

## Clinical and Radiological Diagnosis of Comminuted Distal Radius Fractures

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### Abstract

**Background:** Distal radius fractures are the most common upper extremity fracture, representing up to 16% of all fractures seen in the emergency department. The incidence of distal radius fractures is 4 to 5 times greater in old women than men. In women, the greatest lifetime risk for distal radius fracture occurs in the post-menopausal years, due to reduction in bone mass. **Objective:** To evaluate the functional and radiological outcome of Comminuted Distal Radius Fractures. **Conclusion:** that use of the Spanning external fixators could be an alternative treatment method for intra articular distal radius fractures.

**Keywords:** Distal Radius, intra-articular

### Introduction

Exposure of the distal radius and its fracture fragments is complicated by proximity to the surrounding muscle, ligaments, tendons, and neurovascular structures. The individual alignment of various articular fracture fragments of the distal radius is affected by these soft tissue attachments.

### Mechanism of Injury

Most of the distal radius fractures caused by a **Fall On Outstretched Hand (FOOSH)** with the wrist in dorsiflexion. The form and severity of fracture of distal radius as well as the concomitant injury of disco-ligamentary structures (TFCC) of the wrist also depend on the position of the wrist at the moment of hitting the ground. The width of this angle influences the localization of the fracture. Pronation, supination and abduction determine the direction of the force and the compression of carpus and different appearances of ligamentary injuries<sup>(1)</sup>.

Distal radial fractures can result from any trauma to the forearm. Isolated Distal radial fractures typically include **Colles**, **Smith's**, **Parton**, **Chauffeur** and **Die-punch**<sup>(2)</sup>.

The **Colles'** fracture is the most common fracture of the distal radius in adults. It gets its name from Irish Surgeon, **Dr. Abraham Colles**, who first described this injury pattern in 1814. The mechanism of injury is classically a **Fall On Outstretched Hand**. Characteristically, it presents with dorsal angulation and displacement of the distal fragment of the radius.

The Smith's fracture is essentially the opposite of the **Colles'** fracture. It is often referred to as a "reverse **Colles'**" and occurs with a **fall onto or a direct blow or force to the dorsum of the hand**. The Smith's fracture will have a volar angulation of the distal fragment.

The Chauffeur's fracture is an intra-articular fracture of the radius that includes the radial styloid. The fracture fragment can be variable in size. The injury is often the result of a **Fall On Outstretched Hand injury with a blow to the back** of the wrist causing dorsiflexion and abduction causing the scaphoid to compress against the radial styloid.

A die-punch fracture occurs with **axial loading of the lunate**, which causes an impaction fracture to the lunate facet of the radius. This fracture often occurs in isolation but can have associated injuries<sup>(3)</sup>.

A **Barton's** fracture is an intra-articular rim fracture of the distal radius. It can be classified as either dorsal or volar. Dorsal rim fractures are more common and result from **forced dorsiflexion and pronation**. Volar rim fractures often occur with a **fall onto a supinated hand/ wrist**.<sup>(3)</sup>

## Diagnosis of Distal Radius Fractures

### History:

Patient reports falling on outstretched hand. Other mechanisms include: road traffic accident (RTA); direct trauma; fall from height (FFH).

### Clinical picture:

- Swelling which occupies the wrist and metacarpal region and may cause fullness of the distal 1/3 of the forearm.
- Tenderness and crepitus.
- Deformity with variable degree of prominence of the ulnar head. The radial styloid process may be at the same level of that of the ulna or at even more proximal level.
- Neurological and vascular assessment should be done for treatment planning and patient follow up.<sup>(4)</sup>

## Radiological assessment:

### X-Ray:

**Posteroanterior view:** It shows the following:

- Fracture lines and the degree of extension to the radiocarpal and distal radioulnar joints. <sup>(5)</sup>
- Degree of radial deviation of the distal fragment (the normal is 22 to 30°).
- Radial shortening by measuring the radial length. The normal radial length is about 11-12 mm.
- Radial width.
- Articular step off. <sup>(5)</sup>

**Lateral view:** It shows the following:

- Tilt of the distal fragments either volar or dorsal. Normally the volar tilt measures 10-12°.
- Cortical comminution and the impaction of cancellous bone.

- Subluxation of the radioulnar joint. <sup>(5)</sup>

### **Computerized tomography (CT- Scan):**

Can be valuable in accurately defining anatomic disruption, particularly for intra-articular fractures with multiple components. This technique permits a clear definition of the fragments and their displacement. Often, centrally impacted fragments cannot be appreciated on plain radiographs. Sagittal and coronal reformatted views allow clear visualization of these fragments and almost always reveal greater comminution and displacement than can be appreciated on plain radiographs <sup>(6)</sup>.

### **Fracture stability:**

The following radiological signs should alert the surgeon that an initial satisfactory closed reduction would not be maintained by a splint or cast or what is called (The criteria of fracture instability) <sup>(5)</sup>:

1. Dorsal comminution exceeding more than 50% of the dorsal to palmar distance
2. Palmar metaphyseal comminution.
3. Initial dorsal tilt > 20°.
4. Initial displacement > 1cm.
5. Initial shortening >5mm.
6. Associated ulnar fractures.
7. Intra-articular extension.
8. Massive osteoporosis.

The unstable fractures have the tendency to re-displace after the initial reduction with the recurrence of the deformity. <sup>(5)</sup>

### **Treatment of Distal Radius Fractures**

The methods for treatment of fractures of the distal radius include:

**Conservative:** above-elbow and below-elbow cast immobilization, or

**Operative:** percutaneous pins and cast immobilization, external fixation with or without percutaneous pins, and limited or open reduction. combination of these methods may be required <sup>(6)</sup>.

### **Extra-articular fractures:**

### **Stable Fractures:**

Closed reduction with cast immobilization remains the accepted method of treatment for approximately 75 to 80 percent of distal radius fractures that are considered stable <sup>(6)</sup>.

### **Unstable Fractures:**

A number of treatment options exist to offset the loss of reduction in an unstable extra-articular distal radius fracture in a patient in whom maintained the anatomic position. These include percutaneous pinning of the distal fragment external skeletal fixation devices, and open reduction and internal fixation<sup>(6)</sup>.

### **Intra-Articular Fractures:**

#### **Stable Fractures:**

Treatment of the stable intra-articular fracture that enters either the distal radioulnar or the radiocarpal joint follows the same principles as for the stable extra-articular fracture. Care must be taken to watch these injuries closely, because initially minimally displaced fractures with intra-articular extension can collapse and displace in a cast<sup>(6)</sup>.

As previously outlined, intra-articular extension into the radiocarpal joint is itself a sign of potential fracture instability. Frequent radiographs must be obtained until the fracture proves to be stable then treated with cast immobilization in minimally displaced fractures, or by close reduction and k-wire pinning in displaced fractures<sup>(6)</sup>.

#### **Unstable Fractures:**

The most common intra-articular distal radius fracture is that which disrupts the distal radioulnar joint without radiocarpal joint displacement, for example, the simple two-part bending fracture. These are treated like unstable extra-articular fractures, most commonly open reduction and internal fixation or with spanning external fixator<sup>(6)</sup>.

#### **Intra-articular fractures with five or more parts**

Intra-articular fractures with five or more parts are associated with higher energy trauma and are often associated with concomitant skeletal or soft tissue injuries<sup>(6)</sup>.

The severity of these injuries is reflected in the fact that after treatment, most patients, who improved functionally, have some residual limitation in wrist mobility and in grip strength.

Several studies have suggested that restoration of the articular anatomy is the most critical factor in obtaining a good functional result and preventing late posttraumatic arthritis.

The surgical management of these fractures is particularly difficult and is associated with significant early and late morbidity.

### **Preoperative planning:**

It included X-ray (postero Anterior and lateral views) and CT scan often helpful. Care must be taken to assess the injury to the soft tissues. If swelling is present and reduction can be accomplished, the definitive surgery can be delayed. An extensive surgical procedure in the presence of severe soft tissue swelling is troubled with its own complications.

Commonly its helpful to wait several days before performing definitive treatment to allow resolution of swelling, and recovery of digital motion<sup>(6)</sup>.

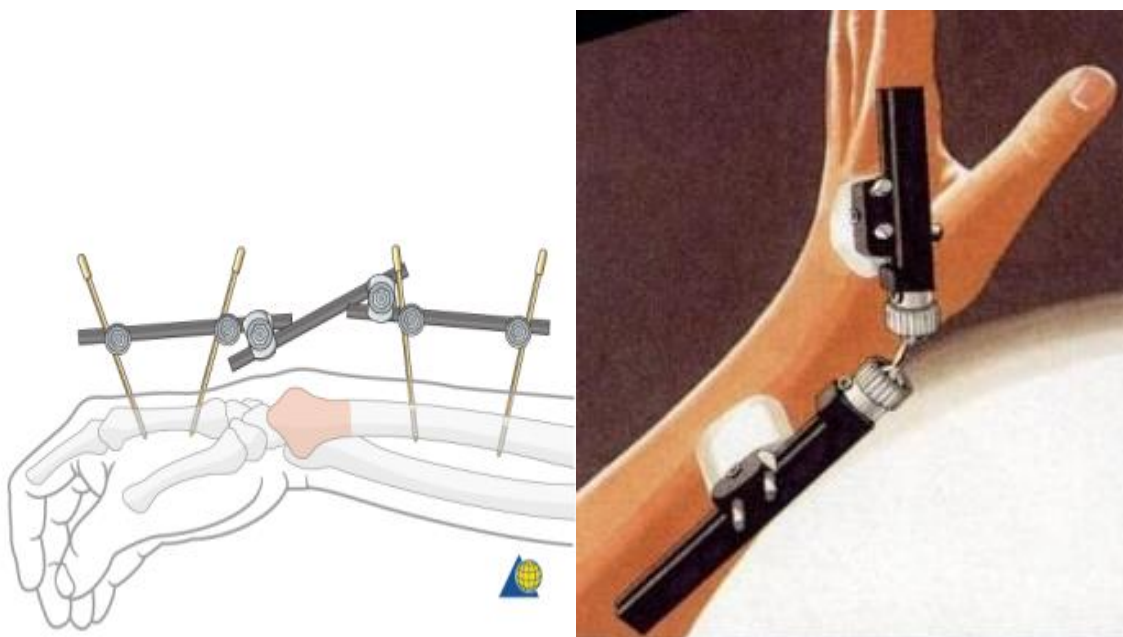
The surgical approach is dictated by the displacement of the fracture fragments. Some injuries have severe fragmentation and comminution of the articular surface without significant volar cortical disruption. These fractures can attempt to fix through palmar approach, but dorsal exposure is more familiar to most of surgeons.

Severe joint comminution remains an excellent indication for external fixation, which can now be used to neutralize the articular fragments following reduction. Many of these injuries are multi-fragmentary comminuted to allow for stabilization of the articular surface with standard palmar locking plates and screws. The fixator allows for restoration of length and can aid intraoperatively in neutralizing compressive forces across the joint. Occasionally, joint reduction can be accomplished by reduction and external fixation alone (using supplemental pins) <sup>(6)</sup>.

### External Skeletal Fixation:

#### Types:

- 1- Static external fixator (Non-hinged).
- 2- Dynamic external Fixator (Hinged).



**Figure (1):** Bridging external fixation, static and dynamic ex. fixator.<sup>(7)</sup>

#### Advantages:

- Less damage to blood supply of bone.
- Minimal interference with soft-tissue covers.
- Useful for stabilizing open fractures
- Adjustable after surgery.
- Avoids the complications of circumferential plaster.<sup>(8)</sup>

#### Disadvantages:

- Pins and wires can irritate the soft tissues.
- Restricted joint motion.
- Pin-track complications.
- Risk of pin loosening.<sup>(8)</sup>

#### Indications for wrist external fixation:

The use of an external fixation device is a very important means of overcoming the force of the muscles of the forearm that pull comminuted distal radial fractures into a collapsed,

shortened position. Because the loss of radial length is associated with a poorer functional outcome, an external fixation device can often be an important part of the treatment of intra-articular fractures of the distal aspect of the radius. In many instances of severe comminution of the metaphysis, the surgeon can reconstruct the articular surface but cannot stabilize it to the shaft of the radius. An external fixation device can allow alignment of the articular surface with the shaft without reliance on support from the metaphysis. It is also very important for stabilization of open fractures giving a good chance for wound care.<sup>(9)</sup>

### Technique:

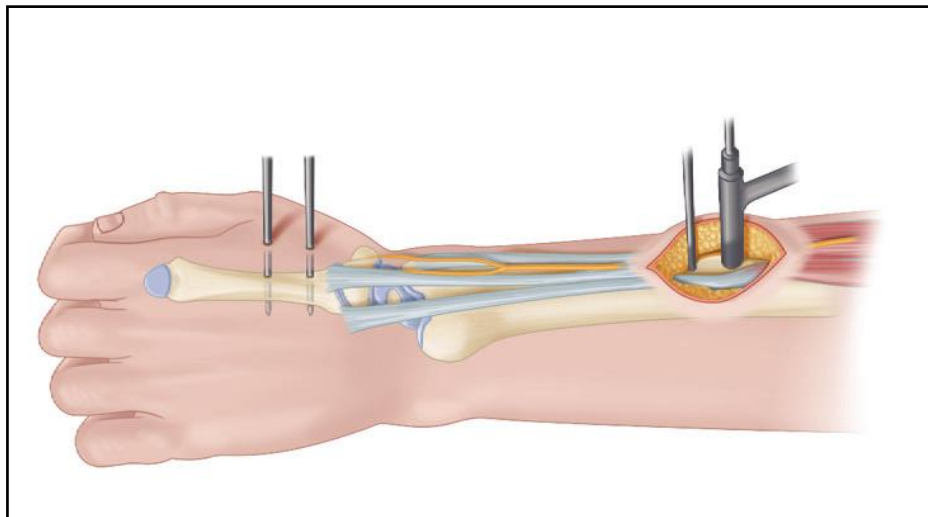
With the use of brachial block or general anesthesia, prepare and drape the upper extremity. Reduce the fracture manually or with the aid of sterile finger traps or traction device.<sup>(10)</sup>

Make a 2- to 3-cm incision over the dorsoradial aspect of the index metacarpal base, and use blunt dissection with scissors to expose the metacarpal. Take care to preserve and reflect the branches of the dorsal radial sensory nerve<sup>(10)</sup>.

Place a soft tissue protector on the metacarpal, then use the drill bit and insert 3-mm self-tapping half-pins at a 30- to 45- degree angle dorsal to the frontal plane of the hand and forearm. Confirm pin position and length with fluoroscopy <sup>(10)</sup>.

Make a 4-cm skin incision 8 to 10 cm proximal to the wrist joint and just dorsal to the midline<sup>(10)</sup>.

With blunt dissection, expose the superficial branches of the lateral antebrachial cutaneous nerve and the radial sensory nerve, the latter of which exits in the midforearm from the investing fascia between the brachioradialis and extensor carpi radialis longus (**Figure 28**)<sup>(10)</sup>.



**Figure (2):** Two 3-mm half pins introduced into base or second metacarpal and two into distal radius. BR, brachioradialis; ECRB, extensor carpi radialis brevis; ECRL, extensor carpi radialis longus<sup>(10)</sup>.

Insert two 3-mm half pins, 1.5 cm apart, through a soft tissue protector between the radial wrist extensors at a 30-degree angle dorsal to the frontal plane of the forearm. The pins should just perforate the medial cortex of the radius. Confirm pin position and length with fluoroscopy. Irrigate and close both incisions with sutures<sup>(10)</sup>.

## CONCLUSION

The good outcomes achieved in this study suggest that use of the Spanning external fixators could be an alternative treatment method for intra articular distal radius fractures.

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