

# Management of Severely Comminuted Distal Radius Fractures

David M. Brogan, MD, MSc,<sup>†</sup> Marc J. Richard, MD,<sup>†</sup> David Ruch, MD,<sup>†</sup> Sanjeev Kakar, MD\*

Distal radius fractures are among the most common fractures of the upper extremity. Indications for operative and nonsurgical management have evolved over time, as have fixation techniques. Volar locking plates are commonly used in the treatment of selected distal radius fractures such as low-energy or relatively uncomplicated fractures. They have limitations, however, in the management of highly comminuted fracture patterns and in polytrauma patients. In these patients, other methods ranging from spanning fixation to fragment-specific fixation have emerged as useful alternatives in the surgeon's armamentarium for treatment of these challenging fractures. (*J Hand Surg Am.* 2015;40(9):1905–1914. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)

**Key words** Distal radius fracture, fragment specific fixation, dorsal bridge plate, external fixation.

UPPER EXTREMITY FRACTURES HAVE been estimated to account for up to 1.5% of all United States emergency room visits, and 44% of these are attributed to fractures of the radius and ulna.<sup>1</sup> Distal radius fractures tend to occur in a bimodal age distribution: young patients involved in high-energy trauma and elderly patients with low to moderate energy injuries secondary to osteopenia or osteoporosis. Higher-energy fractures are more likely to result in greater articular involvement and comminution.<sup>2</sup> Risk factors for these higher-energy fractures include younger age, rural areas, and the summer season.<sup>3</sup> Men have a 5-fold higher risk of sustaining a high-energy distal radius fracture than women (Fig. 1). Despite this, the overall age-adjusted incidence of distal radius fractures is 4 to 5 times greater in women than men.<sup>3–5</sup> In women, the greatest lifetime risk for a distal radius fracture occurs

in the postmenopausal years, owing to a reduction in bone mass,<sup>5</sup> and the incidence of comminuted intra-articular fractures increases in both sexes with advancing age.<sup>6</sup>

The increasing incidence of distal radius fractures with advancing age has a profound impact on health care expenditures. In 2007, Medicare spent \$170 million on distal radius fracture care.<sup>7</sup> A review of Medicare claims over a 10-year period ending in 2005 demonstrated an increase in internal fixation of distal radius fractures in the elderly from 3% to 16%.<sup>8</sup> In short, patients are living longer, sustaining more fractures, and undergoing more surgery than before.

## DIAGNOSIS

Assessment of the patient begins with an examination of the injured limb, noting any deformity, ecchymosis, and swelling or breaks in the skin that may indicate an open fracture. A careful neurovascular examination should be performed, particularly to assess for associated median nerve injury or perhaps acute carpal tunnel syndrome. After a thorough history and physical examination, the next step in treatment is an evaluation of the injury with plain radiographs. X-rays (including posteroanterior, oblique, lateral, and 10° tilt lateral views) and sometimes computed tomographic scans are used to examine the fracture. There are a number of classification systems, including Gartland and Werley, Mayo, Melone, the AO, Fernandez, Frykman, and

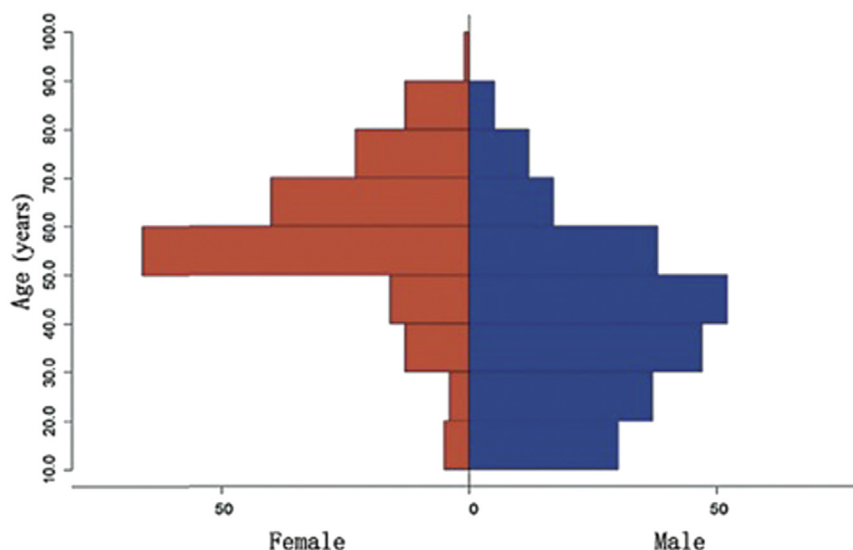
From the \*Division of Hand Surgery, Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN; and the †Division of Hand Surgery, Department of Orthopedic Surgery, Duke University, Durham, NC.

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D.R. is a consultant for Acumed. S.K. is a consultant for Skeletal Dynamics and Arthrex. M.J.R. is a consultant for Acumed and DePuy-Synthes.

**Corresponding author:** Sanjeev Kakar, MD, Division of Hand Surgery, Department of Orthopaedic Surgery, Mayo Clinic, 200 First Street SW, Rochester, MN 55905; e-mail: [kakar.sanjeev@mayo.edu](mailto:kakar.sanjeev@mayo.edu).

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**FIGURE 1:** Histogram demonstrating relative distribution of distal radius fractures by age and sex (reprinted with permission from Koo KOT, Tan DMK, Chong AKS. Distal radius fractures: an epidemiological review. *Orthop Surg.* 2013;5[3]:209–213.<sup>2</sup> Copyright © 2013 John Wiley and Sons.).

Fragment Specific, to help guide treatment. In terms of the latter, fracture fragments that are created include the radial column, volar rim, dorsal rim, free intra-articular fragments, and the ulnar corner.

Functionally, the distal radius may be thought of as having 3 distinct articular surfaces: the scaphoid facet, lunate facet, and sigmoid notch. The mechanism of injury directly affects the fracture pattern, and injuries with the wrist extended at the time of impact tend to be more common than those with the wrist in flexion. Tanabe and colleagues<sup>9</sup> studied the fracture patterns of 91 patients with intra-articular distal radius fractures. When the wrist was in an extended position at the time of injury, fractures of the sigmoid notch and dorsal ulnar corner were most common. In neutral position, the 3 main fracture fragments were the sigmoid notch, dorsal radial, and volar radial corners; in wrist flexion, fractures of the sigmoid notch and dorsal radial corner were most common. Recognition of these various fracture patterns is important because failure to address these can result in loss of reduction or radiocarpal subluxation.<sup>10</sup> The ligamentous anatomy of the distal radius can also influence the fracture pattern, with fractures more likely to occur between ligamentous attachments.<sup>11</sup> This suggests that the ligament attachment confers some form of protection to the bone, or that the ligaments tend to insert in areas of greater bone strength.<sup>11</sup>

## TREATMENT

Treatment of distal radius fractures has evolved substantially over the past 4 decades. In treating these fractures, it is important to recognize that adequate

function may be achieved despite articular incongruity. Several case series have shown a high percentage of good to excellent patient-reported outcomes in elderly patients treated with casting,<sup>12</sup> with operative and nonsurgical groups displaying similar outcomes.<sup>13,14</sup> Surgical treatment results in better radiographic parameters, but in the elderly population this has not been proven to affect outcome.<sup>13,15</sup> However, in younger, active patients, improving articular incongruity possibly maximizes functional outcomes. Knirk and Jupiter<sup>16</sup> found an association between residual articular stepoff of greater than 2 mm and development of posttraumatic arthritis in a young patient population (average age, 27.6 y), with worse patient-reported outcomes in those with arthritis. In contrast, Forward et al<sup>17</sup> reviewed a series of 106 adults with distal radius fractures treated with casting at a mean follow-up of 38 years. Among all patients with intra-articular and extra-articular fractures, they found little difference in functional outcome scores compared with population norms. The authors noted an increased evidence of radiographic arthritis in patients with intra-articular fractures, and patients with the most severe arthritic changes were 10 times more likely to demonstrate worse function compared with those with no arthritic changes.

The American Academy of Orthopaedic Surgeons practice guidelines on treatment of distal radius fractures recommend operative fixation for the following parameters: radial shortening greater than 3 mm, dorsal tilt greater than 10° from neutral, or intra-articular displacement/stepoff of more than 2 mm. Rigid immobilization is advocated over removable orthoses for

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