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Clinical Faceoff

Clinical Faceoff: Controversies in the Management of Distal Radius Fractures

Sanjeev Kakar MD, MRCS

Distal radius fractures are among the most common fractures of the upper extremity, and account for approximately 20% of all fractures seen within the emergency room. The distal radius comprises of three articular surfaces, namely the scaphoid facet, lunate facet, and sigmoid notch. Treatment goals are centered on restoration of articular congruity, and where appropriate, early ROM with minimal complications to permit early functional recovery. Numerous fracture classifications exist which aim to define the fracture and guide treatment [1] (Fig. 1).

Despite the frequency of these injuries, controversy exists about how best to manage them. The American Academy of Orthopaedic Surgeons practice guidelines on treatment of distal radius fractures recommend operative fixation for radial shortening greater than 3 mm, dorsal tilt greater than 10° from neutral, or intraarticular displacement greater than 2 mm [4].

To explore the controversies that are abound in terms of how to manage these injuries, it is my distinct pleasure to introduce two experts in the field of hand surgery. Ghazi Rayan MD is a Professor of Orthopaedic Surgery at University Oklahoma College of Medicine. Martin Boyer MD is the Jerome T. Loeb Professor of Orthopaedic Surgery at Washington University Medical School, St. Louis.

Sanjeev Kakar MD: *Let us start the discussion by considering what clinical and radiographic factors influence your decision about whether or not to operate on a patient with a distal radius fracture?*

Ghazi Rayan MD: The factors that influence my treatment decision are related to the patient's condition, nature of the fracture, mechanism of injury and radiographic findings. The patient's general health and the presence of comorbidities should be taken into consideration. The patient's physical demands may become less with advancing age. Worsening health and advancing age tend to justify nonoperative treatment with closed reduction and cast immobilization followed by early ROM in order to prevent wrist and digital joint stiffness.

The nature of the fracture—whether isolated or associated with neurovascular injuries, open or closed, extra or intraarticular and stable or unstable—can be a defining issue that tips the balance towards one method or the other. The mechanism of injury may be from high-energy trauma as in young males or low-energy trauma, as the fragility fractures that occur in elderly osteoporotic females. Surgical treatment may be indicated for the former and nonoperative treatment may be an option for the latter.

Finally, the radiographic factors that determine treatment options for me are related to the fracture classification and parameters. There are half a dozen

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S. Kakar MD, MRCS (✉)
Department of Orthopaedic Surgery,
Mayo Clinic, 200 First Street SW,
Rochester, MN 55905, USA
e-mail: kakar.sanjeev@mayo.edu

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Fracture Types	Fracture Equivalent in Children	Stability/ Instability*	Displacement Pattern	Number of Fragments	Associated Lesions	Treatment
Type I	Distal forearm fracture Salter II	Stable Unstable	Nondisplaced Dorsal (Colles'-Poteau) Volar (Smith) Proximal Combined	Always two main fragments Metaphyseal comminution	Uncommon	Conservative (stable fractures) Percutaneous pins External fixation Bone graft, on exception
Type II	Salter IV	Unstable	Dorsal Radial Volar Proximal Combined	Two-part Three-part Comminuted	Common	Open reduction Screw-plate fixation
Type III	Salter III, IV, V	Stable Unstable	Nondisplaced Dorsal Radial Volar Proximal Combined	Two-part Three-part Four-part Comminuted	Frequent	Conservative Closed, limited, or extensile open reduction Percutaneous pins, combined external and internal fixation, bone graft
Type IV	Very rare	Unstable	Dorsal Radial Volar Proximal Combined	Two-part (radial styloid, ulnar styloid) Three-part (volar, dorsal, margin) Comminuted	Very frequent	Closed or open reduction Pin or screw fixation Tension wiring
Type V	Very rare	Unstable	Dorsal Radial Volar Proximal Combined	Comminuted (frequently intra-articular, open, seldom extra-articular)	Always present	Combined method

*High risk of secondary displacement after initial adequate reduction

Fig. 1 . A fracture classification system that defines the fracture and guides treatment is shown. Reprinted with permission from: Fernandez DL: Fractures of the Distal Radius: Operative Treatment, in Heckman JD, (ed): *Instructional Course Lectures 42*. Rosemont, IL, American Academy of Orthopaedic Surgeons, 1993, pp 73–88.

classifications for distal radius fractures; these do not only guide treatment towards nonoperative or surgical, but most importantly, determine the most appropriate surgical treatment. Important radiographic parameters that should be taken into account include: radial inclination, palmar tilt, radial shortening with ulna variance and intraarticular step-off. Also, the distal fragment tends to supinate in a classic distal radius fracture. Tilted beam

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posteroanterior or lateral radiographic views are helpful in assessing the extent of articular step-off. In my opinion, loss of radial inclination with radial shortening of 3 mm to 4 mm, dorsal tilt of at least 10° from neutral, which amounts to a total of 20° after factoring loss of palmar tilt, or intraarticular step-off equal to or greater than 2 mm are indications for surgical treatment provided that other factors do not preclude the surgical option.

Martin Boyer MD: There are no universally applicable "always" or "never" decision-making methods for distal radius fractures in terms of operative versus nonoperative treatment. For Fernandez Type 2 and Fernandez Type 4 fractures (Fig. 2), operative treatment is preferred given the degree of carpal subluxation and potential for intercarpal ligament disruption, respectively. For Fernandez Type 1 (dorsally directed bending) fractures, an initial closed reduction followed by an assessment of fracture stability (the ability of the fracture to withstand normally applied physiologic forces during healing without attendant loss of position) will guide treatment. Apex dorsal bending type fractures (Smith fractures) are usually treated operatively. It is the Fernandez Type 3 fractures (joint depression) that evoke the most spirited debate. Do these even require operative treatment, especially

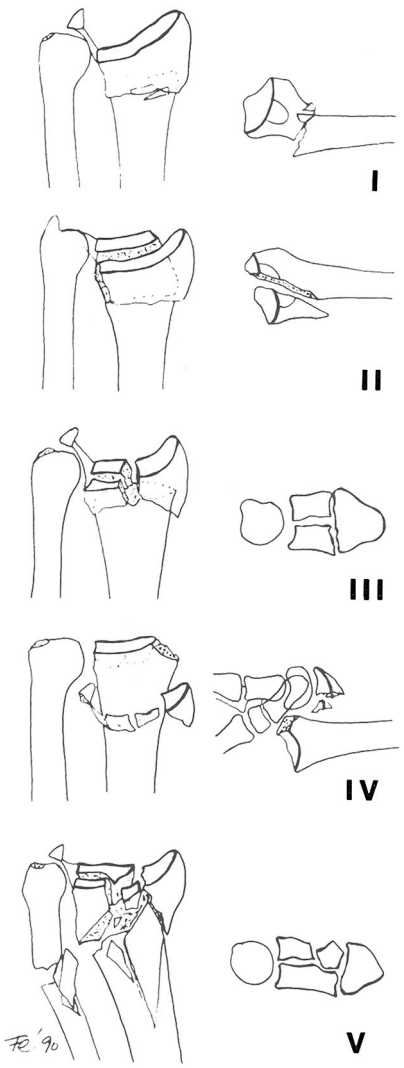

Fig. 2 A distal radius fracture classification system. Reprinted with permission from: Fernandez DL: Fractures of the Distal Radius: Operative Treatment, in Heckman JD, (ed): *Instructional Course Lectures 42*. Rosemont, IL, American Academy of Orthopaedic Surgeons, 1993, pp 73–88.

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since data suggest that even the presence of radiocarpal arthrosis fifteen years following injury and operative fixation does not lead to significant disability? [2] I do not have an answer to this question except to say that the Knirk and Jupiter article [3] tends to suggest that greater than 2 mm of joint surface incongruity in younger patients should point towards operative reduction and fixation.

Dr. Kakar: *With the advent of volar plates, are other fixation methods including arthroscopic reduction, closed reduction with percutaneous pinning, and external fixation becoming lost arts? What are your indications for using these techniques compared with a volar plate?*

Dr. Rayan: Historically, several new devices or techniques in surgery pursued a trend of early swift adoption and pervasive application only to be followed by reversal of the vogue to the conventional approaches. This is not said to discredit the volar plating systems that are available on the market today, but rather a reminder that one should not hasten in adopting every new method of treatment. Volar plates have been proven to be efficacious for treating certain distal radius fractures. Notwithstanding this, they are not panacea for all distal radius fractures. The character of the fracture should determine the method of fixation. The fixation device should be tailored to the fracture not the fracture to the device. Hand surgeons must be proficient with a variety of fixation techniques for distal radius fractures and employ the most suitable tool.

Closed reduction and percutaneous pin fixation is best suited for extra articular fractures without substantial metaphyseal comminution and for some isolated intraarticular radial styloid fractures. Dorsal plate fixation used as a buttress, is appropriate for unstable intraarticular dorsal shear fractures. New, low profile plates cause less tendon irritation than original implants.

Bridging external fixation is indicated for intraarticular unstable fractures. Traction from the device can reliably maintain radial length whereas ligamentotaxis improves alignment of the fracture. This tool is not intended to reduce the fracture per se but to maintain reduction after manipulation. External fixation can prevent dorsal collapse and maintain palmar tilt after achieving reduction but has limited capability of correcting a die-punch fragment. The intraarticular step-off, however, can be improved by combining external fixation with percutaneous Kirschner wire fixation or minimal internal fixation.

Arthroscopic assisted reduction and internal fixation helps to restore volar tilt, ulnar variance, and intraarticular step-off, but I rely on intraoperative fluoroscopy rather than arthroscopy to evaluate these parameters.

Dr. Boyer: If direct articular visualization and reduction is required, then I prefer a dorsal approach through the third dorsal compartment, followed by elevation of the second compartment in a radial direction, and the fourth compartment in an ulnar direction until the distal radioulnar joint (DRUJ) dorsal capsule is exposed. In this way, release of the brachioradialis can be done radially to facilitate radial styloid reduction, and exposure of the dorsal ulnar fragment can be done directly.

Closed pinning is acceptable if care is taken to avoid radial sensory nerve injury, and arthroscopic reduction and fixation of Fernandez Type 4 fractures in the hands of an experienced arthroscopist is also reasonable if associated inter-carpal ligamentous injuries are sought and addressed at the same surgical operation. External fixation or bridge plating are used infrequently, and are reserved for the extremely comminuted fractures that cannot be reduced and fixed (or pinned) acutely due to patient health status, associated injuries, wound contamination or fragment size.

Dr. Kakar: *In patients with a high-energy injury comminuted distal radius fracture not amenable to standard volar plating, do you advocate fragment-specific fixation, external fixation, or distraction (bridge) plating with or without bone grafting, and what factors do you use to make this decision?*

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Dr. Rayan: There is no consensus on this. Regardless of the method of fixation, initial surgical treatment often results in wrist stiffness and posttraumatic arthritis and may be a prelude to an ultimate second stage partial or total wrist fusion. While the treatment goal is to approximate bony fragments as practically as possible, perfect anatomical reduction may not be achievable. Fragment-specific fixation and distraction dorsal-bridge plating have emerged as practical alternatives to volar plating for these injuries. Both treatment options have drawbacks.

Fragment specific fixation provides rigid fixation, but it is technically demanding and usually calls for more than one incision and placement of up to three plates, which may cause tendon irritation.

Dorsal bridge-spanning plates act as internal distraction devices and employ ligamentotaxis for maintaining reduction. They are best suited for polytrauma patients in the presence of osteoporotic bone and for diaphyseal metaphyseal extension. They offer more rigid fixation than fragment specific fixation. Nevertheless, they require the utility of long plates, long or more than one incision, and another surgery for plate removal. They also have the potential for extensor tendon irritation and screw pullout from the middle finger metacarpal shaft.

For fractures that are not amenable to volar plate fixation, external fixation can be used either alone or combined with other methods. It can be used alone in the absence of diaphyseal involvement, or more often combined with Kirschner wire fixation for articular fragments or Steinman-pin fixation in the case of concomitant transverse diaphyseal metaphyseal fractures. External fixation does not offer the same rigid fixation as fragment specific fixation or distraction dorsal bridge plating. However, it provides sufficient rigidity and ligamentotaxis and less morbidity than other more invasive techniques. Using an incision for adequate visualization and placement of proximal pins in the forearm rather than percutaneously will mitigate the previously encountered complication of sensory radial nerve damage.

While all three methods have a role, I tend to use external fixation whenever possible and combine it with additional internal fixation if necessary. For polytrauma patients with comminuted diaphyseal metaphyseal extension, a dorsal bridge spanning plate would be more pertinent.

Finally, I don't use bone grafting as an adjunct to fixation of acute distal radius fractures, both for reasons of cost (for allografts) and morbidity (for autografts), but most importantly because metaphysis of the radius has sufficient vascularity to support bone formation during healing.

Dr. Boyer: Fragment-specific plating with modern plating systems (which are low profile and have screws that are sunk below the level of the plate) do not cause tendon irritation. However, screws placed that are too long can and do cause tendon irritation and rupture. The fragments have to be large enough to either be buttressed at the least, or accept a screw. I do not use allograft, because of the cost and the absence of evidence to support its use.

Dr. Kakar: *How do you examine for distal radioulnar joint instability in the OR after fixation of the distal radius fracture and how do you define instability? If it is unstable, how do you treat it?*

Dr. Boyer: Instability can be thought of as a greater sense of AP "play" of the distal ulna when the forearm is held in the neutral position, and the metacarpals, carpus and radius are held by the examiner. The ulna is then translated in the AP plane by the surgeon, to gauge whether or not there is a sense of greater allowed motion on the affected side when compared with the unaffected side. On occasion, the instability is obvious, and the contralateral side need not be tested. I do not personally place the forearm in either the pronated (to increase the sense of dorsal distal ulnar instability) or supination (to increase the sense of palmar distal ulnar

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instability) to assess translation. My mindset is that I only want to pick up obvious substantial instability, not subtle instability.

Dr. Rayan: I concur with Dr. Boyer's description of the ulnar head ballottement test for static distal radioulnar joint instability, which elicits a piano key sign. I use the same maneuver that he described to diagnose this injury. But one must recognize the difference between longitudinal instability that is encountered with Essex Lopresti lesion and diagnosed with radial pull test, and distal radioulnar joint instability in the sagittal plane that is encountered with distal radius fracture as in this case scenario. One must be also be cognizant of possible concomitant extensor carpi ulnaris tendon instability, which is a dynamic problem that occurs during forearm rotation and often unrecognized.

A mild or moderate degree of distal radioulnar joint instability can be treated with a long arm splint immobilization, whereas grossly unstable distal radioulnar joint can be transfixed with a horizontal Steinman pin with the forearm in neutral position.

Dr. Kakar: *Moving on to associated injuries, which ones do you see most commonly, and how do you treat them? I am thinking here about scapholunate ligament tears, TFCC tears and distal ulnar fractures.*

Dr. Boyer: Rarely, if ever. The only time I evaluate specifically for these injuries is in those fractures that are bad Fernandez Type 3s, or Fernandez Type 5s. Of course, with Chauffeur injuries (Fernandez Type 4s) one has to be especially vigilant regarding scapholunate ligament injuries, and evaluate and treat accordingly.

Dr. Rayan: I agree with Dr. Boyer. These associated injuries are uncommon. The most common associated injury with a distal radius fracture is ulnar styloid fracture followed by median nerve injury. Triangular fibrocartilage complex (TFCC) damage should be expected in the presence of distal radioulnar joint instability as mentioned previously. TFCC injury, however, may occur sometimes without gross distal radioulnar joint instability. TFCC disruption can be encountered with displaced ulnar styloid fracture that occurs at the base. Most distal ulnar styloid fractures do not require any treatment and if nonunion develops it is often painless. A large displaced ulnar styloid fracture fragment, if present, can be fixed with Kirschner wire(s) using a relatively small incision.

Dr. Kakar: *What steps do you take to prevent complex regional pain syndrome, and if you think it is developing with or without median nerve symptoms, how and when do you intervene?*

Dr. Boyer: I believe that the vast majority of these postfracture pain syndromes are related to either subtle or not-so-subtle median nerve compression within the carpal tunnel. So, these are complex regional pain syndrome Type 2s, not Type 1s. There is frequently a definable peripheral nerve lesion that should be treated, operatively if necessary, to facilitate motion rehabilitation and alleviate pain and stiffness/dysfunction. I do not use Vitamin C, but some of my partners do.

Dr. Rayan: Dr. Boyer is right on. I rarely make a diagnosis of complex regional pain syndrome with distal radius fracture. Pain out of proportion to physical findings in this setting is most probably due to associated median nerve injury. Fortunately most of these will resolve spontaneously shortly after closed reduction. A median nerve deficit that does not recover spontaneously 24 hours after closed reduction especially in the presence of severe dysesthesia and neurogenic pain deserves exploration. Median nerve deficit associated with open distal radius fractures or with severe fractures that requires open reduction and internal fixation should also be explored and often require "neurolysis" or more accurately evacuation of the hematoma from within

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and outside the nerve. An important fact to be remembered here is the pathology does not lie within the carpal tunnel and releasing the tunnel alone will not address the problem. This is usually a median nerve injury proximal to the carpal tunnel and adjacent to the fracture site rather than an acute carpal tunnel syndrome. I also do not use Vitamin C in the care of my patients unless they have scurvy.

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