



A Retrospective Evaluation of Functional and Radiological Outcomes in Adult Distal End of Radius Fractures

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Abstract

Background: Distal radius fractures are frequent and may cause lasting functional problems when alignment is not restored. Knowing which factors influence recovery helps surgeons choose treatment and counsel patients.

Methods: We reviewed 191 adults who had surgical treatment for distal radius fractures from October 2010 to October 2017. Treatments were closed reduction with percutaneous K-wires or open reduction with volar plate fixation. Demographic and clinical details, radiographic measures (radial height, radial inclination, palmar tilt, ulnar variance) and outcomes at one year (DASH, PRWE, wrist motion, grip strength) were recorded and analysed.

Results: The cohort was mostly young adults with a male predominance; AO type A2 fractures were common. At one year 146 patients had DASH scores ≤ 10 , indicating minimal disability. Patients whose radiographic parameters were restored closer to the uninjured wrist had better DASH and PRWE scores, superior range of motion and stronger grip. Volar locking plates provided more consistent radiographic restoration than K-wires. Diabetes was linked to poorer recovery across measures.

Conclusion: Restoring distal radius anatomy is associated with better one-year function. Surgeons should aim for anatomic reduction and ensure timely postoperative rehabilitation, especially for diabetic patients.

Keywords: Distal radius fracture, Volar plate, K-wire, DASH, Palmar tilt, Ulnar variance

Introduction

Distal radius fractures are among the most frequent injuries seen in adults and account for a large share of wrist trauma in emergency and orthopedic clinics. Historically described by Colles and later classified by numerous authors, these fractures range from simple extra-articular breaks to complex intra-articular, comminuted patterns that can seriously affect wrist mechanics and daily function [1–3]. The immediate aim of treatment is to obtain and maintain anatomic alignment so that

the wrist can heal with correct radial height, inclination, and volar tilt—parameters that directly influence load transfer across the radiocarpal and distal radioulnar joints [4, 5]. Conservative treatment with closed reduction and casting remains appropriate for many minimally displaced fractures, but unstable or displaced patterns commonly require surgical fixation to prevent malunion and long-term disability [6–8]. Over the last two decades volar fixed-angle plating has become widely used because it offers stable fixation even in osteoporotic



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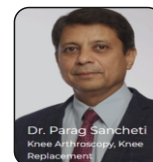
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or comminuted bone and often permits earlier wrist mobilization compared with traditional dorsal plating or prolonged external fixation [9, 10]. Despite technical advances, complications such as tendon irritation, hardware problems, stiffness, and residual pain still affect outcomes and patient satisfaction [11, 12].

Predicting which patients will have the best functional recovery remains a clinical challenge. Radiographic restoration of ulnar variance, radial height, radial inclination, and palmar tilt has been linked to better objective and patient-reported outcomes in several series, but findings are not uniform across all studies [13–15]. Patient factors such as age, comorbidities (notably diabetes), bone quality, and the dominant hand also influence recovery and must be considered when planning treatment and rehabilitation [16]. This study examines which clinical and radiographic factors are associated with one-year functional results after surgical treatment of distal radius fractures, with the goal of identifying modifiable elements surgeons can address to improve patient recovery [17–18].

Review of Literature

Longstanding fracture descriptions and modern classification systems give structure to how surgeons assess distal radius injuries and choose treatment. Early works by Colles and later by Frykman and AO provided the anatomical and radiographic language still used today [1, 19]. Radiographic parameters measured on standard PA and lateral views—radial height, radial inclination, palmar tilt, and ulnar variance—are commonly reported and serve as benchmarks for reduction quality [4, 5, 10].

Over the years, treatment evolved from closed reduction and casting to percutaneous pinning, external fixation, and open reduction with internal fixation. Volar locking plates were developed to offer stable, fixed-angle support that resists collapse of the articular surface and metaphyseal comminution; this has translated into improved radiographic outcomes in many reports and has encouraged early mobilization [6, 9, 14]. External fixation and percutaneous K-wires still have a role for select fracture patterns and when soft tissue concerns exist [7, 16].

Comparative studies show that volar plating more reliably restores radiographic parameters compared with percutaneous techniques, particularly in AO type C and comminuted extra-articular fractures [8, 13]. However, better radiographs do not always equate to better patient perception of function; some studies report weak to moderate associations between alignment and patient-reported outcomes such as DASH and PRWE, suggesting pain, stiffness, and psychosocial factors also play important roles [11, 12, 20]. Diabetes and other systemic conditions have been linked to delayed recovery, reduced range of motion, and worse patient-reported scores, possibly because of altered tendon and capsular biology and impaired healing [16, 17].

Taken together, literature supports aiming for anatomic reduction when feasible, while recognizing that individual patient factors and access to rehabilitation will influence final recovery. This body of evidence underpins the present study's focus on radiographic restoration and comorbidity status as predictors of one-year outcome [2, 3, 15].

Materials and Methods

This retrospective cohort study reviewed adult patients treated surgically for acute distal radius fractures at a tertiary care centre between October 2010 and October 2017. Inclusion criteria were skeletally mature adults with closed distal radius fractures who underwent either closed reduction with percutaneous K-wire fixation (CRIF) or open reduction and internal fixation (ORIF) using a volar locking plate. Exclusion criteria included open fractures, associated neurovascular injuries, pathological fractures, prior ipsilateral wrist injury, and inadequate follow-up.

Demographic and clinical data recorded included age, sex, hand dominance, affected side, mechanism of injury, and comorbidities (with specific attention to diabetes mellitus). Fractures were classified from initial radiographs using AO and Frykman systems. Standardized surgical techniques were followed: CRIF involved closed manipulation under anesthesia followed by multiple percutaneous K-wires; ORIF used a volar Henry approach with elevation of the pronator quadratus and placement of a volar locking plate after reducing the fragments. Postoperative immobilization and rehabilitation protocols were similar for both groups, with early finger and shoulder motion and gradual wrist mobilization guided by radiographic healing.

Outcomes were captured preoperatively and at one year. Patient-reported outcome measures included the Disabilities of the Arm, Shoulder and Hand (DASH) score and the Patient-Rated Wrist Evaluation (PRWE). Objective measures included wrist range of motion (flexion, extension, pronation, supination, radial and ulnar deviation) and grip strength compared to the contralateral side using a dynamometer. Radiographic measurements—palmar tilt, radial inclination, radial height, and ulnar variance—were obtained preoperatively, immediately postoperatively, and at one year using standard techniques. Statistical analysis compared groups with t-tests or nonparametric equivalents and used correlation and regression analyses to assess relationships between radiographic restoration, comorbidity status, and functional outcomes. Statistical significance was set at $p < 0.05$. Institutional review and ethical approval were obtained before data collection.

Results

Nineteen-one patients met the study criteria. Most were men (about 59%), and nearly half were younger than 31. The right wrist was affected in the majority of cases (about 79%).

Diabetes was present in roughly one in ten patients. The commonest fracture pattern was AO type A2. Treatment split into two main approaches: around 62% had closed reduction with percutaneous K-wires (CRIF), and 38% underwent open reduction and volar plate fixation (ORIF).

At one year, the majority were doing well: 146 patients had DASH scores of 10 or less, indicating minimal functional limitation. When we looked closer, patients whose operated wrist measurements (radial height, radial inclination, palmar tilt and ulnar variance) matched the uninjured side more closely tended to have better wrist motion and stronger grip. Those treated with volar locking plates more consistently kept those radiographic targets — especially radial height and palmar tilt — compared with the K-wire group. People with diabetes showed consistently poorer recovery: higher DASH and PRWE scores, less wrist movement, and weaker grip strength. Statistical analysis confirmed these links — better radiographic restoration was associated with better subjective and objective outcomes at one year ($p < 0.05$).

Discussion

The main message from this study is straightforward: when the wrist is put back into something close to its normal shape, people usually recover better. Restoring radial height, inclination, palmar tilt and ulnar variance matters — not just on X-rays, but for how people use their hands day to day. In our group, volar locking plates held these measurements more reliably than percutaneous K-wires, which helps explain why patients with plates often ended up with better motion, strength and lower disability scores. Fixed-angle plates resist collapse of broken fragments and give a stable base for early rehabilitation, especially in comminuted or osteoporotic fractures.

That said, anatomic reduction is only one piece of the recovery puzzle. Pain control, timely and guided physiotherapy, scar management and patient expectations all play big roles. We encountered patients with near-perfect X-rays who still complained of pain or stiffness, and others with minor radiographic imperfections who returned to work and hobbies without trouble. This shows the need to treat patients, not images: combine sound surgery with attentive post-op care and clear communication about likely recovery.

The consistently worse outcomes in people with diabetes are important. Diabetes can affect soft tissues and healing capability, leading to more stiffness, slower recovery and worse patient-reported scores. Knowing a patient has diabetes before surgery should prompt closer follow-up, tailored rehabilitation plans and realistic goal-setting so recovery can be optimized.

This study has limits. It's retrospective and surgeons may have chosen fixation based on fracture severity, which can bias results. We also lacked data on socioeconomic or psychological factors that influence recovery. Strengths include a substantial number of patients, standardized measurements and complete one-year follow up. Clinically, the findings support aiming for

anatomic restoration when it is safe to do so and paying extra attention to modifiable care factors especially for patients with diabetes — to help them achieve the best possible outcome.

Conclusion

Accurate restoration of distal radius anatomy—radial height, radial inclination, palmar tilt, and ulnar variance—was associated with better one-year function as measured by DASH and PRWE, improved range of motion, and stronger grip. Volar locking plate fixation achieved more reliable radiographic restoration in this series, especially for comminuted patterns, compared with percutaneous K-wiring. Diabetes emerged as a consistent negative factor for recovery, underscoring the need for focused counselling and rehabilitation for these patients. Surgeons should prioritize anatomic reduction when safe and feasible and ensure coordinated postoperative rehabilitation to maximize the chances of a good functional outcome. Future prospective studies that include psychosocial and socioeconomic variables will help refine prognostic models and individualize care.

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