SCIENTIFIC ARTICLE

Factors Delaying Recovery After Volar Plate Fixation of Distal Radius Fractures

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Purpose To evaluate the factors influencing delayed functional recovery in patients with a distal radius fracture treated by volar plate fixation.

Methods A total of 122 patients with a distal radius fracture treated by volar locking plate were enrolled. The wrist range of motion, grip strength, and functional outcome by the Michigan hand score were assessed 3, 6, and 12 months after surgery. The factors assessed for their influence on delayed functional recovery include age, sex, bone mineral density (BMD), hand dominance, the type of fracture, the energy of trauma, the time to surgery, and the duration of immobilization. A multivariate regression analysis was conducted to identify independent predictors of delayed functional recovery in terms of the Michigan hand score.

Results There was a significant decrease in the wrist range of motion in patients with a high-energy trauma, severe type fracture, or increase in duration of immobilization at month 3, whereas only a severe fracture type was associated with a decreased range of motion after 6 and 12 months. An increase in age, a decrease in BMD, and high-energy trauma reduced grip strength at months 3 and 6, whereas only an increase in age and a decrease in BMD reduced grip strength at month 12. According to the multivariate regression analysis, severe type fracture and high-energy trauma reduced functional outcomes at months 3 and 6. Conversely, at month 12, an increase in age and a decrease in BMD reduced functional outcome.

Conclusions An increase in age and a decrease in BMD were important risk factors influencing delayed functional recovery up to 12 months after distal radius fracture surgery, whereas fracture severity and high-energy trauma were associated with decreased functional outcomes up to 6 months after surgery. *(J Hand Surg Am. 2014;39(8):1465–1470. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Prognostic II.

Key words Distal radius fractures, functional recovery, risk factors, volar plate fixation.

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Distal radius fractures (DRFs) are the most common fracture in the upper extremity and represent a serious public health concern.[1] There is an increasing incidence of these fractures in recent decades, with reports of increases in the last 3 to 4 decades ranging from 17% to 100%.[2,3] These fractures cause functional limitations up to or beyond a year after surgery,[4,5] and impairments or disabilities caused by these fractures have comprehensive impacts on daily life.[6] Surgical fixation enables patients to resume daily activities earlier and more independently,[1,7] and there has been an increasing trend toward more surgical fixation in patients with DRFs.[1,8]

The course of functional recovery and subsequent limitations in daily activity after a fracture varies across patients,[9] although a similar level of function has been reported to be present in the final long-term follow-up regardless of radiological results.[4,10,11] Therefore, the course of functional recovery is an important factor to consider in the process of managing patients with DRFs. Some studies have evaluated the temporal course of disability after distal radius surgery,[12,13] but few have comprehensively evaluated the factors influencing delayed functional recovery after the surgical treatment of a DRF. Understanding the temporal course of patients' impairments/disability and identifying factors influencing delayed functional recovery can help clinicians in predictions of prognosis and interpretations of treatment outcomes.

The primary purpose of this study was to evaluate the factors influencing delayed functional recovery in patients with a DRF treated by volar plate fixation. We hypothesized that baseline patient characteristics (age, gender, bone mineral density [BMD], and hand dominance), the type of injury (the type of fracture and the energy of trauma), or the mode of treatment (time to surgery and the duration of immobilization) were related to patient's functional recovery for a year after DRF fixation.

MATERIALS AND METHODS

A total of 136 consecutive patients older than 50 years of age with a DRF treated by volar plate fixation between July 2011 and December 2012 were initially enrolled. These patients were recruited from a tertiary care university hospital serving as a regional emergency trauma center. The institutional review board of the university approved this study, and all patients provided informed consent. The operative criteria were as follows: radial shortening of greater than 5 mm, dorsal angulation of greater than 10° or volar angulation of greater than 20° in wrist lateral radiographs, radial inclination of less than 10° in wrist poster-anterior view, and an articular stepoff of greater than 2 mm. A total of 14 patients with systemic, multiorgan, or head injuries; concomitant wrist or upper extremity injuries; bilateral fractures; treated more than 2 weeks after initial injury; or with less than a year follow-up were excluded. Table 1 shows the demographics for the remaining 122 patients.

The patients returned for their functional assessment 3 (range, 3−4), 6 (range, 5−8), and 12 (range, 12−14) months after their surgical procedure. The wrist range of motion and grip strength were assessed by 2 orthopedic hand specialists, and a Michigan hand questionnaire was administered after the clinical examination during each visit. Grip strength (kgf) was measured using the Jamar dynamometer (Asimow Engineering, Los Angeles) with the elbow flexed at 90° and the forearm in neutral rotation, and the values were changed to a percentage of the injured side relative to the noninjured side. The wrist range of motion was evaluated by recording wrist flexion/extension and forearm rotation with a standard goniometer. The wrist flexion/extension was reported as a percentage of the injured side relative to the noninjured side.

TABLE 1. Demographics of Participants

Characteristics	
Number	122
Mean age	59 ± 8
Male/female, n (%)	54 (44%)/68 (56%)
Body mass index (kg/m^2)	23.9 ± 6.1
BMD (T score)	−2.74 ± 0.55
Affected side (dominant/nondominant)	64/58
AO fracture type, n (%)	
Type A	72 (41)
Type B	19 (13)
Type C	31 (47)
Energy of injury	
Low	101 (83)
High	21 (17)
Time to surgery (ds)	3 ± 2
Duration of immobilization (d)	22 ± 6

The factors influencing the rate of functional recovery after surgery for DRF can be multifactorial and include patient-, injury-, and treatment-related factors. In this study, several patient-, trauma-, and treatment-related factors were considered: age, gender, BMD, hand dominance as patient-related factors; the type of fracture and the energy of injury as trauma-related factors; time to surgery and the duration of immobilization as treatment related factors. The energy of the trauma was classified as low (a simple fall from a standing position) or high (any other injury including open fractures, combined muscle/tendon injuries, and car accident or industrial crushing/abrasion wounds).

Fractures were classified with a radiographic evaluation method using the AO classification system. There were 72 type A, 19 type B, and 31 type C fractures. The BMD was measured at the femur neck within 3 weeks of the fracture and rated using