Evidence-Based Review of Distal Radius Fractures

Benjamin M. Mauck, MD[a], Colin W. Swigler, MD[b,*]

KEYWORDS

• Distal radius • Distal radius fracture • Wrist fracture • Wrist fracture treatment • Colle fracture • Barton fracture • Smith fracture

KEY POINTS

- Distal radius fractures are one of the most commonly treated fractures in the United States. The highest rates are seen among the elderly, second only to hip fractures. With the increasing aging population these numbers are projected to continue to increase.
- Distal radius fractures include a spectrum of injury patterns encountered by general practitioners and orthopedists alike.
- This evidence-based review of distal radius fractures incorporates current and available literature on the diagnosis, management, and treatment of fractures of the distal radius.

INTRODUCTION

Distal radius fractures are one of the most common occurring in the United States, second only to hip fractures in elderly, with an estimated incidence of 643,000 per year.[1,2] This carries a large financial burden in the elderly alone, with an estimated Medicare system expenditure of $385 to $535 million dollars annually.[3,4] Treatment of distal radius fractures historically has been predominantly by inexpensive means including casting or limited percutaneous fixation. Following the release of the volar locking plate in the early 2000s, and early reports of success with internal fixation, popularity has steadily increased for treatment of distal radius fractures in younger populations.[5–8] Multiple studies have demonstrated good outcomes following internal plate fixation, yet prospective randomized controlled trials are limited in quantity and study design.[9–11] Among the elderly, rates of internal fixation increased from 3% in 1997 to 16% in 2005.[12] Other studies have demonstrated increases of 39% from 1999 to 2007.[13] Given the high rate of distal radius fractures in the elderly, and the higher cost of internal fixation, this has profound economic implications. Studies of Medicare expenditures for treatment of distal radius fractures found that $170 million in Medicare funds were spent in 2007, a total of 32% of which were toward internal fixation. If physician preference continues to follow progressive trends toward internal fixation, this implies large increases in Medicare expenditure.[14]

In addition, one must also consider the hidden costs, such as loss of productivity, because these injuries average least 1 or more day off work to see a physician, radiographic/routine follow-up, and prescribed days of restricted activity regardless of treatment type. Recent American Academy of Orthopedic Surgeons (AAOS) guidelines recommend weekly radiographic surveillance for 3 weeks following reduction and at cessation of immobilization.[15] Rates of return to work following distal radius fractures have been found to be highly variable and those who have high self-reported pain/disability at baseline are at risk for prolonged loss of work days.[16] Although the highest rate (351.5 per 100,000) of distal radius fractures incurred

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[a] Department of Orthopaedic Surgery, Campbell Clinic Orthopaedics, 1211 Union Avenue, Suite 510, Memphis, TN 38104, USA; [b] PGY4, Orthopaedic Surgery Residency, Campbell Clinic, University of Tennessee, 1211 Union Avenue, Suite 510, Memphis, TN 38104, USA
* Corresponding author.
E-mail address: colinswig@campbellclinic.com

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annually are in the 75 to 84 year age range, there are still substantial rates (up to 189.3 per 100,000 ages 25–34, 104.5 ages 35–44, and 179.8 ages 45–54) incurred within the working population.[1]

In 2009, AAOS released guidelines for distal radius fractures. However, there still exist large geographic variations in preference for internal fixation over traditional closed treatment methods (ranging from 4.6% to 42.1% for open reduction internal fixation [ORIF]).[17] The lack of prospective level I or II studies leaves treatment decisions largely based on respective review and clinician experience. Koval and colleagues[13] found that hand-fellowship surgeons were significantly more likely to treat with internal fixation than nonfellowship-trained surgeons. Current trends toward ORIF are thought to be related to surgeon's belief that ORIF and locked volar plating are associated with lower complication rates, better function, and better satisfaction than percutaneous or external fixation; however, these have not been completely substantiated in the literature. It is generally accepted that ORIF provides more stable fixation and facilitates earlier range of motion but the clinical significance of this has not been proven. Given the commonality of the distal radius fracture, and surprising inconsistencies in treatment practices, this indicates the need for a better understanding of current treatment methods, outcomes, and the need for more prospective randomized controlled trials. This article serves to review the pertinent and available literature available regarding distal radius fractures.

BONY ANATOMY

There are three independent articulating surfaces of the distal radius: (1) the scaphoid facet, (2) lunate facet, and (3) sigmoid notch. The carpal articulations of the distal radius are concave relative to the carpus. The radioscaphoid articulation occurs on the radial aspect of the distal radius, including the radial styloid. The radiolunate articulation and the sigmoid notch compose the ulnar aspect of the distal radius. The sigmoid notch is oriented in a perpendicular fashion to the lunate facet to comprise the distal radioulnar joint (DRUJ). The sigmoid notch is semicylindrical, providing a saddle for the distal ulna, and forming the DRUJ, a trochoid joint that facilitates a combination of translation and rotation.[18] The distal ulna is thought of as the pivot point for pronation/supination of the wrist, around which the distal radius and carpus pivots. Translation occurs because of the larger radius of curvature of the sigmoid notch (shallow) and the ulnar head. This results in dorsal and volar translation during pronation and supination, respectively.[18] There are differing degrees of bone density in the distal radius, and as discussed later, are implicated in fracture propagation between the scaphoid and lunate facets.[19–21]

LIGAMENTOUS ANATOMY

Stout ligamentous complexes provide essential stabilization to the articulations of the wrist. Extrinsic ligaments bridge carpal bones to the distal radius or metacarpals. Intrinsic ligaments originate and insert on carpal bones. The radioscapholunate, radiolunotriquetral, radioscaphocapitate, and dorsal radiotriquetral ligaments attach at the articular margin of the distal radius and the respective carpals. The combination of the intrinsic and extrinsic ligaments function to form stable articulations and guide force vectors to the radiocarpal joint. The triangular fibrocartilage complex (TFCC) and it's palmar and dorsal radioulnar ligaments are the prime stabilizers of the DRUJ.[22,23] The robust ligaments of the lunate facet in combination with the TFCC play a large role in stabilization of the ulnar wrist. This exceptionally strong ligamentous complex is why the carpus is virtually always displaced with the volar/dorsal medial fragment of the fractured distal radius.[24]

THREE-COLUMN MODEL

As described by Rikli and Regazzoni,[25] the distal radius and ulna, radiocarpal articulation, and DRUJ can conceptually be divided anatomically into a model with three distinct columns: (1) radial column, (2) intermediate column, and (3) ulnar column.[26] The radial column and intermediate column are supported by the "shaft" or "pedestal" formed by the metadiaphyseal distal radius. The radial column is formed by the radial styloid, scaphoid facet, and attachments of radiolunate ligament, radioscaphocapitate ligament, and brachioradialis. The radial column serves as a buttress for the carpus in radioulnar deviation, the ligamentous attachments of the radioscaphocapitate and radial collateral ligaments prevent translation of the carpus, and has little weight bearing function.[27] The deforming pull of the brachioradialis, with its insertion on the radial column, can cause loss of radial height, inclination, and radial translation. The intermediate column is the primary load-bearing component of the three-column model, which must be assessed for articular