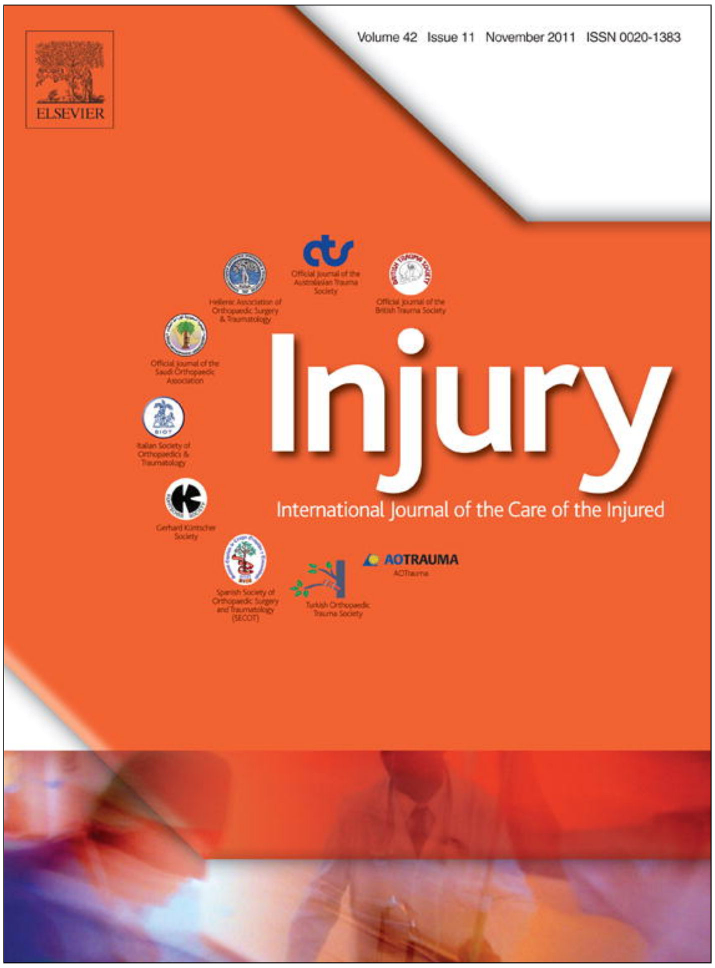
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Comparison of depressive symptoms during the early recovery period in patients with a distal radius fracture treated by volar plating and cast immobilisation

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ABSTRACT

Introduction: Patients with orthopaedic trauma experience substantial psychological and physical morbidities. The purpose of this study was to assess depressive symptoms in patients with a distal radius fracture, and to determine whether early use of the wrist after volar plating reduces depressive symptoms as compared with cast immobilisation during the early recovery period.
Materials and methods: Twenty-six patients with a distal radius fracture, who underwent volar plating and were allowed immediate use of the wrist, and 24 patients treated by cast immobilisation for 6 weeks were prospectively compared with respect to depressive symptoms at week 0, and at 2, 6, 12 and 24 weeks after injury, using the Center for Epidemiologic Studies Depression Scale (CES-D). Physical morbidity was assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and a pain Numerical Rating Scale (NRS). Multivariate analysis was performed to identify factors that independently predicted CES-D scores at each time point.
Results: No differences in the CES-D scores were found between the volar plating and the cast immobilisation groups, although volar plating group had marginally better CES-D scores at 24 weeks. Multivariate analysis indicated that CES-D scores at each time were independently associated with pain NRS scores at 0 and 24 weeks, and DASH scores at 6 weeks.
Conclusion: Early use of the wrist after volar plating was not found to reduce depressive symptoms as compared with cast immobilisation in the early treatment period following a distal radius fracture. Pain was found to be an important predictor of depression, suggesting that caution is needed to address pain during the early rehabilitation period.

Introduction

Patients with orthopaedic trauma experience substantial psychological and physical morbidities. In fact, 6.5–51% of such patients have been estimated to experience psychological symptoms following musculoskeletal trauma.[2,8,9,21–23,29,30] However, the prevalence of psychological symptoms following injuries depends on the diagnostic criteria, assessment tools, the definition of trauma used and on the timing of assessments.[2,30]

Distal radius fracture is the most common fracture of the upper extremity, and is a public health concern amongst the elderly, who often experience fragility fractures.[7] Distal radius fracture can cause considerable disability with respect to daily activities, and, furthermore, the level of disability has been shown to be correlated with depression in those recovering on conservative treatment,[27] although it is not a life-threatening injury like hip fracture. Several studies have demonstrated that psychological response is not necessarily correlated with severity of the injury,[11,10,21] though a few studies have reported the opposite.[3,12]

Recently, open reduction and internal fixation using the volar locking plating system has become an increasingly popular option for the treatment of unstable distal radius fractures,[7] because this method provides sufficiently stable fixation to maintain good reduction and allow early motion.[6,26] Rozental et al.[28] showed better functional outcomes with less disability as early as 6 weeks after open reduction and internal fixation with volar plating (VP) as compared with closed reduction and percutaneous fixation. We hypothesised that VP, which allows an early use of the wrist and early return to daily activities, may better address depressive symptoms in patients with a distal radius fracture than conservative treatment during recovery from injury. No previous study has been performed to compare depressive symptoms in patients with a distal radius fracture according to treatment method or regarding their temporal pattern. The purpose of this study was to assess depressive symptoms in patients with a distal radius fracture, and to determine whether early use of the wrist after VP reduces depressive symptoms as compared with cast immobilisation (CI) during the early recovery period.

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Materials and methods

Study population

We obtained Ethics Committee/Human Studies Committee approval for this study. From July 2008 through June 2009, 168 patients presented with a distal radius fracture at the authors' hospital, which is an urban tertiary referral hospital for trauma. All were initially managed by closed reduction and a cast, and those with inadequately reduced fractures or those who experienced reduction loss during follow-up evaluations underwent surgery. The operative criteria were as follows: (1) radial shortening of >5 mm, (2) dorsal angulation of >10° or volar angulation of >20° in wrist lateral radiographs, (3) radial inclination of <10° in wrist postero-anterior view and (4) an articular step-off of >2 mm. During the study period, 60 patients underwent surgery by open reduction and internal fixation with VP or with closed pinning and CI, and 108 were treated by CI. No patient was treated by external fixation during the study period. Because the authors' hospital is a tertiary referral hospital for hand trauma, more patients were treated surgically than would be expected generally for patients with a distal radius fracture.

We designed a prospective case–control study, in which we compared patients treated by open reduction and internal fixation with VP and patients treated by CI for 6 weeks. We excluded patients with multiple trauma, neurovascular injuries, a combined distal radio-ulnar joint instability, associated carpal instability, those with a known psychiatric illness, those who regularly used narcotics or hypnotics, those who could not read or answer the questionnaires and those with litigation issues. In addition, we excluded the following from the VP cohort; those with an associated styloid fracture fragment requiring fixation or additional CI, and those that had to undergo surgery late after trauma due to loss of reduction at 2 weeks or more after initial closed reduction and cast application. Furthermore, we excluded those with an undisplaced fracture or a stable fracture that could be treated by CI for 3 or 4 weeks from the CI cohort, because we wanted all patients in the CI cohort to have a 6-week period of CI. We also excluded those who declined to undergo recommended surgery from the CI cohort, as this might have been a manifestation of underlying anxiety or excessive fear of surgery, which could have affected subsequent assessments of depressive symptoms. The remaining patients were approached regarding enrolment in this study at the time of surgery or cast application, and 30 patients per treatment who agreed to participate were consecutively enrolled. However, four patients in the VP group and six in the CI group failed to complete all follow-up evaluations and were excluded. Accordingly, the analysis was performed on 26 patients in the VP group and 24 patients in the CI group. There were 6 men and 20 women in the VP group, and 3 men and 21 women in the CI group. Average patient age was 53 years (range, 25–74 years) in the VP group and 58 years (range, 28–80 years) in the CI group. Demographic data and AO fracture classifications[14] are presented in Table 1.

Surgery/CI

Patients in the VP group underwent open reduction and internal fixation. All operations were performed by one hand surgeon under regional anaesthesia. Bone grafting was not performed. Postoperatively, wrists were immobilised using a short-arm volar plaster splint, and patients were encouraged to perform active shoulder, elbow and finger motion exercises. At 1 week postoperatively, all wrists were placed in a removable wrist brace. Physiotherapy and occupational therapy were started at 2 weeks postoperatively. Patients were encouraged to perform active wrist range-of-motion exercises as often as possible. Braces were used for around 6 weeks, as required.

Patients in the CI group underwent closed reduction and CI. When acceptable alignment had been achieved, a sugar-tong splint was applied to the affected forearm. Both active and passive finger motion were encouraged early during the post-trauma period. Three or four weeks after sugar-tong splint placement, patients were transitioned to a short-arm cast. At 6 weeks after initial cast application, wrists were placed in a removable wrist brace and physiotherapy and occupational therapy were started. Patients were educated to discard braces gradually over the following 2 weeks, and were encouraged to perform active and passive wrist range-of-motion exercises.

Outcome evaluations

Patients were routinely followed up at 1, 2, 6, 12 and 24 weeks after surgery or cast application. Primary study outcome questionnaires were obtained at baseline (week 0), and at 2, 6, 12 and 24 weeks. Clinical examinations were performed by the first author. Wrist ranges of motion were evaluated by recording flexion, extension, radio-ulnar deviation and prono-supination using a standard goniometer. Grip power was measured using a Jamar dynamometer (Asimow Engineering, Los Angeles, CA, USA) with the elbow flexed at 90° and the forearm in neutral rotation. Results were recorded in kilogrammes.[15]

Outcome questionnaires were administered by an independent examiner, who was a research assistant at the Department of Orthopedic Surgery and was not directly involved in the care of our patients. It took on average 15 min to administer the questionnaires. They included the Center for Epidemiologic Studies Depression Scale (CES-D) for the assessment of depressive symptoms, the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and a pain Numerical Rating Scale (NRS). CES-D is composed of 20 items rated on a scale of 0–3. Thus, possible total scores range from 0 to 60, and the average score for the general population is 9.1 ± 8.6.[4] The CES-D is used for the screening of symptoms related to depression or psychological distress, and is regarded as a valuable tool for identifying those at risk of depression.[20,24] A score of 16 is widely used as a predictive cut-off when estimating the prevalence of major depressive disorder.[4] The DASH questionnaire was used to quantify general disabilities related to the upper extremity.[16] This questionnaire contains 30 items: 21 concern difficulties with specific tasks, five evaluate symptoms and the other four address social functions, work, sleep and confidence. DASH scores range from 0 and 100, where higher scores indicate greater upper-extremity disability. The average DASH score for the general population has been reported to be 10.10 ± 14.68.[17] Pain intensity was measured using a 11-point pain NRS, which is a reliable and valid measure of pain intensity from 0 (no pain) to 10 (worst imaginable pain).[18,32]

Table 1
Demographic data.

	Volar plating (N = 26)	Cast immobilization (N = 24)	*p* value
Age (years)	53 ± 13 (25–74)	58 ± 13 (28–80)	0.17
Gender			
Female	20 (77%)	21 (88%)	0.47
Male	6 (23%)	3 (22%)	
Dominant hand fracture	11 (42%)	11 (46%)	1
AO classification			
A2	3 (12%)	11 (46%)	0.03
A3	7 (27%)	5 (21%)	
C1	7 (27%)	6 (25%)	
C2	9 (35%)	2 (8%)	

Statistical analysis

The primary outcome variable used to determine statistical power was CED-S score. The study was designed to determine a 9-point mean difference in CED-S score between the two study groups, given a standard deviation of 9 points in the general population (for an effect size of 1.0). Power analysis indicated that a sample size of 23 patients per group was required for a statistical power of 90% to detect this effect size between the groups (alpha = 0.05, beta = 0.10) using the Student's *t*-test. Thirty patients per group were initially enrolled and 26 patients in the VP group and 24 patients in the CI group were finally analysed.

Group results were compared using the Pearson chi square or Fisher's exact test for categorical variables, and the Student's *t*-test for continuous variables. Changes of scores between week 0 and 24 were assessed using the paired *t*-test. *P* values of <0.05 were considered significant.

Univariate analysis was conducted to determine associations between independent variables (patient age, sex, dominant hand involvement, DASH scores and pain NRS scores) and the dependent variable (CES-D) at each time point. Independent variables found to have significant ($p < 0.05$) or near-significant ($p < 0.1$) associations were entered into a multivariate regression model.

Results

Outcome scores (CES-D, DASH, pain NRS)

No differences in the CES-D scores were found between the VP and the CI groups, although VP group had marginally better CES-D scores at 24 weeks ($p = 0.08$). CES-D scores improved significantly between week 0 and week 24 in both groups ($p < 0.01$ respectively).

Immediately after injury (0 week), 19 (73%) of the 26 in the VP group and 19 (79%) of the 24 in the CI group had CES-D scores ≥16, which is considered the cut-off value for estimating the prevalence of major depression disorder. At 2 weeks, 11 (42%) in the VP group and 13 (54%) in the CI group had scores ≥16. The average CES-D scores in the patients are presented in Table 2.

The VP group had significantly better DASH scores ($p = 0.01$) and pain NRS scores ($p < 0.01$) than the CI group at 24 weeks after injury, and significantly better pain NRS scores ($p = 0.01$) and marginally better DASH scores ($p = 0.10$) than the CI group at 12 weeks. No significant differences were found between the two groups at earlier time points (Table 2).

Table 2
Comparison of outcome scores.

Outcome scores	Volar plating	Cast immobilization	*p* value
CES-D scores			
Week 0	18.4 ± 6.3	20.9 ± 7.0	0.17
Week 2	17.1 ± 8.9	19.4 ± 7.8	0.40
Week 6	13.1 ± 8.8	15.5 ± 10.5	0.46
Week 12	11.7 ± 6.4	14.8 ± 10.7	0.34
Week 24	7.4 ± 4.2	10.7 ± 8.1	0.08
DASH			
Week 0	65.8 ± 17.3	73.2 ± 19.2	0.11
Week 2	61.7 ± 16.8	63.2 ± 20.3	0.83
Week 6	37.9 ± 23.0	50.7 ± 24.4	0.23
Week 12	21.3 ± 11.7	38.8 ± 23.9	0.10
Week 24	13.9 ± 8.8	25.9 ± 14.0	0.01
Pain NRS			
Week 0	4.1 ± 1.3	4.7 ± 1.5	0.15
Week 2	3.0 ± 1.4	3.1 ± 1.6	0.80
Week 6	1.9 ± 1.2	2.5 ± 1.7	0.10
Week 12	1.4 ± 1.2	2.3 ± 1.9	0.01
Week 24	0.8 ± 0.8	1.6 ± 1.4	<0.01

Table 3
Univariate analysis of predictors of CES-D score at each measurement.

Variables	Week 0	Week 2	Week 6	Week 12	Week 24
	Significance (*p*)				
Age	0.48	0.83	0.21	0.25	0.31
Gender	0.14	0.51	0.54	0.78	0.68
Dominant hand	0.62	0.49	0.16	0.21	0.13
DASH					
0 week	0.32				
2 week		0.22			
6 week			<**0.01**		
12 week				<**0.01**	
24 week					<**0.01**
Pain NRS					
0 week	<**0.01**				
2 week		**0.04**			
6 week			<**0.01**		
12 week				<**0.01**	
24 week					<**0.01**

Boldface, significant or nearly significant (included in multivariate model).

Predictors of depressive symptoms

Univariate analysis was conducted to identify associations between independent variables (patient age, sex, dominant hand involvement, DASH scores and pain NRS) and CES-D at each time point (Table 3).

Univariate analysis demonstrated a significant association between CES-D and DASH scores at week 0 ($r = 0.27$, $p = 0.05$), week 6 ($r = 0.72$, $p < 0.01$), week 12 ($r = 0.65$, $p < 0.01$) and at week 24 ($r = 0.682$, $p < 0.01$). Furthermore, a significant association was found between CES-D and pain NRS scores at week 0 ($r = 0.47$, $p < 0.01$), week 2 ($r = 0.44$, $p = 0.04$), week 6 ($r = 0.58$, $p < 0.01$), week 12 ($r = 0.68$, $p < 0.01$) and at week 24 ($r = 0.734$, $p < 0.01$) (Table 3). Multivariate regression analysis indicated that CES-D scores at each time point were independently associated with pain NRS scores at week 0 ($p < 0.01$), with DASH scores at week 6 ($p < 0.01$), and with pain NRS scores at week 24 ($p = 0.01$) (Table 4). A model including DASH and pain NRS was found to account for 20% of CES-D variability at week 0 ($R^2 = 0.20$, $F = 6.5$, $p = 0.01$). Furthermore, at week 24 after injury, this model explained 58% of CES-D variability ($R^2 = 0.58$, $F = 21.6$, $p < 0.01$) (Table 4).

Table 4
Multivariate analysis of predictors of CES-D score at each measurement time.

Predictors	*β*	*p* value
CES-D baseline ($R^2 = 20\%$)		
DASH baseline	0.25	0.52
Pain NRS baseline	0.5	<**0.01**
CES-D 2 weeks ($R^2 = 29\%$)		
DASH 2 weeks	−0.16	0.925
Pain NRS 2 weeks	0.46	0.1
CES-D 6 weeks ($R^2 = 51\%$)		
DASH 6 weeks	0.64	<**0.01**
Pain NRS 6 weeks	0.23	0.14
CES-D 12 weeks ($R^2 = 55\%$)		
DASH 12 weeks	0.34	0.16
Pain NRS 12 weeks	0.43	0.07
CES-D 24 weeks ($R^2 = 58\%$)		
DASH 24 weeks	0.29	0.59
Pain NRS 24 weeks	0.51	**0.01**

Boldface: significant.

Radiographic and functional results

All fractures healed uneventfully. At final radiographic examination at 24 weeks, patients in the VP group had a mean volar tilt of 8.1° (standard deviation (SD), 1.5°), a radial inclination of 19.2° (SD, 2.2°) and a radial length of 9.5 mm (SD, 1.3 mm), and corresponding values in the CI group were 5.3° (SD, 3.4°), 14.3° (SD, 5.6°) and 6.3 mm (SD, 3.2 mm) respectively. No significant inter-group difference was found in terms of volar tilt ($p = 0.73$), but radial inclination and radial lengths were significantly greater in the VP group ($p < 0.01$ respectively).

Mean flexion–extension arc of the wrist was 96.1° (SD, 21.2°) in the VP group at 6 weeks after injury, which was significantly greater than the 46.5° (SD, 18.3°) of the CI group ($p < 0.01$). This value improved to 105.3° (SD, 23.5°) at 12 weeks in the VP group, and this was also significantly greater than that of the CI group (89.5°; SD, 25.4°) at 12 weeks ($p = 0.03$). At 24 weeks, flexion–extension arc in the VP group averaged 112.2° (SD, 22.3°) and that in the CI averaged 110.3° (SD, 27. 7), which was not significantly different ($p = 0.79$).

No major complication occurred in either group. Minor complications included one case of a pressure sore caused by the cast, which healed after dressing, in the CI group, one case of late development of carpal tunnel syndrome in the VP group, which resolved after a corticosteroid injection and five cases of adhesive capsulitis of the shoulder (two in the VP group and three in the CI group).

Discussion

In the present study, we assessed depressive symptoms in patients with a distal radius fracture, and asked whether presumed early use of the wrist and early return to daily activities after VP ameliorates depressive symptoms as compared with CI during the early recovery period after injury. This study demonstrates that there are no differences in the CES-D scores between the VP and the CI groups, although VP group had marginally better CES-D scores at 24 weeks.

Initially, we expected that patients in the VP group would have better CES-D scores early in the postoperative period, because they were allowed early wrist motion exercise, whereas patients in the CI group experienced the discomfort of wearing a heavy cast. However, the expected benefits of early use of the wrist were not evident in the current study. As pain was found to be an important predictor of depressive symptoms during the early recovery period, we believe that caution is needed to give patients sufficient pain control medications and not to overly emphasise early use of the wrist in the early postoperative period since this may increase pain.

In the present study, 38 (76%) of the study subjects at the time of injury and 24 (48%) at 2 weeks post-injury had CES-D scores of ≥16 (the cut-off value for major depression disorder).[4] Although many studies have reported that psychological symptoms are common after musculoskeletal trauma, with rates ranging from 6.5% to 51%,[2,8,9,21–23,29,30] little information is available on the prevalence of depression in patients with a distal radius fracture. Our results indicate that although distal radius fracture is a relatively less severe injury than an open low-extremity fracture,[2] a considerable percentage of patients with a distal radius fracture experience depressive symptoms, and that levels of depressive symptoms continue at a higher than average level until 12 weeks post-injury, which supports the finding that psychological response is not necessarily correlated with the severity of injury.[11,10,21]

This study found strong association between depressive symptoms and disability and pain scores. Correlations between psychological morbidity and physical complaints have been reported by several authors.[1,25,27,33] Ring et al. reported that DASH scores are correlated with depression in several upper-extremity conditions, including distal radius fracture. However, they examined only non-operatively treated patients at 6 weeks after injury.[27] Zatzick et al.[33] also reported that patients with post-traumatic stress disorder demonstrated significant adverse outcomes according to Short Form (36) (SF-36) results, and Opsteegh et al. found that pain intensity predicts symptoms of acute post-traumatic stress disorder in patients with acute hand injuries.[25] The present study also showed that pain and disability accounted more for the variability of CES-D scores with the passage of time. It seems that pain and disability become more important predictors of depression when chronic conditions are established, as it is well-known that psychological symptoms correlate well with chronic pain and disability conditions.[1,13]

The strength of the present study is that it reports depressive symptoms in patients with a distal radius fracture at different times after injury and for different treatment methods, and shows correlations between depressive symptoms and physical disability and pain. However, the present study also has several limitations. First, it was not a randomised controlled study because the indications of treatments differed. In particular, the VP group had more unstable fractures, which can result in poorer outcomes. However, VP group members had better outcomes than members of the CI group, suggesting that a randomised study would also have results similar to ours. Furthermore, with the exception of fracture patterns, demographic variables were not significantly different in the groups. Second, we lacked data on the preoperative psychological statuses of our patients, and, thus, we could not determine to what extent psychological morbidities were attributed to injury and treatment. However, CES-D scores at week 0 were similar in the two groups, which made it possible to evaluate the effect of the two treatments on depressive symptoms after injury. Third, our assessment of depressive symptoms was limited to CES-D, and a more comprehensive assessment including coping, the cognitive process, self efficacy, illness behaviour, anxiety and other aspects of psychological morbidity would have been more informative.[19,31] Fourth, we did not examine several important predictors of depressive symptoms after trauma, such as, social support, education level, socioeconomic status and aesthetic results.[5,25] Fifth, we did not apply an equal physiotherapy protocol to both groups, thus the VP group started physiotherapy earlier than the CI group, which may have a positive effect on the patient and therefore may reduce depressive symptoms, although the differences were not significant. Further studies may be needed to evaluate the effect of physiotherapy on patients' psychological recovery after trauma. Finally, the study lacks a long-term follow up of depressive symptoms and of its effect on clinical outcomes. However, our focus was to determine whether an early return to daily activities after VP improves psychological aspects during the critically important first 6 months, because VP is known to be particularly effective in terms of achieving early functional recovery.

Conclusions

Early use of the wrist after VP was not found to reduce depressive symptoms as compared with CI in the early treatment period following a distal radius fracture. Pain was found to be an important predictor of depression, suggesting that caution is needed to address pain during the early rehabilitation period.

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References

1. Badcock LJ, Lewis M, Hay EM, *et al.* Chronic shoulder pain in the community: a syndrome of disability or distress? *Ann Rheum Dis* 2002;**61**:128–31.
2. Bhandari M, Busse JW, Hanson BP, *et al.* Psychological distress and quality of life after orthopedic trauma: an observational study. *Can J Surg* 2008;**51**:15–22.
3. Blanchard EB, Hickling EJ, Mitnick N, *et al.* The impact of severity of physical injury and perception of life threat in the development of post-traumatic stress disorder in motor vehicle accident victims. *Behav Res Ther* 1995;**33**: 529–34.
4. Boyd JH, Weissman MM, Thompson WD, Myers JK. Screening for depression in a community sample. Understanding the discrepancies between depression symptom and diagnostic sales. *Arch Gen Psychiatry* 1982;**39**:1195–200.
5. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol* 2000;**68**:748–66.
6. Chung KC, Watt AJ, Kotsis SV, *et al.* Treatment of unstable distal radial fractures with the volar locking plating system. *J Bone Joint Surg Am* 2006;**88**:2687–94.
7. Chung KC, Shauver MJ, Birkmeyer JD. Trends in the United States in the treatment of distal radial fractures in the elderly. *J Bone Joint Surg Am* 2009;**91**:1868–73.
8. Crichlow RJ, Andres PL, Morrison SM, *et al.* Depression in orthopaedic trauma patients. Prevalence and severity. *J Bone Joint Surg Am* 2006;**88**:1927–33.
9. Dijkstra PU, Groothoff JW, ten Duis HJ, Geertzen JH. Incidence of complex regional pain syndrome type I after fractures of the distal radius. *Eur J Pain* 2003;**7**:457–62.
10. Ehlers A, Mayou RA, Bryant B. Psychological predictors of chronic posttraumatic stress disorder after motor vehicle accidents. *J Abnorm Psychol* 1998;**107**:508–19.
11. Feinstein A, Dolan R. Predictors of post-traumatic stress disorder following physical trauma: an examination of the stressor criterion. *Psychol Med* 1991;**21**:85–91.
12. Frommberger UH, Stieglitz RD, Nyberg E, *et al.* Prediction of posttraumatic stress disorder by immediate reactions to trauma: a prospective study in road traffic accident victims. *Eur Arch Psychiatry Clin Neurosci* 1998;**248**:316–21.
13. Gettings L. Psychological well-being in rheumatoid arthritis: a review of the literature. *Musculoskeletal Care* 2010;**8**:99–106.
14. Graff S, Jupiter J. Fracture of the distal radius: classification of treatment and indications for external fixation. *Injury* 1994;**25**(4):D14–25.
15. Gunther CM, Burger A, Rickert M, *et al.* Grip strength in healthy Caucasian adults: reference values. *J Hand Surg Am* 2008;**33**:558–65.
16. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). *Am J Ind Med* 1996;**29**:602–8.
17. Hunsaker FG, Cioffi DA, Amadio PC, *et al.* The American academy of orthopaedic surgeons outcomes instruments: normative values from the general population. *J Bone Joint Surg Am* 2002;**84**:208–15.
18. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. *Pain* 1986;**27**:117–26.
19. Koestler AJ. Psychological perspective on hand injury and pain. *J Hand Ther* 2010;**23**:199–210.
20. Margo GM, Dewan MJ, Fisher S, Greenberg RP. Comparison of three depression rating scales. *Percept Mot Skills* 1992;**75**:144–6.
21. Mason S, Wardrope J, Turpin G, Rowlands A. The psychological burden of injury: an 18 month prospective cohort study. *Emerg Med J* 2002;**19**:400–4.
22. McCarthy ML, MacKenzie EJ, Edwin D, *et al.* Psychological distress associated with severe lower-limb injury. *J Bone Joint Surg Am* 2003;**85**:1689–97.
23. Michaels AJ, Michaels CE, Smith JS, *et al.* Outcome from injury: general health, work status, and satisfaction 12 months after trauma. *J Trauma* 2000;**48**:841–8.
24. Myers JK, Weissman MM. Use of a self-report symptom scale to detect depression in a community sample. *Am J Psychiatry* 1980;**137**:1081–4.
25. Opsteegh L, Reinders-Messelink HA, Groothoff JW, *et al.* Symptoms of acute posttraumatic stress disorder in patients with acute hand injuries. *J Hand Surg Am* 2010;**35**:961–7.
26. Orbay JL, Fernandez DL. Volar fixed-angle plate fixation for unstable distal radius fractures in the elderly patient. *J Hand Surg Am* 2004;**29**:96–102.
27. Ring D, Kadzielski J, Fabian L, *et al.* Self-reported upper extremity health status correlates with depression. *J Bone Joint Surg Am* 2006;**88**:1983–8.
28. Rozental TD, Blazar PE, Franko OI, *et al.* Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. *J Bone Joint Surg Am* 2009;**91**:1837–46.
29. Rusch MD. Psychological response to trauma. *Plast Surg Nurs* 1998;**18**:147–53.
30. Starr AJ, Smith WR, Frawley WH, *et al.* Symptoms of posttraumatic stress disorder after orthopaedic trauma. *J Bone Joint Surg Am* 2004;**86**:1115–21.
31. Vranceanu AM, Barsky A, Ring D. Psychosocial aspects of disabling musculoskeletal pain. *J Bone Joint Surg Am* 2009;**91**:2014–8.
32. Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. *J Clin Nurs* 2005;**14**:798–804.
33. Zatzick DF, Jurkovich GJ, Gentilello L, *et al.* Posttraumatic stress, problem drinking, and functional outcomes after injury. *Arch Surg* 2002;**137**:200–5.