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Distal radius fractures: an evidence-based approach to assessment and management

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Abstract

Distal radius fractures account for one in five bony injuries in both primary and secondary care. These are commonly the result of a fall on outstretched hands or high-energy trauma. On assessment, clinicians should determine the mechanism of injury, associated bony or soft tissue injuries, and neurovascular symptoms. Investigations should always include radiographs to evaluate for intra-articular involvement and fracture displacement. Owing to the heterogeneous injury patterns and patient profiles, the preferred management should consider the severity of the fracture, desired functional outcome and patient comorbidities. Non-operative management in select patients can give good results, especially in older adults. Immobilisation with or without reduction forms the mainstay of non-operative treatment. Surgical management options include closed reduction and application of a cast, percutaneous K-wires, open reduction and internal fixation with plates, or external fixation. Patients should be encouraged to mobilise as soon as it is safe to do so, to prevent stiffness. Median nerve compression is the most common complication followed by tendon rupture, arthrosis and malunion. This article outlines the British Orthopaedic Association Standards for Trauma and Orthopaedics for the management of distal radius fractures.

Key words: British Orthopaedic Association Standards for Trauma and Orthopaedics; BOAST; Distal radius; Falls; Fractures; Trauma

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Introduction

Isolated distal radius fractures are typically the result of falls on outstretched hands or high-energy trauma. In osteopenic patients, distal radius fractures result from low-energy falls from sitting or standing. In younger patients, fractures result from high-energy mechanisms such as sporting activities and road traffic accidents (Caldwell et al, 2019). Distal radius fractures are the most common orthopaedic injury and account for up to 20% of fractures in skeletally mature adults, affecting 9% of individuals by the time they turn 90 years of age (Costa et al, 2015; Jerrhag et al, 2017). The British Orthopaedic Association Standards for Trauma and Orthopaedics (BOAST) are a set of evidence-based guidelines published by the British Orthopaedic Association. These are succinct documents that describe auditable best practice standards, which outline the level of care expected for patients in the UK. The BOAST for management of distal radius fractures was published in December 2017 in a collaborative effort between the Orthopaedic Trauma Society and the British Society for Surgery of the Hand. The standard draws on evidence from the National Institute of Health and Care Excellence (2018) non-complex trauma guidelines and the British Society for Surgery of the Hand Blue Book (British Orthopaedic Association and British Society of Surgery of the Hand, 2018) on the management of distal radius fractures. This article reviews the diagnosis, management and treatment of fractures of the distal radius based on the BOAST guidelines.

Anatomy

The distal radius is responsible for 80% of the axial load at the wrist. It articulates with the lunate, scaphoid and distal ulna via the scaphoid fossa, lunate fossa and sigmoid notch respectively. Most tendons cross the distal radius and insert onto carpal or metacarpal bony prominences; only the brachioradialis tendon inserts at the radial aspect of the distal radius (Trumble et al, 1998). The normal anatomical alignment at the articular surface of the distal radius tilt is 21° in the anterior–posterior plane and up to 11° in the lateral plane (Brigstocke et al, 2013).

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Table 1. Eponymous names for distal radius fractures

Fracture	Description	Injury pattern
Smith fracture	Fracture of the distal radius with associated volar angulation of the distal extra-articular fracture fragment(s)	Low energy, fall on a flexed wrist A direct blow to the back of the wrist
Colles fracture	Fracture of the distal radius with associated dorsal angulation of the distal extra-articular fracture fragment(s)	Low energy, fall on an extended wrist, pronated arm
Barton's fracture	Fracture and dislocation of the radiocarpal joint with intra-articular fracture (dorsal/volar)	High energy
Die-punch fracture	Depressed fracture of the lunate fossa	High energy, punching motion (transverse load through lunate)

Classification

To date, over 20 classification systems have been documented (notably AO, Frykman, Melone and Fernandez) (Arora et al, 2011; Meena et al, 2014). However, no system has shown superiority in clinical use (Jayakumar et al, 2017; Mulders et al, 2017).

Despite the popularity of eponymous names to describe injury patterns, best practice guidelines depend on the radiographic appearance and the stability of the fracture, rather than a specific injury pattern and as such eponyms are best avoided (Table 1) (Meena et al, 2014; Tang, 2014).

Assessment

Mechanism of injury

The nature of a fracture and its degree of severity depends on the mechanism of injury and patient factors (including bone quality, body mass index and age of the patient). The energy of impact and position of the wrist at the time of impact determines the force vector on the bone and subsequent fracture. Shearing forces commonly result in articular surface involvement; this is associated with poorer outcomes (Egol et al, 2012). As would be expected, the combination of these forces results in heterogeneous fracture patterns and ligamentous injuries, each with unique considerations for management.

A detailed clinical history should ascertain the mechanism of injury, baseline patient health and neurovascular symptoms (British Orthopaedic Association Audit Standards for Trauma, 2017). Where appropriate, a full fall risk assessment should be conducted with stratification of the risk of fragility fractures using the Fracture Risk Assessment Tool. Investigations such as DEXA (dual energy-ray absorptiometry) scans and treatment with bisphosphonates should be initiated, in line with National Institute of Health and Care Excellence guidelines. Patients should be referred to local fracture liaison services to facilitate this care (Levin et al, 2017; National Institute for Health and Care Excellence, 2018).

Initial examination and management

The initial assessment should follow an 'ABCDE' approach, according to Advanced Trauma Life Support guidelines (ATLS Subcommittee et al, 2013). Skin integrity surrounding a suspected fracture must be promptly evaluated; in open fractures, surgical debridement and stabilisation are indicated as directed by BOAST open fracture guidelines (British Orthopaedic Association, 2017).

Wrist examination should assess for swelling, deformity, tenderness and range of motion, typically limited by pain. Tenderness over the distal radius is the hallmark of distal radius fracture. Pain may also be elicited over the scaphoid and carpus if there are co-existing injuries. A visible deformity will be apparent if the fracture is displaced (Tang, 2014).

Full neurovascular findings are essential and must be documented at presentation, including median ulnar and radial nerve sensation and motor function. Simple motor tests include the 'OK-sign' (anterior interosseous branch of the median nerve) and finger abduction and adduction (ulnar nerve) (Beleckas and Calfee, 2017). Distal radio-ulnar joint injuries and soft tissue injuries, namely triangular fibrocartilage complex, scapholunate ligament

Table 2. Radiographic assessment of distal radius fractures

View	Measurement	Normal	Acceptable criteria
Anterior–posterior	Radial height	13 mm	<5 mm shortening
	Radial inclination	23°	Change <5° or within 20° of the contralateral distal radius
	Articular step-off	Congruous	<2 mm step-off
Lateral	Volar tilt	11°	Dorsal angulation <5° or within 20° of the contralateral distal radius

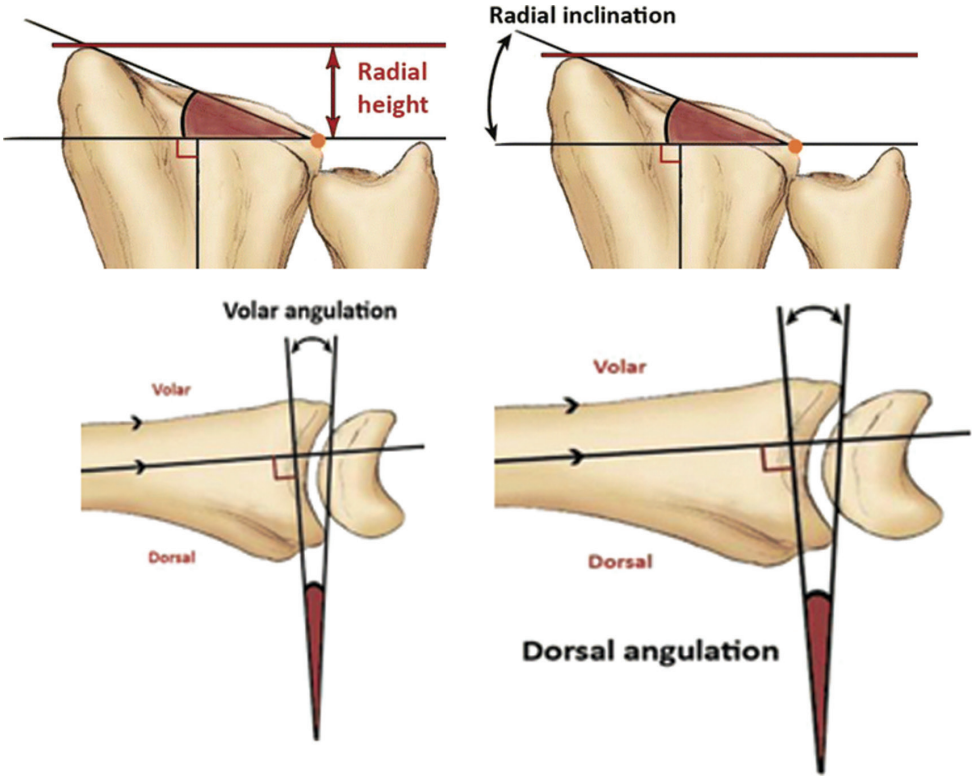

Figure 1. Important radial measurements to determine stability of fracture. a. Radial height. b. Radial inclination. c. Volar angulation. d. Dorsal angulation. From Mulders et al (2017).

and lunotriquetral ligament injuries, should be considered and managed appropriately (Beleckas and Calfee, 2017). Accurate assessment in an acute injury is often challenging as a result of oedema and pain. Compartment syndrome is a serious complication of distal radius fractures; while rare, it should be actively ruled out in the acute phase. A high index of suspicion is necessary where reported pain is out of proportion to the injury and in high-energy injuries with significant soft tissue disruption. Appropriate monitoring and safety netting is mandatory.

Further, clinical assessment at a specialist fracture clinic must be performed within 72 hours of presentation in line with BOAST guidelines (British Orthopaedic Association Standards for Trauma, 2013).

Investigations

Posteroanterior and lateral radiographs centred on the wrist are indicated (Table 2; Figure 1) (Mulders et al, 2017). Once immobilisation has been performed, with or without manipulation, a repeat radiograph should be requested and reviewed. Follow up at 1 week post-injury with radiographic review should be considered for patients with unstable fracture patterns or if there is clinical risk of subsequent displacement that would indicate surgical intervention. A radiograph of the patient's wrist at the time of removing immobilisation is not required unless there is a clinical cause for concern (British Orthopaedic Association Audit Standards for Trauma, 2017).

Computed tomography of the wrist is indicated to assess intra-articular involvement and degree of displacement or, if surgical management is indicated in complex fracture patterns, to improve surgical planning. Further imaging, such as magnetic resonance scans, can be used if there is concern about soft tissue injuries such as scapholunate ligament or triangular fibrocartilage complex tears (Ogawa et al, 2013; Meena et al, 2014; British Orthopaedic Association Audit Standards for Trauma, 2017).

Management

The heterogeneous injury patterns associated with distal radius fractures warrant a patient-specific tailored management approach. This should be guided by best practice guidelines to help inform decision making and must always consider the patient's personal circumstance, required outcome and comorbidities (Chen and Jupiter, 2007; Costa et al, 2015).

This article now discusses the BOAST guidelines as the best quality evidence and outlines their recommendations in line with best practice management (British Orthopaedic Association Audit Standards for Trauma, 2017).

Fractures for non-operative management

Fracture displacement and fracture stability help determine fracture management. In non-displaced extra-articular fractures, immobilisation is applied for pain relief and fracture healing. Removable supports can be chosen in these stable fracture patterns and the importance of early mobilisation should be emphasised and encouraged once pain allows (British Orthopaedic Association Audit Standards for Trauma, 2017).

Closed reduction in the emergency department is indicated for extra-articular stable fractures where radiographic alignment is displaced (Table 1) or any unstable displaced fracture pattern where the soft tissue envelope is threatened. A suitably trained practitioner should oversee any manipulation with regional anaesthesia and sedation (British Orthopaedic Association Audit Standards for Trauma, 2017; Orbach et al, 2018). For dorsally displaced stable distal radius fractures, closed manipulation and reduction should be performed using traction, distraction and reduction (Table 3). When applying the moulded backslab, the wrist should be fixed in neutral flexion using three-point moulding to ensure the stability of immobilisation. It is vital to minimise extreme flexion and ulnar deviation to prevent complications, namely carpal tunnel syndrome (Verdecchia et al, 2018).

Removal of plaster cast and mobilisation with a course of hand and wrist physiotherapy should be encouraged as early as possible; typically after 4 weeks for undisplaced and stable fractures and 6 weeks for other fracture patterns.

Fractures for operative management

Timely surgical intervention is of paramount importance – operations should occur within 1 week for extra-articular fractures and within 72 hours of the decision to operate for intra-articular fractures or where closed reduction is unsuccessful (British Orthopaedic Association and British Association of Plastic, Reconstructive and Aesthetic Surgeons Audit Standards for Trauma, 2017; British Orthopaedic Association Audit Standards for Trauma, 2017).

In displaced and unstable fractures, radiographic alignment (Table 1) should be used to inform and justify surgical intervention (Diaz-Garcia et al, 2011). There are multiple options

Table 3. Reduction of a dorsally angulated (Colles) fracture

Manual traction	Assistant provides counter-traction
	Operator applies longitudinal traction and dorsal pressure to the distal fracture fragment
	The deformity is initially exaggerated (dorsal angulation) and then volar and ulnar deviation is performed to reverse the deforming forces
Finger-trap traction	Weights provide counter-traction
	Forearm suspended by finger-traps (radial fingers), operator can apply dorsal pressure if necessary

available for the operative treatment of distal radius fractures, which include manipulation under anaesthetic and application of a moulded plaster, manipulation under anaesthetic and percutaneous K-wires, open reduction and internal fixation with locking plates, external fixators and internal bridging plates. The British Society for Surgery of the Hand Blue Book reviews the various operative options and presents the most recent evidence (British Orthopaedic Association and British Society of Surgery of the Hand, 2018).

K-wire fixation

Manipulation under anaesthetic and K-wire fixation involves the reduction of injury under fluoroscopic guidance and placement of percutaneous K-wires. This holds the fracture is position with supplementary plaster application. It is commonly used in dorsally displaced distal radius fractures, which can be satisfactorily reduced using this closed method. This method is quicker and cheaper than open reduction and internal fixation with a locking plate, but is not suitable for fractures that have significant intra-articular displacement, where closed methods cannot achieve satisfactory reduction (Karantana et al, 2015). The UK DRAFFT trial was a pragmatic, multicentre, randomised control trial that compared percutaneous K-wires to volar locking plate fixation. This study found no difference in functional outcome between each group. The results should be interpreted with caution, as only a small subset of patients was included in the overall analysis; this population was weighted to older women so has limited generalisability (Costa et al, 2015; Fullilove and Gozzard, 2016).

Open reduction and internal fixation

Where there is significant intra-articular displacement or where closed reduction and fixation has failed, open reduction and internal fixation using a locking plate and screws can be performed. This method enables anatomical reduction of a fracture and provides a stable construct for early mobilisation. This operative method is notably more expensive and comes with inherent risks including tendon rupture (Bartl et al, 2014; Søsborg-Würtz et al, 2018). In the presence of a distal radius fracture with a stable distal radio-ulnar joint it is not necessary to fix an ulnar styloid fracture (British Orthopaedic Association and British Society of Surgery of the Hand, 2018).

External fixation

External fixation may be considered in patients with severely comminuted fractures, open fractures with poor soft tissue envelope requiring reconstruction, or as part of damage control surgery. A wrist fusion plate can be a temporising ‘internal–external’ fixation device for fractures that are not constructable (Iorio et al, 2018).

Special considerations

In patients over 65 years of age with unstable fractures, functional outcomes and needs must be assessed in unstable fractures alongside radiographic alignment before operative management. As mentioned previously, non-operative management can be prioritised as primary treatment for dorsally displaced unstable radial fractures, so long as there is no significant deformity or neurological compromise (British Orthopaedic Association Audit Standards for Trauma, 2017).

Follow up

All patients should receive information regarding expected functional recovery and rehabilitation, including advice about the return to normal activities (work, education, driving) (British Orthopaedic Association Audit Standards for Trauma, 2017). Common complications should be discussed (Table 4) (Diaz-Garcia et al, 2011; Mathews and Chung, 2015; Iorio et al, 2018; Verdecchia et al, 2018). When discussing the ongoing care plan, patients should be ‘safety-netted’, by informing them to seek medical advice if any neurovascular symptoms are experienced or worsening, or if the pain worsens, and have direct contact with the fracture service if healing is not progressing as anticipated; all hospitals should provide this service in line with BOAST guidelines (Mathews and Chung, 2015; British Orthopaedic Association Audit Standards for Trauma, 2017).

Table 4. Complications of distal radius fractures

Complication	Association
Median nerve compression syndrome	Those with significant initial displacement or soft tissue injury
Ulnar nerve neuropathy	Patients with soft tissue injury at the distal ulnar radial joint
Spontaneous extensor pollicus longus rupture	Non-displaced stable fractures, as a result of local mechanical attrition or local ischaemia
Flexor pollicus longus tendon rupture	Patients with plate fixation causing local attrition. Plate placement distal to the watershed line or improper placement
Arthrosis	Those with intra-articular fractures or significant extra-articular malunion
Malunion leading to stiffness and pain	Those with displaced fractures

Conclusions

When assessed and managed appropriately, distal radius fractures carry a good prognosis. Successful outcomes are related to the restoration of anatomical relationships and rehabilitation of normal wrist and finger movements.

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Conflicts of interest

The authors declare no conflicts of interest.

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Key points

- Distal radius fractures affect both young and old patients and account for 20% of bony injuries in skeletally mature individuals. A wide variety of fracture patterns exists.
- Establishing a management plan should include radiographic findings, required functional outcome, patient age and comorbidities.
- Manual traction and finger-trap traction are both acceptable reduction methods for displaced fractures. This should always be done under appropriate anaesthesia, using three-point moulding of the plaster.
- In displaced or unstable fractures operative management should be prompt: <1 week for extra-articular fractures, and <72 hours for intra-articular fracture or unsuccessful closed reduction.
- Good functional results can be gained if the appropriate information is taken into account in decision making and appropriate physiotherapy started to optimise recovery.

Curriculum checklist

This article addresses the following requirements from the trauma and orthopaedics curriculum:

- Should demonstrate ability to clinically assess and manage complex fractures of the distal radius and scaphoid
- Acquire competence in the diagnosis and management of all types of fractures of the phalanges, metacarpals, carpus and distal radius
- Should demonstrate ability to manage distal radius and scaphoid fractures by standard techniques
- Should demonstrate ability to clinically assess and manage complex fractures of the distal radius and scaphoid

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