SCIENTIFIC ARTICLE

The Effects of Pain, Supination, and Grip Strength on Patient-Rated Disability After Operatively Treated Distal Radius Fractures

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Purpose The correlation between physician-observed parameters and patient-rated disability in distal radius fractures is complex and poorly understood. Anecdotal clinical experience suggests that supination is an important factor in the return of functional status after distal radius fracture. To explore this relationship, we conducted a retrospective multivariate linear regression analysis of an existing patient database to evaluate the hypothesis that range of motion and other objective parameters are important determinants of patient-rated disability.

Methods We analyzed a prospectively gathered registry of patients undergoing operative fixation of distal radius fractures using physical examination parameters measured at each follow-up visit and patient-based outcomes including Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and visual analog scale for pain. We constructed a multivariate linear regression model to evaluate the association of range of motion, grip strength, and visual analog scale score with the DASH score.

Results We analyzed data from 190 patients and 611 total clinic visits. Pain, grip strength, and supination were significantly correlated with DASH scores, controlling for all other factors. These 3 variables were able to predict 56% of the variability of the DASH score. Flexion-extension, radial-ulnar deviation, and pronation had no significant correlation to DASH score.

Conclusions Pain, strength, and supination appear to be important determinants of patient-rated outcomes after distal radius fracture. Pain and strength continuously improve over time up to 2 years after surgery, whereas supination plateaus more quickly, usually within the first 3 to 6 months. *(J Hand Surg 2012;37A:957–962. Copyright © 2012 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Diagnostic II.

Key words DASH, distal radius fracture, radius, volar plate.

Fractures of the distal radius account for 20% of all fractures seen in emergency departments and are the most common fractures in all patients under the age of 75.[1,2] Over the past decade, there has been a rapid expansion in the fixation technology available to treat these fractures as well as a shift toward the use of patient-based measures to evaluate outcomes. Despite this shift, examination-based measures (eg, range of motion, strength, stability) continue to be reported and remain important parameters for measuring the success of treatment. However, the relationship between objective, physician-based outcome measures

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such as grip strength and range of motion and subjective, patient-based evaluations remains poorly understood, despite recent attempts at elucidation.[3–6]

The association between radiographic outcomes and subjective disability in distal radius fractures is similarly unclear. Although the radiographic parameters initially described by Knirk and Jupiter[7] (ie, dorsal tilt, radial inclination, radial length) are still considered critical, multiple studies have recently described a lack of correlation between these parameters and the more recently adopted patient-rated outcome measures.[8–12]

Few explanations have been proposed to account for these inconsistencies.[13] The role of restoring the anatomy of the distal radioulnar joint (DRUJ) is critical, although often overlooked by traditional radiographic evaluations and classification systems. Some classification systems, such as the Frykman classification system,[14] describe DRUJ anatomy but do not account for fracture displacement or direct treatment. Loss of congruence in this joint can result in the impairment of pronation and supination, the most clinically relevant deficit being supination, in our opinion, because compensatory movement at the shoulder and elbow cannot accommodate for loss of motion in that plane. One other study looking at the relationship among "modern" activities of daily living has supported this relationship.[15] However, the prevailing wisdom has been that pronation is the more critical motion,[16,17] which illustrates that the complex relationship between forearm motion and functional capacity remains unclear. We undertook this study to clarify which objective and motion-related parameters are important determinants of patient-rated disability.

MATERIALS AND METHODS

We analyzed a prospectively acquired database of all patients undergoing operative fixation of distal radius fractures to test which parameters were important determinants of patient-rated disability after distal radius fracture, by comparing objective examination-based parameters (ie, strength and range of motion) with subjective, patient-based parameters (pain and Disabilities of the Arm, Shoulder, and Hand [DASH] score).

Patient population

Our hospital institutional review board approved the study, and we obtained appropriate informed consent from all subjects. The inclusion criteria to be enrolled in the database were isolated distal radius fractures treated with surgical repair and age of at least 18 years at the time of injury. Radiographic indications for surgery included assessment on postreduction films including dorsal tilt greater than 10° or volar tilt less than 15°, 3-mm radial shortening with respect to the uninjured side (as measured by ulnar variance), and radial inclination less than 15°. Surgery was also indicated when the fracture was thought to be unstable (assessed by dorsal comminution or initial tilt greater than 20°, intra-articular stepoff, associated ulnar fracture, or age greater than 60 years[18,19]), despite reduction within acceptable limits. The attending orthopedic surgeon made the decision to undergo operative fixation in each case; this was not formally a part of the study process. Patients were excluded when there were concomitant fractures other than associated ulnar styloid fractures (ie, carpal fractures, fractures about the elbow, or any fractures in the contralateral arm).

All patients were treated by 1 of 3 fellowship-trained hand surgeons at a single institution. Patients were enrolled at their first follow-up appointment after surgery at 1 to 2 weeks, and both physical examination parameters and patient-based outcome instruments were evaluated at every subsequent follow-up visit at standard follow-up times of 2, 4, 12, 24, and 52 weeks, and then annually. From September 2004 to June 2010, 190 patients were enrolled and seen for a total of 611 follow-up visits. A total of 122 patients (64%) were female, and the dominant hand was affected in 89 patients (47%). The average age at the time of surgery was 55 ± 17 years (range, 18–84 y); the average age of male patients was 45 ± 17 years and the average age of female patients was 61 ± 14 years.

Surgical technique

The attending surgeon chose the fixation type, including volar, radial column, dorsal plate, or external fixation, or a combination of these, according to the fracture pattern and personal preference. In this study group, 82 patients (43%) received volar locking plates, 7 received a dorsal plate alone (4%), 10 (5%) had radial column plating alone, 30 (16%) had external fixation alone, and 61 (32%) had some combination of these methods.

All patients who underwent open reduction and internal fixation received precontoured locking plates (EBI OptiLock, Parsippany, NJ; or Stryker Variax, Kalamazoo, MI). Volar plating was achieved using a modified Henry approach,[20] while dorsal plates were placed through the interval between the fourth and fifth dorsal compartments,[21] Radial column plates used an incision over the first dorsal compartment, as reported in previous literature.[21] All patients undergoing internal fixation were placed in a volar splint postoperatively with immediate finger motion; wrist motion and hand therapy were started once the splint was removed 10 to