level II; Prospective Cohort Design; Treatment Study
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Keywords: Patient outcomes; elbow fractures; psychosocial determinants; resilience

Although adult fractures of the elbow are relatively uncommon (ie, around 5% of all fractures), some of these injuries and their sequelae substantially affect quality of life.[12,22,28,31,35] The World Health Organization (WHO) International Classification of Disability, Functioning and Health provides a framework to assess this impact from the patient's perspective[7,8] (Fig. 1).

The WHO framework includes domains representing psychological factors (eg, depression, anxiety, pain interference, kinesiophobia [the fear of movement or reinjury], and catastrophization [the exacerbation of fearful aspects of pain]) that are predictive of limitations quantified by patient-reported outcome measures (PROMs) in studies involving elbow conditions.[9-11,13] Most of these are cross-sectional investigations involving cohorts that combine traumatic and nontraumatic conditions throughout the upper limb.[9-11,13]

This work represents a prospective, longitudinal study of a focused cohort of isolated elbow fractures assessed from first orthopedic review after the emergency department to several months after injury.[37,48] We aimed to identify the demographic, injury, psychological, and social factors associated with limitations 6-9 months after elbow fractures using the WHO International Classification of Disability, Functioning and Health as a framework for organizing these variables (Fig. 2).

The primary null hypothesis was that the magnitude of limitations measured by the Patient-Reported Outcome Measurement Information System (PROMIS) Upper Extremity Physical Function Computer Adaptive Test (PROMIS UE PF CAT) 6-9 months after an elbow fracture was not associated with psychological and social factors assessed within a week of injury, accounting for demographic and injury-related factors. Secondarily, we assessed the influence of psychological and social variables measured 2-4 weeks after injury on 6- to 9-month PROMIS UE PF CAT. Finally, we repeated these evaluations for other PROMs (Quick Disabilities of the Arm, Shoulder and Hand [QuickDASH], EuroQol 5-Dimension 3-Level [EQ-5D-3L], and Oxford Elbow Score [OES]) measured 6-9 months after injury.

Materials and methods

A consecutive series of 191 adult patients sustaining isolated elbow fractures attending new patient fracture clinics between January 1, 2016, and August 31, 2016, at a level I trauma center were enrolled in a research and ethics committee-approved study. Inclusion criteria included fluency in English, being 18 years of age or older, and ability to provide informed consent. Patients with other injuries were excluded, as were those with refracture of the elbow during recovery from a prior injury, fracture in a malunited elbow after a previous fracture, and periprosthetic fracture surrounding a prior elbow fixation or joint replacement. Of the 191 patients invited to participate, 8 patients (4.2%) declined because of time constraints, leaving a total of 183 in the study, including 91 women and 92 men with a mean age of 48.2 ± 20.2 years (range, 18-93 years; Table I).

Participants provided demographic details including level of education; marital, social, and work status; and arm dominance. Clinical variables included prior arm injury, neurovascular compromise, open or closed fracture, having a surgical procedure, and adverse events gathered from electronic health records. Chart-derived complications include stiffness treated with manipulation under anesthesia and disproportionate pain after injury despite corticosteroid injection and physical therapy. Age-adjusted Charlson Comorbidity Index[8] and Index of Multiple Deprivation 2015 (IMD)[24] were generated using comorbidity data and postal codes, respectively. The age-adjusted Charlson Comorbidity Index is a validated scoring tool predictive of 1-year mortality accounting for a range of comorbidities.[8] The IMD combines information from national administrative data to form a relative rank of social deprivation based on geographic location defined by the UK Office for National Statistics.[24] The rank was converted to a percentage (IMD factor), with lower percentage signifying greater deprivation.

PROMs were completed on a secure, web-based data collection platform (Assessment Center, Northwestern University, Chicago, IL, USA).[16] Data were captured at baseline (initial orthopedic consultation, within a week of attendance in the emergency department), early follow-up (2-4 weeks), and final assessment (6-9 months). Patients completed assessments in person (58%), by telephone (34%), or through an electronic online link (8%). None were lost to follow-up.

Complications included those related to operative treatment (eg, wound infection) as well as those with a strong subjective component (eg, elbow stiffness treated with manipulation under anesthesia) or prolonged pain leading to a pain specialist referral.

Injuries were independently classified by two authors (PJ, SG) by energy (eg, high-speed road traffic accident [high]; fall from standing height [low]) and by the AO/OTA Fracture and Dislocation Classification[2] and modified Mason[6,23,32] systems to enable a comprehensive characterization of injuries. These were further categorized into radial head and neck, intra-articular, or extra-articular fractures to simplify analysis. The majority were isolated fractures of the radial head and neck, followed by intra-articular fractures (eg, distal humerus and olecranon fractures) and extra-articular fractures of the distal humerus, proximal radius, and ulna.

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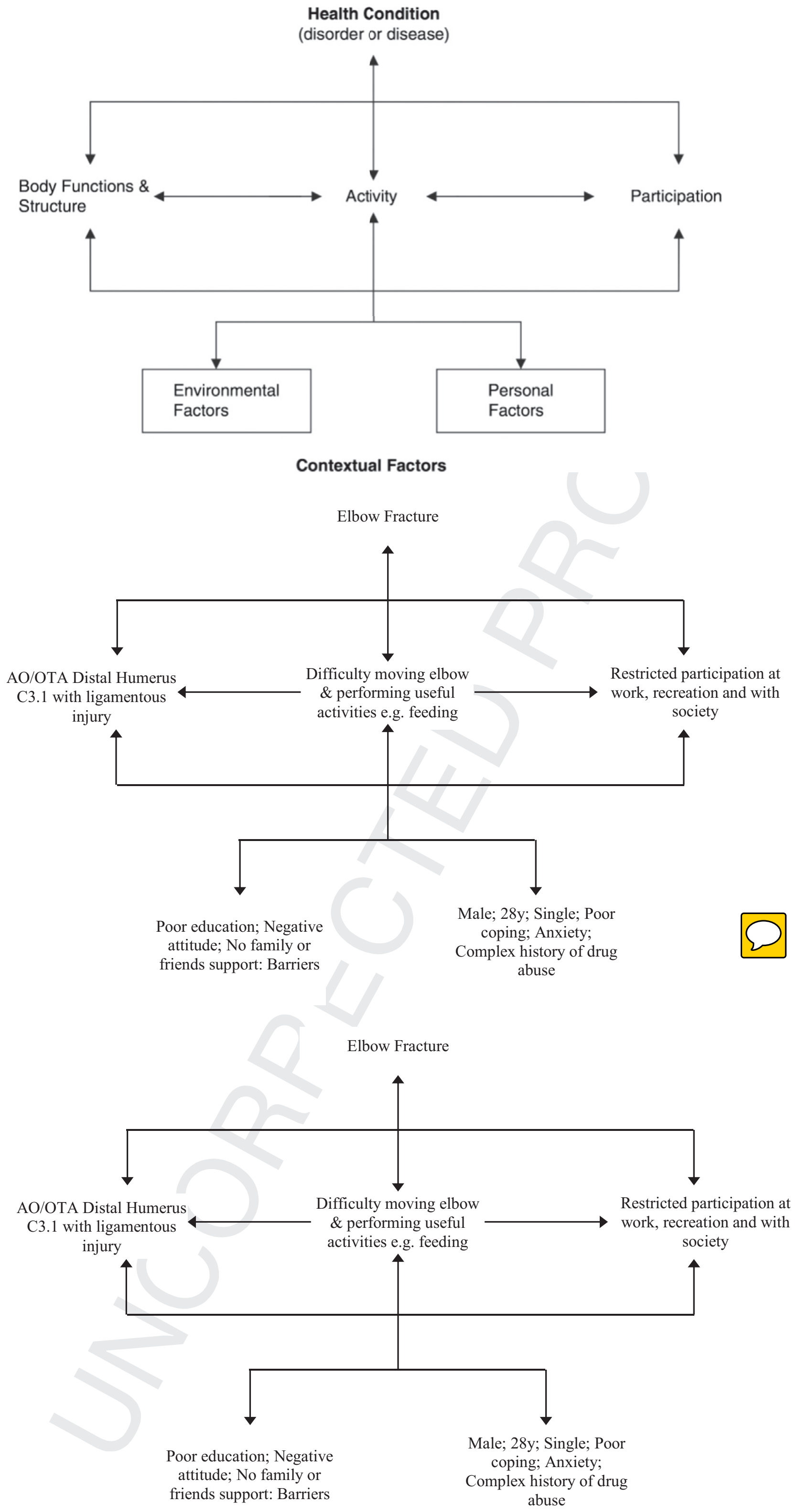

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Figure 1 The World Health Organization International Classification of Disability, Functioning and Health and the framework applied to 2 examples of patients with elbow fractures. The examples represent a few domains of each component related to the health condition and are not intended to represent a complete overview of impairments, activity limitations, participation restrictions, or environmental and personal factors. The direction or magnitude of the *arrows* may differ for specific situations or individuals. *Two-directional arrows* represent a multidirectional influence. *AO/OTA*, AO Foundation and Orthopaedic Trauma Association.

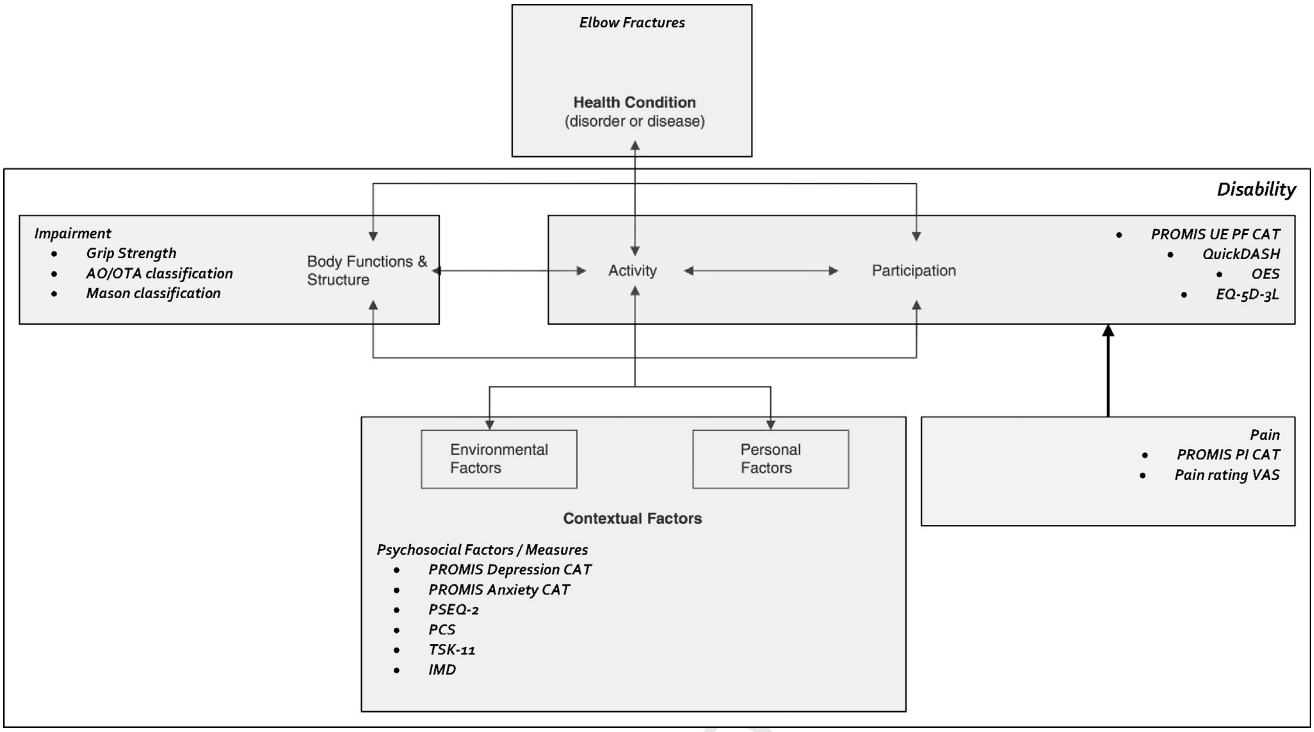

Figure 2 Components of the World Health Organization International Classification of Disability, Functioning and Health Framework represented by patient-reported outcome measures and other variables used to assess limitations after elbow fractures. *AO/OTA*, AO Foundation and Orthopaedic Trauma Association; *PROMIS*, Patient-Reported Outcome Measurement Information System; *PROMIS UE PF CAT*, PROMIS Upper Extremity Physical Function Computer Adaptive Test; *QuickDASH*, Quick Disabilities of the Arm, Shoulder and Hand; *OES*, Oxford Elbow Score; *EQ-5D-3L* EuroQol 5-Dimension 3-Level; *PSEQ-2*, Pain Self-Efficacy Questionnaire-2; *PCS*, Pain Catastrophizing Scale; *TSK-11*, Tampa Scale for Kinesiophobia-11; *IMD*, Index of Multiple Deprivation 2015; *PROMIS PI*, PROMIS Pain Interference; *VAS*, visual analog scale.

Regarding medications, antidepressant use was recorded and defined as any earlier use, that is, for pre-existing depression or a new diagnosis of depression in the acute recovery phase (the first month after injury). Use of opioid analgesia was defined as continued use of any opioids $\geq$2 weeks after injury. Patients using opioids before injury were included in this opioid use group only if there was an increase in their intake after fracture.

Outcome measures

PROMs were administered in the following order: PROMIS UE,[21] PROMIS Pain Interference (PROMIS PI),[1] PROMIS Depression,[17,41] PROMIS Anxiety[41], PROMIS Emotional Support (PROMIS ES),[43] PROMIS Instrumental Support (PROMIS IS),[43] QuickDASH,[3,34,51] OES,[39] EQ-5D-3L,[14,50] Pain Catastrophizing Scale,[49] Pain Self-Efficacy Questionnaire-2 (PSEQ-2),[5,36] and Tampa Scale for Kinesiophobia-11 (TSK-11).[56] Descriptions of these measures are detailed in Appendix I and scores are provided in Appendix II.

Statistical analysis

Descriptive statistics included frequencies and percentages for discrete variables and mean, standard deviation, and range for normally distributed continuous variables. Bivariate analysis involved unpaired Student *t*-test or analysis of variance for comparing continuous and discrete variables and Pearson correlation for continuous variables. Strength of correlations was classified as high (>0.70), high-moderate (0.61-0.69), moderate (0.40-0.60), moderate-weak (0.31-0.39), and weak (<0.30).[47]

Data were checked for multicollinearity, in which 2 or more predictor variables in a multiple regression model are highly correlated, meaning that 1 can be linearly predicted from the other with a substantial degree of accuracy. This may be indicated by high β, high standard error, and wide 95% confidence intervals and assessed with partial R^2, correlation matrices at $\leq$1 week and 2-4 weeks, and variable inflation factor. The variable inflation factor measures the extent to which the variance of estimated regression coefficients and independent variables increases because of collinearity. A correlation $\geq$0.80 was considered an indication of multicollinearity and led to omission of 1 of the 2 variables with this high correlation (Appendix III).

After adjustment for multicollinearity, the remaining psychosocial measures and each independent variable correlating with limitations at $\leq$1 week and 2-4 weeks, with $P \leq .10$ in bivariate analysis, were entered into multivariable regression. Eight multivariable models were created in total, that is, one for each PROM with independent variables at $\leq$1 week and at 2-4 weeks. $P < .05$ was considered statistically significant in multivariable analysis.

An a priori power analysis indicated that a minimum sample size of 160 would provide 80% statistical power with α set at .05.

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Table I Patients' demographics

Demographic	Value
Patients enrolled (within 1 week after injury)	183
Patients at 2-4 weeks	183
Patients at 6-9 months	183
Age (yr)	48.2 ± 20.2 (18-93)
Female	50 (91)
Age-adjusted Charlson Comorbidity Index	1.2 ± 1.6 (0-6)
Marital status	
Single	32 (59)
Partner/married	51 (93)
Separated/divorced/widowed	17 (31)
Social status	
Alone	16 (30)
Partner/friends/family	81 (148)
Full/part-time care	3 (5)
Education (yr)	14.6 ± 2.7 (8-21)
Work status	
Working	57 (105)
Homemaker	3 (5)
Retired	26 (48)
Unemployed	7 (13)
Workers compensation/litigation	7 (12)
Index of Multiple Deprivation	66.3 ± 27 (0-99.5)
Broad injury classification	
Radial head/neck fracture	66 (122)
Extra-articular fracture	9 (16)
Intra-articular fracture	25 (45)
Dominant side injured	45 (83)
High-energy injury	19 (34)
Neurovascular compromise	4 (7)
Open injury	4 (7)
Joint aspiration	7 (13)
Surgery	21 (39)
Complication	26 (47)
Prior fracture to dominant arm	16 (30)
Prior fracture to nondominant arm	11 (20)
Opioid use	31 (56)
Antidepressant use	26 (47)

Continuous variables are presented as mean ± standard deviation (range). Discrete variables are presented as percentage (number).

This was based on a regression with 10 predictors and an assumption that an independent variable would account for 3.5% or more of the variability in limitations and the complete model would account for at least 30% variability. All statistical analysis was performed using Stata 14.0 (StataCorp LP, College Station, TX, USA). No sources of funding were related to this work.

Results

Multiple variables within a week of injury correlated with PROMIS UE 6-9 months after elbow fractures in bivariate analysis (Appendix IV). Of these variables, kinesiophobia was the strongest psychological predictor in multivariable regression after adjustment for multicollinearity. This accounted for 14% of the variance (TSK-11: partial R^2 = 0.14; P = .005; Table II). Other factors related to work status, that is, not being retired (partial R^2 = 0.21; P = .000) and not being unemployed (partial R^2 = 0.18; P = .000), also explained a significant proportion of the variability.

Multiple variables at 2-4 weeks after injury also correlated with PROMIS UE 6-9 months after elbow fractures in bivariate analysis (Appendix V). Of these variables, coping strategy (measured by PSEQ-2) was the strongest psychological predictor in multivariable regression after adjustment for multicollinearity. This accounted for 12% of the variance (PSEQ-2: partial R^2 = 0.123; P = .003; Table III). Other dominant factors included being male (partial R^2 = 0.115; P = .000) and not being retired (partial R^2 = 0.126; P = .000).

Kinesiophobia within a week of injury also consistently explained a substantial proportion of the magnitude of limitations at 6-9 months measured by QuickDASH (partial R^2 = 0.08; P = .005), OES (partial R^2 = 0.122; P = .000), and EQ-5D-3L (partial R^2 = 0.069; P = .001; Table II). Other factors that explained a substantial proportion of the variance included older age, the use of opioids, the use of antidepressants, and being retired, but these were not consistent across PROMs.

Pain self-efficacy and instrumental support consistently accounted for a substantial proportion of the variability in QuickDASH, OES, and EQ-5D-3L in multivariable analysis (PSEQ-2 [QuickDASH (partial R^2 = 0.136; P = .004); OES (partial R^2 = 0.195; P = .002); EQ-5D-3L (partial R^2 = 0.125; $P < .001$)]; PROMIS IS [QuickDASH (partial R^2 = 0.273; $P < .001$); OES (partial R^2 = 0.256; $P < .002$); EQ-5D-3L (partial R^2 = 0.166; $P < .001$)]. Other factors that explained a substantial proportion of the variance in greater limitations included being male, antidepressant use, not being retired, and being unemployed, but these were not consistent across PROMs. No injury-related correlates of limitations at either stage of recovery were selected in multivariable analysis.

Discussion

The combination of psychosocial variables in this study explained a high proportion of the variability in measures of limitations. In particular, kinesiophobia, the fear of movement or further injury within a week of elbow fracture, appears to be a dominant predictor of limitations at 6-9 months. At 2-4 weeks, self-efficacy, the resilience and ability to cope with injury, and instrumental support were the strongest determinants. These findings held true for region-specific and general health PROMs.

The concept of kinesiophobia encompasses a fear that activities and movements may risk further injury, pain, and disruption of the underlying fracture. One could consider

Table II Multivariable analysis of influential factors at <1 week for limitations measured using PROMIS UE PF, QuickDASH, OES, and EQ-5D-3L at 6-9 months

Variables	Regression coefficient	95% Confidence interval		Standard error	*P* value	VIF	Partial R^2	Adjusted R^2
PROMIS UE PF*								
Female	−4.93	−6.85	−3.01	0.04	.113	1.79	0.15	0.77
Work status								
Retired	−9.26	−13.48	−5.03	2.14	.000	3.29	0.21	
Unemployed	−7.83	−11.92	−3.73	2.07	.000	2.32	0.18	
Complications	−3.32	−6.11	−0.53	1.41	.020	2.86	0.11	
PROMIS PI	0.14	0.02	0.27	0.064	.028	1.62	0.01	
PSEQ-2	0.41	0.05	0.77	0.18	.026	2.79	0.05	
TSK-11	−0.20	−0.34	−0.06	0.07	.005	2.72	0.14	
QuickDASH†								
Age	0.28	0.16	0.41	0.07	.000	4.49	0.10	0.86
Female	3.96	0.73	7.18	1.63	.017	1.79	0.05	
Marital status: partner/married	−4.59	−8.33	−0.86	1.89	.016	2.39	0.07	
Work status								
Retired	9.45	2.36	16.55	3.59	.009	3.29	0.05	
Unemployed	12.24	5.37	19.11	3.48	.001	2.32	0.07	
Complications	6.69	2.01	11.37	2.37	.005	2.86	0.07	
Opioid use	8.91	4.59	13.22	2.19	.000	2.72	0.09	
Antidepressant use	20.60	14.98	26.22	2.84	.000	4.07	0.24	
PROMIS PI	−0.26	−0.48	−0.05	0.11	.015	1.62	0.01	
TSK-11	0.34	0.11	0.57	0.12	.005	2.72	0.08	
OES‡								
Age	−0.08	−0.14	−0.01	0.03	.028	4.49	0.354	0.83
Marital status: partner/married	2.15	0.19	4.10	0.99	.032	2.39	0.058	
Work status: retired	−4.04	−7.75	−0.33	1.88	.033	3.27	0.02	
Opioid use	−2.92	−5.18	−0.66	1.14	.012	2.71	0.061	
Antidepressant use	−10.27	−13.18	−7.37	1.47	.000	3.96	0.328	
PROMIS PI	0.23	0.11	0.34	0.06	.000	1.62	0.070	
PROMIS Depression	0.18	0.08	0.27	0.05	.000	3.90	0.104	
PROMIS Anxiety	−0.27	−0.41	−0.14	0.07	.000	3.91	0.108	
PSEQ-2	0.38	0.06	0.69	0.16	.019	2.79	0.065	
TSK-11	−0.29	−0.41	−0.16	0.06	.000	2.72	0.122	
EQ-5D-3L§								
Charlson Comorbidity Index	−0.05	−0.08	−0.02	0.17	.004	3.60	0.059	0.74
Marital status: separated/divorced/widowed	0.14	0.03	0.25	0.06	.016	2.21	0.033	
Work status: retired	−0.34	−0.50	−0.18	0.08	.000	3.24	0.103	
Antidepressant use	−0.25	−0.37	−0.12	0.06	.000	3.78	0.183	
PROMIS PI	0.01	0.00	0.01	0.00	.023	1.58	0.019	
PROMIS Depression	0.00	0.00	0.01	0.00	.029	3.42	0.032	
PROMIS Anxiety	−0.01	−0.02	−0.01	0.00	.000	3.75	0.119	
TSK-11	−0.01	−0.01	0.00	0.00	.001	2.67	0.069	

PROMIS UE PF, Patient-Reported Outcome Measurement Information System Upper Extremity Physical Function Computer Adaptive Test; *QuickDASH*, Quick Disabilities of the Arm, Shoulder and Hand; *OES*, Oxford Elbow Score; *EQ-5D-3L*, EuroQol 5-Dimension 3-Level; *VIF*, variable inflation factor; *PROMIS PI*, PROMIS Pain Interference; *PSEQ-2*, Pain Self-Efficacy Questionnaire-2; *TSK-11*, Tampa Scale for Kinesiophobia-11.

Partial R^2 shown only for variables with $P < .05$.

* In model: age, sex, marital status, social status, education, work status, energy of injury, neurovascular status, complications, joint aspiration, surgery, prior nondominant arm fracture, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PROMIS depression, PROMIS anxiety, PSEQ-2, TSK-11.

† In model: age, sex, marital status, social status, education, work status, energy of injury, neurovascular status, joint aspiration, surgery, complications, prior nondominant arm fracture, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PROMIS depression, PROMIS anxiety, PSEQ-2, TSK-11.

‡ In model: age, female sex, marital status, social status, education, work status, high-energy injury, joint aspiration, surgery, complications, prior nondominant arm fracture, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PROMIS depression, PROMIS anxiety, PSEQ-2, TSK-11.

§ In model: Charlson Comorbidity Index, marital status, social status, work status, high-energy injury, joint aspiration, surgery, complications, prior nondominant arm fracture, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PROMIS depression, PROMIS anxiety, PSEQ-2, TSK-11.

Table III Multivariable analysis of the influential factors at 2-4 weeks for limitations measured using PROMIS UE PF, QuickDASH, OES, and EQ-5D-3L at 6-9 months

Variables	Regression coefficient	95% Confidence interval		Standard error	P value	VIF	Partial R^2	Adjusted R^2
PROMIS UE PF*								
Female	−3.57	−5.43	−1.71	0.94	.000	1.81	0.115	0.78
Work status								
Retired	−8.21	−12.32	−4.10	2.08	.000	3.30	0.126	
Unemployed	−6.70	−10.58	−2.81	1.97	.001	2.33	0.094	
Neurovascular status	−4.34	−8.56	−0.11	2.14	.044	1.37	0.022	
Complications	−2.79	−5.55	−0.04	1.39	.047	3.03	0.016	
PROMIS PI	−0.11	−0.17	−0.04	0.03	.002	1.33	0.034	
PSEQ-2	0.89	0.30	1.48	0.30	.003	3.81	0.123	
PROMIS IS	0.30	0.13	0.47	0.09	.001	3.36	0.075	
QuickDASH†								
Age	0.18	0.06	0.30	0.06	.003	4.91	0.078	0.8849
Marital status: partner/married	−3.99	−7.35	−0.63	1.70	.02	2.45	0.056	
Work status: unemployed	13.23	7.20	19.26	3.05	.000	2.33	0.118	
Antidepressant use	11.93	6.56	17.30	2.72	.000	4.78	0.163	
PSEQ-2	−1.36	−2.27	−0.45	0.46	.004	3.81	0.136	
PROMIS IS	−0.83	−1.10	−0.57	0.14	.000	3.36	0.273	
OES‡								
Female	1.75	0.07	3.43	0.52	.042	1.81	0.006	0.83
Antidepressant use	−5.80	−8.86	−2.74	1.55	.000	4.57	0.129	
PROMIS PI	−0.08	−0.14	−0.02	0.03	.013	1.32	0.010	
PSEQ-2	0.83	0.31	1.35	0.27	.002	3.66	0.195	
PROMIS IS	0.54	0.39	0.70	0.08	.000	3.27	0.256	
EQ-5D-3L§								
Charlson Comorbidity Index	−0.03	−0.06	0.00	0.02	.045	3.75	0.005	
Work status: homemaker	0.13	0.01	0.24	0.06	.027	3.36	0.011	
Grip strength %	0.47	0.07	0.87	0.20	.022	3.00	0.021	0.76
PSEQ-2	0.04	0.02	0.06	0.01	.000	3.08	0.125	
PROMIS IS	0.01	0.01	0.02	0.00	.000	2.99	0.166	

PROMIS UE PF, Patient-Reported Outcome Measurement Information System Upper Extremity Physical Function Computer Adaptive Test; *QuickDASH*, Quick Disabilities of the Arm, Shoulder and Hand; *OES*, Oxford Elbow Score; *EQ-5D-3L*, EuroQol 5-Dimension 3-Level; *VIF*, variable inflation factor; *PROMIS PI*, PROMIS Pain Interference; *PSEQ-2*, Pain Self-Efficacy Questionnaire-2; *PROMIS IS*, PROMIS Instrumental Support; *PROMIS ES*, PROMIS Emotional Support.

Only partial R^2 of significant values is displayed (ie, $P < .05$).

* In model: age, sex, marital status, social status, education, work status, energy of injury, neurovascular status, complications, joint aspiration, surgery, prior nondominant arm fracture, opioid use, antidepressant, use, broad classification, grip strength %, PROMIS PI, PROMIS ES, PROMIS IS.

† In model: age, female sex, marital status, social status, education, work status, high-energy injury, neurovascular status, joint aspiration, surgery, complications, prior fracture in nondominant arm, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PSEQ-2, PROMIS ES, PROMIS IS.

‡ In model: age, female sex, marital status, social status, education, work status, high-energy injury, joint aspiration, surgery, complications, prior nondominant arm fracture, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PSEQ-2, PROMIS ES, PROMIS IS.

§ In model: Charlson Comorbidity Index, marital status, social status, work status, high-energy injury, joint aspiration, surgery, complications, prior nondominant arm fracture, opioid use, antidepressant use, broad classification, grip strength %, PROMIS PI, PSEQ-2, PROMIS ES, PROMIS IS.

such fears a normal part of the post-traumatic experience. However, such fears may also evoke maladaptive responses, such as a heightened desire to protect the arm and become overcautious about movement, which may slow recovery. This psychological barrier to movement could compound the biologic processes involved in the development of post-traumatic stiffness, a common complication of elbow trauma.[30] Despite the lack of evidence supporting the timing of mobilization after elbow fractures, most surgeons agree on the principle of stretching the elbow and using it for light daily tasks as soon as it is safe. For most fractures, this is after a few days of immobilization for comfort.[20,30,40] Based on these findings, recovery from a fracture of the elbow may be delayed by unhelpful thoughts, perceptions, and behaviors related to pain with movement within a week of injury. Interactions that instill confidence, increase engagement, and grant license to ideas that may be unfamiliar or counterintuitive during recovery could provide the best response in this instance and limit adverse sequel, such as elbow stiffness.

A few weeks to a month after elbow fracture, there appears to be a transition toward self-efficacy being the dominant factor in influencing limitations. One explanation could be that as symptoms diminish after the acute event and patients begin to experience life with their injury, the focus shifts from fear-based thoughts around painful movement toward learning to cope and adapt. Those with less adaptive mindsets may have greater limitations than expected for their condition.[29]

Other psychological factors had variable interactions with limitations during the recovery process. Depression and anxiety at <1 week were predictive of disability measured by OES and EQ-5D-3L. Because of multicollinearity, particularly at 2-4 weeks, multiple psychological variables including depression, anxiety, and pain catastrophizing were omitted from regression analysis. Studies involving nontraumatic upper extremity conditions demonstrate a strong correlation between depression, anxiety, and the magnitude of limitations.[26,33,38,44,53,55] Notably, in this study, the use of antidepressants explained a substantial proportion of the variation in limitations represented by QuickDASH, OES, and EQ-5D-3L at <1 week and QuickDASH and OES at 2-4 weeks.

Social factors, such as marital status (ie, being married or having a partner; being separated, widowed, or divorced) and work status (ie, being retired or unemployed) also explained a proportion of the variation in limitations, although somewhat inconsistently, both at <1 week and at 2-4 weeks after injury. Instrumental support, the perceived availability of support from others in fulfilling specific functions, in particular accounted for a significant proportion of the variation in limitations 2-4 weeks after injury. The provision of tangible support from family, friends, and partners to fulfill daily functions appeared to have a stronger impact on future health-related outcomes than emotional support, which is the perceived feeling of being cared for and valued when faced with the stresses and strains of a painful elbow fracture. This may reflect the needs of relatively younger, more active individuals who may be faced with greater practical commitments related to their activities of daily life and work.

Surprisingly, no clinical or injury-related factors, except complications, explained significant amounts of the variability in disability across measures at <1 week and at 2-4 weeks after injury.

As additional findings, this study also demonstrated the feasibility of delivering multiple PROMs during recovery from elbow trauma, as early as day 0 after injury; the ability to efficiently administer PROMs, including computer adaptive tests, by a web-based electronic portal; and the possibility of achieving a robust set of patient outcomes with low levels of missing data and participant attrition using a full-time investigator.[7,13,15,52]

These findings must be considered in light of some limitations. First, it is recognized that a single-center study may not be representative of the wider population despite a wide range in demographic profile and indices of deprivation. Second, the best multivariable models in this study demonstrated a large proportion of the variance in limitations; however, other unaccounted factors could also have had a substantial influence on PROMs (eg, fracture displacement during recovery, reinjury, uncontrolled pain, and development of stiffness in injured and adjacent joints). Third, injury type may have been too variable and classified too broadly, with each category containing a heterogeneous range of injuries of varying levels of severity. For instance, the management of a comminuted intra-articular fracture of the distal humerus is often more complex than an isolated simple intra-articular fracture of the olecranon. Despite this, the majority were isolated fractures of the radial head and neck. Future studies should assess more homogeneous diagnoses and treatments (eg, isolated, nonoperatively managed radial head and neck fractures) and perform similar assessments to see whether the findings are replicated. Fourth, PROMIS ES and IS were not assessed at <1 week because of a programming error. Although this may have influenced the analysis, it is unlikely to have substantially affected the overall interpretation of results.

Finally, a more detailed approach could also have been taken to define complications, with future studies delineating operative adverse events (eg, infection) from "subjective" issues, such as disproportionate pain and pain requiring a cortisone injection.

Conclusion

Identifying factors, such as kinesiophobia, self-efficacy, and instrumental support, that are modifiable and predictive of limitations early in the recovery process supports greater attention to the mental health and social well-being of elbow fracture patients alongside their physical needs and clinical management during the healing process. The use of enhanced communication with enabling and empowering language should be applied by health care professionals; some patients may require more intensive coaching, cognitive therapies, and social support. These strategies may be the most effective way of further improving patient outcomes after elbow injuries.[19,45,48]

Disclaimer

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Supplementary data

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Uncited References

4, 18, 25, 27, 42, 46, 54, 57, 58.

References

1. Amtmann D, Cook KF, Jensen MP, Chen WH, Choi S, Revicki D, et al. Development of a PROMIS item bank to measure pain interference. Pain 2010;150:173-82. https://doi.org/10.1016/j.pain.2010.04.025
2. AO Foundation. AO/OTA fracture and dislocation classification compendium—2018. Available at: https://classification.aoeducation.org/?_ga=2.157844474.1167809572.1544422099-877738355.1544153610. Accessed December 10, 2018
3. Beaton DE, Wright JG, Katz JN, Upper Extremity Collaborative Group. Development of the QuickDASH: comparison of three item-reduction approaches. J Bone Joint Surg Am 2005;87A:1038-46. https://doi.org/10.2106/JBJS.D.02060
4. Bernstein J, Weintraub S, Hume E, Neuman MD, Kates SL, Ahn J. The new APGAR score: a checklist to enhance quality of life in geriatric patients with hip fracture. J Bone Joint Surg 2017;99:e77. https://doi.org/10.2106/JBJS.16.01149
5. Bot AG, Nota SP, Ring D. The creation of an abbreviated version of the PSEQ: the PSEQ-2. Psychosomatics 2014;55:381-5. https://doi.org/10.1016/j.psym.2013.07.007
6. Broberg MA, Morrey BF. Results of treatment of fracture-dislocations of the elbow. Clin Orthop Relat Res 1987;216:109-19.
7. Cella D, Yount S, Rothrock N, Gershon R, Cook K, Reeve B, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS): progress of an NIH Roadmap cooperative group during its first two years. Med Care 2007;45(Suppl 1):S3-11. https://doi.org/10.1097/01.mlr.0000258615.42478.55
8. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373-83.
9. Clement ND, Duckworth AD, McQueen MM, Court-Brown CM. The outcome of proximal humeral fractures in the elderly: predictors of mortality and function. Bone Joint J 2014;96-B:970-7. https://doi.org/10.1302/0301-620X.96B7.32894
10. Clement N, McQueen M, Court-Brown C. Social deprivation influences the epidemiology and outcome of proximal humeral fractures in adults for a defined urban population of Scotland. Eur J Orthop Surg Traumatol 2014;24:1039-46. https://doi.org/10.1007/s00590-013-1301-3
11. Dawson J, Fitzpatrick R, Carr A. Questionnaire on the perceptions of patients about shoulder surgery. J Bone Joint Surg Br 1993;78:593-600.
12. de Putter CE, Selles RW, Haagsma JA, Polinder S, Panneman MJ, Hovius SE, et al. Health-related quality of life after upper extremity injuries and predictors for suboptimal outcome. Injury 2014;45:1752-8. https://doi.org/10.1016/j.injury.2014.07.016
13. Döring AC, Nota SP, Hageman MG, Ring DC. Measurement of upper extremity disability using the Patient-Reported Outcomes Measurement Information System. J Hand Surg Am 2014;39:1160-5. https://doi.org/10.1016/j.jhsa.2014.03.013
14. The European Quality of Life Index. EQ-5D-3L; 2017. Available at: https://euroqol.org/eq-5d-instruments/eq-5d-3l-about/. Accessed ***.
15. Fries J, Rose M, Krishnan E. The PROMIS of better outcome assessment: responsiveness, floor and ceiling effects, and Internet administration. J Rheumatol 2011;38:1759-64. https://doi.org/10.3899/jrheum.110402
16. Gershon R, Rothrock NE, Hanrahan RT, Jansky LJ, Harniss M, Riley W. The development of a clinical outcomes survey research application: assessment center. Qual Life Res 2010;19:677-85. https://doi.org/10.1007/s11136-010-9634-4
17. Gibbons RD, Weiss DJ, Pilkonis PA, Frank E, Moore T, Kim JB, et al. Development of a computerized adaptive test for depression. Arch Gen Psychiatry 2012;69:1104-12. https://doi.org/10.1001/archgenpsychiatry.2012.14
18. Golkari S, Teunis T, Ring D, Vranceanu AM. Changes in depression, health anxiety, and pain catastrophizing between enrollment and 1 month after a radius fracture. Psychosomatics 2015;56:652-7. https://doi.org/10.1016/j.psym.2015.03.008
19. Handoll H, Brealey S, Rangan A, Keding A, Corbacho B, Jefferson L, et al. The ProFHER (PROximal Fracture of the Humerus: Evaluation by Randomization) trial—a pragmatic multicentre randomised controlled trial evaluating the clinical effectiveness and cost-effectiveness of surgical compared with non-surgical treatment for proximal humerus fractures. Health Technol Assess 2015;19:1-280. https://doi.org/10.3310/hta19240
20. Harding P, Rasekaba T, Smirneos L, Holland AE. Early mobilization for elbow fractures in adults. Cochrane Database Syst Rev 2011;6:CD008130. https://doi.org/10.1002/14651858.CD008130.pub2
21. Hays RD, Spritzer KL, Amtmann D, Lai JS, Dewitt EM, Rothrock N, et al. Upper-extremity and mobility subdomains from the Patient-Reported Outcomes Measurement Information System (PROMIS) adult physical functioning item bank. Arch Phys Med Rehabil 2013;94:2291-6. https://doi.org/10.1016/j.apmr.2013.05.014
22. Horrigan P, Braman JP, Harrison A. Fractures and dislocations about the elbow and their adverse sequelae: contemporary perspectives. Instr Course Lect 2016;65:41-51.
23. Hotchkiss RN. Displaced fractures of the radial head: internal fixation or excision? J Am Acad Orthop Surg 1997;5:1-10.
24. The English Index of Multiple Deprivation (IMD) 2015—Guidance; 2015. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/464430/English_Index_of_Multiple_Deprivation_2015_-_Guidance.pdf. Accessed ***.
25. Janssen S, ter Meulen D, Nota SP, Hageman M, Ring D. Does verbal and nonverbal communication of pain correlate with disability? Psychosomatics 2015;56:338-44. https://doi.org/10.1016/j.psym.2014.05.009
26. Jayakumar P, Overbeek CL, Lamb S, Williams M, Funes C, Gwilym S, et al. What factors are associated with disability after upper extremity injuries? A systematic review. Clin Orthop Relat Res 2018;476:2190-215. https://doi.org/10.1097/CORR.0000000000000427
27. Jayakumar P, Overbeek CL, Ring DC. Relationship of age on enjoyment of physical activity in upper extremity illness. Hand 2015;10:767-72. https://doi.org/10.1007/s11552-015-9754-y
28. King GJ, Faber KJ. Posttraumatic elbow stiffness. Orthop Clin North Am 2000;31:129-43.
29. Kortlever JT, Janssen SJ, van Berckel MM, Ring D, Vranceanu AM. What is the most useful questionnaire for measurement of coping strategies in response to nociception? Clin Orthop Relat Res 2015;473:3511-8. https://doi.org/10.1007/s11999-015-4419-2
30. Lindenhovius AL, Jupiter JB. The posttraumatic stiff elbow: a review of the literature. J Hand Surg Am 2007;32:1605-23. https://doi.org/10.1016/j.jhsa.2007.09.015
31. MacDermid J, Vincent JI, Kieffer L, Kieffer A, Demaiter J, Macintosh S. A survey of practice patterns for rehabilitation post elbow fracture. Open Orthop J 2012;6:429-39. 10.2174/1874325001206010429

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32. Mason ML. Some observations on fractures of the head of the radius with a review of one hundred cases. Br J Surg 1954;42:123-32.
33. Menendez ME, Bot AG, Hagemen M, Neuhaus V, Mudgal CS, Ring D. Computerized adaptive testing of psychological factors: relation to upper-extremity disability. J Bone Joint Surg Am 2013;95:1-6. https://doi.org/10.2106/JBJS.L.01614
34. Mintken PE, Glynn P, Cleland JA. Psychometric properties of the shortened Disabilities of the Arm, Shoulder, and Hand Questionnaire (QuickDASH) and Numeric Pain Rating Scale in patients with shoulder pain. J Shoulder Elbow Surg 2009;18:920-6. https://doi.org/10.1016/j.jse.2008.12.015
35. Nandi S, Maschke S, Evans PJ, Lawton JN. The stiff elbow. Hand 2009;4:368-79. https://doi.org/10.1007/s11552-009-9181-z
36. Nicholas MK, McGuire BE, Asghari A. A 2-item short form of the Pain Self-efficacy Questionnaire: development and psychometric evaluation of PSEQ-2. J Pain 2015;16:153-63. https://doi.org/10.1016/j.jpain.2014.11.002
37. Nota SP, Spit SA, Oosterhoff TC, Hageman MG, Ring DC, Vranceanu AM. Is social support associated with upper extremity disability? Clin Orthop Relat Res 2016;474:1830-6. https://doi.org/10.1007/s11999-016-4892-2
38. Overbeek CL, Nota SP, Jayakumar P, Hageman MG, Ring D. The PROMIS physical function correlates with the QuickDASH in patients with upper extremity illness. Clin Orthop Relat Res 2014;473:311-7. https://doi.org/10.1007/s11999-014-3840-2
39. Oxford Elbow Score (OES). Available at: https://www.ouh.nhs.uk/shoulderandelbow/information/documents/OxfordElbowScore.pdf accessed ***.
40. Paschos NK, Mitsionis GI, Vasiliadis HS, Georgoulis AD. Comparison of early mobilization protocols in radial head fractures. J Orthop Trauma 2013;27:134-9. https://doi.org/10.1097/BOT.0b013e31825cf765
41. Pilkonis PA, Choi SW, Reise SP, Stover AM, Riley WT, Cella D, et al. Item banks for measuring emotional distress from the Patient-Reported Outcomes Measurement Information System (PROMIS): depression, anxiety, and anger. Assessment 2011;18:263-83. https://doi.org/10.1177/1073191111411667
42. Prugh J, Zeppieri G, George SZ. Impact of psychosocial factors, pain, and functional limitations on throwing athletes who return to sport following elbow injuries: a case series. Physiother Theory Pract 2012;28:633-40. https://doi.org/10.3109/09593985.2012.666632
43. Riley WT, Pilkonis P, Cella D. Application of the National Institutes of Health Patient-reported Outcome Measurement Information System (PROMIS) to mental health research. J Ment Health Policy Econ 2011;14:201-8.
44. 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. https://doi.org/10.2106/JBJS.E.00932
45. Rosenberger PH, Jokl P, Ickovics J. Psychosocial factors and surgical outcomes: an evidence-based literature review. J Am Acad Orthop Surg 2006;14:397-405.
46. Sabesan VJ, Valikodath T, Childs A, Sharma VK. Economic and social impact of upper extremity fragility fractures in elderly patients. Aging Clin Exp Res 2015;27:539-46. https://doi.org/10.1007/s40520-014-0295-y
47. Shoukri MM, Pause CA. Statistical methods for health sciences. 2nd. Boca Raton, FL: CRC Press; 1998.
48. Slobogean GP, Johal H, Lefaivre KA, MacIntyre NJ, Sprague S, Scott T, et al. A scoping review of the proximal humerus fracture literature. BMC Musculoskelet Disord 2015;16:112. https://doi.org/10.1186/s12891-015-0564-8
49. Sullivan M, Bishop S, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess 1995;7:524-32.
50. The EuroQol Group. EuroQol—a new facility for the measurement of health-related quality of life. Health Policy 1990;16:199-208.
51. Tsang P, Walton D, Grewal R, MacDermid J. Validation of the QuickDASH and DASH in patients with distal radius fractures through agreement analysis. Arch Phys Med Rehabil 2017;98:1217-22. https://doi.org/10.1016/j.apmr.2016.11.023
52. Tyser AR, Beckmann J, Franklin JD, Cheng C, Hon SD, Wang A, et al. Evaluation of the PROMIS physical function computer adaptive test in the upper extremity. J Hand Surg Am 2014;39:2047-51.e4. https://doi.org/10.1016/j.jhsa.2014.06.130
53. Vranceanu AM, Cooper C, Ring D. Integrating patient values into evidence-based practice: effective communication for shared decision-making. Hand Clin 2009;25:83-96. https://doi.org/10.1016/j.hcl.2008.09.003
54. Vranceanu AM, Hageman M, Strooker J, ter Meulen D, Vrahas M, Ring D. A preliminary RCT of a mind body skills based intervention addressing mood and coping strategies in patients with acute orthopaedic trauma. Injury 2015;46:552-7. https://doi.org/10.1016/j.injury.2014.11.001
55. Vranceanu AM, Jupiter JB, Mudgal CS, Ring D. Predictors of pain intensity and disability after minor hand surgery. J Hand Surg Am 2010;35:956-60. https://doi.org/10.1016/j.jhsa.2010.02.001
56. Woby SR, Roach NK, Urmston M, Watson PJ. Psychometric properties of the TSK-11: a shortened version of the Tampa Scale for Kinesiophobia. Pain 2005;117:137-44. https://doi.org/10.1016/j.pain.2005.05.029
57. World Health Organization. International Classification of Functioning, Disability and Health (ICF); 2001. Available at: https://www.who.int/classifications/icf/en/. Accessed ***.
58. World Health Organization. A practical manual for using the International Classification of Functioning, Disability and Health (ICF); 2013. Available at: https://www.who.int/classifications/drafticfpracticalmanual.pdf. Accessed ***.

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