

Radiological Evaluation of Distal Radius Fracture: What Junior Doctors Want to Know

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Fractures of the distal radius account for an estimated 20% of fractures seen in the Accident and Emergency department in the UK. These injuries are common in the elderly population with osteoporosis, typically caused by a fall on outstretched hand. Most of these fractures are managed by the junior doctors in the department by closed reduction and plaster immobilisation under adequate analgesia and haematoma block.

Having spent 6 months as a Senior House Officer in the Accident and Emergency Department, I found that Junior Doctors find evaluating the post reduction films a bit of a challenge (i.e. to determine whether the reduction achieved is successful or unsuccessful).

This concise article covers the techniques of interpreting wrist radiographs for the junior doctors in the emergency department which will enable them to make an appropriate management plan for patients with wrist fracture.

Anatomy

The metaphysis of the distal radius is composed primarily of cancellous bone. The articular surface has a biconcave surface for articulation with the proximal carpal row (scaphoid and lunate fossae), as well as a notch (sigmoid notch) for articulation with the distal ulna. The sigmoid notch is nearly perpendicular to lunate fossa and articulates with distal ulna to form the Distal Radio-Ulnar Joint (DRUJ), which is stabilized by Triangular Fibrocartilage Complex (TFCC) and ulno-carpal ligaments. The base of ulnar styloid is the insertion point for the TFCC.

Numerous ligamentous attachments exist to the distal radius, which remain intact during distal radius fracture. These intact ligaments are used to facilitate the reduction through "ligamentotaxis".

Radiological Evaluation

A radiographic survey of the distal radius and ulna can be accomplished with posteroanterior (PA) and lateral views.

It is always important to be certain that the lateral projection is a "true" lateral view. The best criterion to confirm that the radiograph is a true lateral view is to observe the palmar cortex of the pisiform, lunate and capitate, in this order, from the

volar to dorsal aspect of the radius.

Oblique views are very useful to identify displacement of fractures that involve the articular surface but are not routinely performed in the accident and emergency department.

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On the PA and lateral films, there are 5 parameters to determine the normal radiographic relationships of the distal radius.

1. Radial Inclination

This represents the angle between a line joining the tip of the radial styloid and the ulnar corner of the articular surface at the distal end of the radius and a line drawn perpendicular to the long axis of the radius.

The radial inclination ranges from 13° to 30° (although this range varies considerably between authors). Average radial inclination is around 23° .

Acceptable reduction is thought to be greater than 15° .

Loss of radial inclination will lead to increased load across the lunate. This will increase the risk of development of chronic pain secondary to radio-lunate joint osteoarthritis especially when there is concomitant loss of dorsal inclination.

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2. Palmar (Volar) Tilt

This represents the angle between a line joining the dorsal and volar margins of the articular surface and the long axis of the radius, from the lateral film.

Palmar or volar tilt ranges from 0 to 28°. Average is around 11°.

Dorsal tilt decreases moment arm of finger extensors, making wrist less efficient.

Normally 82% of compressive load across the wrist is transmitted by radio-carpal

joint, and 18% through the ulno-carpal joint. With a 45° dorsal angulation deformity, 65 % of axial load across the carpus is directed onto ulna and the remaining load on the radius will be concentrated on dorsal aspect of the scaphoid fossa.

Most orthopaedic surgeon will not accept any dorsal angulation past neutral. If dorsal angulation of 20° is left unreduced, there is a high risk of patients becoming symptomatic with pain at the radio-carpal articulation, as well as in limited grip strength (Jupiter JBJS 1991).

Concomitant radial shortening with dorsal tilt may result in the dysfunction of the DRUJ, which manifests itself by limited rotation of forearm and impingement of ulna on radius.

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3. Radial Length

Measured from the PA radiograph, this is the distance between two perpendiculars to the long axis of the radius, one drawn at the tip of the radial styloid process and one drawn at the distal articular surface of the ulna, which should be 11 to 12 mm.

Radial Length shortening results from extensive comminution and impaction of fracture fragments into the metaphysis.

Shortening of up to 5mm is associated with a satisfactory outcome. However most surgeons would try to achieve shortening of less than 2mm. It is thought that shortening of radius is more disabling than an angulation deformity of the distal radius (i.e. dorsal angulation deformity or loss of radial inclination).

When radial shortening is due to comminution, then external fixation is the most reliable method of restoring length.

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4. Radial Shift

From the PA radiograph, this measures the distance between the long axis of the radius and the most radial point of the styloid. Both the injured and uninjured wrist is measured; the difference is the radial shift.

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5. Intra-articular step-off

In fractures involving the articular surface (i.e. radio-carpal and/or DRUJ articular surface), the incongruity seen on PA view should not be greater than 2mm.

Summary

Due to variation of these radiographic parameters between individuals, obtaining a precise measurement requires radiograph of both wrists in order to compare the measurements of the injured and the non-injured wrists. However, this is not routinely performed in the emergency department in the UK.

Useful parameters to determine whether the anatomy of a fracture indicates instability and will need surgical stabilization are: (1) excessive comminution (2) initial loss of 15mm or more of radial length (3) initial dorsal tilt of 20° or more. Surgical intervention becomes an important consideration when an acceptable reduction can not be either achieved or maintained with cast immobilization.

The table below summarizes the parameters that should be looked in evaluating a distal radius radiograph.

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References:

1. Nana D A, Joshi A, Litchman M David. Plating of Distal Radius. Journal of the American Academy of Orthopaedic Surgeons.2005;13:159-171.
2. Koval J K, Zuckerman D J. Handbook of Fractures. 3rd Edition. Lippincott Williams & Wilkins. P 226-230.
3. Goldfarb A C, Yin Y, Gilula A L, Fisher J A, Boyer I M. Wrist Fractures. RSNA Journals.2001; 219: 11-28.
4. Available URL: <http://www.wheelsonline.com> (Accessed 19th December 2006)

