Association between objective clinical variables and patient-rated disability of the wrist
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Although the outcome of fractures of the distal radius is traditionally assessed using objective clinical variables such as grip strength and range of movement of the wrist, the extent to which they reflect function and outcomes of importance for the patient is uncertain. This may cause considerable inconsistencies in the assessment of outcome using current scoring systems. We prospectively studied 31 patients recovering from unstable fractures of the distal radius in order to investigate the association between objective variables and the level of post-traumatic disability of the wrist as measured by the patient-rated wrist evaluation (PRWE) score.

Multiple regression showed considerable differences in the extent to which limitations in specific objective clinical variables reflected the level of disability of the wrist. Grip strength was shown to be a significant predictor of the PRWE score (regression coefficient -1.09, 95% confidence interval -1.76 to -0.42, p < 0.01) and thus appears to be a sensitive indicator of return of function of the wrist. Forearm rotation and flexion and extension of the wrist were not significantly associated with the PRWE score. These observations should be taken into account during the evaluation of methods of treatment and in constructing future clinical outcome scoring systems.


The clinical outcome after treatment of fractures of the distal radius is traditionally based on assessments which include objective clinical variables such as grip strength and range of movement of the wrist. A shortcoming of such variables is that they may not reflect outcomes which are important to the patient and therefore do not necessarily correlate with the level of function. Furthermore, these assessments have not been validated with regard to the function of the wrist. Thus their use may be associated with considerable inconsistencies when assessing disability.

Patient-rating scales have been developed in recent years which are believed to provide a more comprehensive assessment of the outcome compared with traditional objective clinical variables. These have been shown to be highly sensitive in detecting variations in the outcome and should be used as they reflect important aspects of physical performance. The recent development of reliable and valid tools for patient-rated assessment of function of the wrist offers the opportunity to study the association between specific clinical variables and the level of disability. This will assist in the assessment of methods of treatment and the evaluation of current and future scoring systems for clinical outcome. Our aim was to investigate the association between objective variables of clinical outcome and the level of patient-rated disability in a group of patients recovering from fractures of the distal radius.

Patients and Methods

Between January 2000 and June 2001 we prospectively assessed 35 unstable (AO classification types 23-A2 (6), -A3 (8), -C1(2) and -C2 (19)) fractures of the distal radius in 35 consecutive patients who had been treated by closed reduction under general anaesthesia and percutaneous fixation with Kirschner (K-) wires followed by immobilisation in a cast. The wires were removed at four weeks and mobilisation began after removal of the cast at six weeks in all patients. Assessment was carried out at six weeks and three, six, 12 and 24 months after injury. Thirty-one patients, 19 women and 12 men, were available for assessment. Their mean age was 46.1 years (18 to 77). Complications included pin-site infection in seven which settled after local care and/or oral antibiotics, numbness over the distribution of the superficial radial nerve in six which resolved in all except one, and mild reflex sympathetic dystrophy in two which disappeared after aggressive hand physiotherapy. We did not exclude any of these patients from our study.
The patient-rated wrist evaluation (PRWE) score. Fifteen questions are used to rate the amount of pain and difficulty in performing specific tasks using a scale from 0 to 10. Thus, the total function PRWE score ranges from 0 (normal wrist) to 150 (worst possible score).

### Statistical analysis

Multiple regression was used to identify prognostic factors for PRWE scores six weeks after injury. A risk score was formulated by fitting a multiple regression model containing the known risk factors. Four variables, namely the age of the patient, gender, the presence of a high-energy injury and of an intra-articular fracture of the radiocarpal or distal radio-ulnar joints which could affect the outcome and thus the PRWE score, were controlled for in the model-building process by fitting a composite risk score. The coefficients from this model were used to give an equation for risk and the resultant risk score was included in each model to control for the effects of known risk factors. The three clinical variables which were recorded, namely grip strength, forearm rotation arc and wrist flexion/extension arc, were considered as possible prognostic variables. The final model was built using a backward stepwise approach. Factors significant at the 10% level or less were retained. The model assumptions were verified graphically. All analyses were performed using the Stata 7.0 statistical software package (Stata Corporation, College Station, Texas).

### Results

The final multiple regression model was controlled for risk score and contained the variable grip strength. Table II gives the regression coefficients and associated confidence intervals. As grip strength increases, the PRWE score decreases, i.e. improves. The adjusted $R^2$ was 0.43, suggesting that there may well be other factors which influence the PRWE score which have not been considered in this analysis. Neither the forearm rotation arc nor the wrist flexion/extension arc was a significant predictor of the PRWE score in the presence of grip strength.

### Discussion

The most commonly used evaluation system is the modification by Gartland and Werley of McBride’s demerit point system which includes objective evaluation of the function of the wrist based on the concept that a minimum of $45^\circ$ of dorsiflexion, $30^\circ$ of palmar flexion, $15^\circ$ each of radial and ulnar deviation and $50^\circ$ each of pronation and supination are the minimum necessary for normal function.

In the objective evaluation according to this system, the number of demerit points assigned is based purely on the presence of a specific arbitrarily-determined degree of loss of movement of the wrist. For example, five points are given for loss of dorsiflexion of more than $45^\circ$ and only one point for loss of palmar flexion of more than $30^\circ$. Loss of grip strength and pronation were not included. Sarmiento et al then modified it by adding loss of pronation (two points for loss of more than $50^\circ$) and grip strength (one point for loss of more than 40% that of the opposite side). Later, Lucas and Sachtjen further modified it by adding non-objective variables of function of the hand such as impairment of the median nerve, reflex sympathetic dystrophy and stiffness of the digits, and they removed grip strength from the criteria of functional outcome. In 1984 Porter and Stockley developed their ‘functional index’ in an attempt to produce a tool for the objective assessment of function.
the wrist. Despite the extensive use of these systems there have been no studies which have validated the scores against quantified outcome variables of function.

Lack of association between a clinical scoring system based on objective outcome variables and the true level of function can result in considerable inconsistencies when assessing disability of the wrist. For example, Bradway et al \(^5\) compared the outcome of a group of patients after internal fixation of intra-articular fractures of the distal radius using both the modified Gartland and Werley system and the modified scoring system of Green and O’Brien which incorporates pain, function and objective clinical variables. The results were deemed to be good or excellent in 81% of patients using the system of Gartland and Werley, but only 56% had a good or excellent result when scored by the system of Green and O’Brien.

Patient-rating scales are increasingly used in the evaluation of the outcome after treatment of fractures of the distal radius. The PRWE score \(^4,8,10\) is a wrist outcome measurement tool based on the assessment of pain and ability to do activities of daily living and work. Previous studies have shown excellent test-retest reliability, validity and ability to detect significant differences over time \(^8\) as well as a high level of responsiveness, i.e. ability to detect important clinical changes \(^4\) of the PRWE score during recovery from injuries to the wrist. The latter study also showed that questionnaires which were more specific to the wrist, such as the PRWE score were more responsive in detecting clinical changes. However, the results of this study also showed that when compared with patient-rated scores for function of the wrist, objective clinical variables based on affected-to-unaffected-side ratios such as grip strength and range of movement appear to be more responsive, that is they are more sensitive at detecting clinical changes. \(^4\)

With recent focus on the evaluation of disability and handicap after injury \(^8\) knowledge of the relative contribution of limitations in specific objective variables to the extent of disability of the wrist becomes of considerable significance. There are no previously published data on the association between specific objective clinical variables and the level of function of the wrist as assessed by modern patient-rating scales, although this information would be of significance when assessing new methods of treatment and validating current and future clinical outcome scoring systems. Moreover, it is possible that quantitatively similar limitations in clinical variables will have dissimilar effects on the level of disability of the wrist. This may be of significance when comparing the outcome of existing or new methods of treatment characterised by variations in the rate or extent of recovery of objective variables, for example, earlier or more complete recovery of the wrist flexion/extension arc than grip strength or forearm rotation arc, etc.

Our results show considerable differences in the extent to which limitations in specific objective clinical variables affect the level of disability of the wrist. Only grip strength, as the ratio of affected-to-unaffected-side and adjusted for hand dominance, was shown to be a significant predictor of the PRWE score. It appears to be a sensitive indicator of return of function of the wrist.

These results question the validity of traditional scoring systems for the wrist. For example, in the original system of Gartland and Werley demerit points are given only for loss of dorsiflexion of more than 45° and grip strength was excluded from the total score. Although Sarmiento et al \(^1\) recognised that grip strength is an important outcome variable and included it in their modified system, they believed that loss of grip strength is common even when the outcome is excellent. They assigned only one point for loss of grip strength of more than 40% which, for scoring purposes, they considered to be equivalent to loss of palmar flexion of 30°. Later, Lucas and Sachtjen \(^3\) again excluded grip strength from their modification of the demerit point scoring system.

Although there was no radiological or clinical evidence of ligamentous carpal injuries such as scapholunate dissociation in our study, the potential effect which these associated injuries may have on the clinical outcome of fractures of the distal radius would affect the results. Marked carpal instability associated with a tear of the scapholunate ligament has been reported in 30% of cases \(^1\) and it is possible that injuries of individual ligaments can affect isolated clinical variables. Thus, scapholunate dissociation causes pain on flexion of the wrist but not on rotation.

Our results indicate that not all clinical variables related to the wrist reflect the level of overall function of the wrist to the same extent. This must be taken into account in the assessment of methods of treatment and the validation of clinical outcome scoring systems.

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References


