Chapter 14
Distal Radius Fractures with Ulnar Head and Neck Fractures

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Case Presentation

AC is a 52-year-old right-hand dominant homemaker who was involved in a motor vehicle accident as a restrained passenger. She complained of pain to the right distal forearm without loss of sensation. On examination, there was a 3 cm wound overlying the ulnar border of the right distal forearm with exposed bone but viable surrounding soft tissues and she had an intact neurovascular examination. Radiographs (Fig. 14.1a, b) demonstrate a comminuted, extra-articular metadiaphyseal fracture of the distal radius (AO type A3) and an open Gustilo Anderson grade II ulnar neck fracture (type Q2) [1, 2]. The patient underwent urgent surgical intervention with no other injuries and well controlled hypertension.

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Fig. 14.1 PA (**a**) and lateral (**b**) radiograph demonstrate a comminuted, extra-articular metadiaphyseal fracture of the distal radius with a concomitant ulnar neck fracture

Literature Review

Fractures of the distal radius with concomitant ulnar neck or head fractures occur in approximately 6 % of patients. Forty-six percent of these patients having abnormalities of the distal radioulnar joint (DRUJ) [3]. Anatomic reduction of these fractures with restoration of the DRUJ is imperative to help restore stability and motion through the DRUJ, while trying to minimize the risk of posttraumatic osteoarthritis. A malunited fracture with the ulnar head located volar to the distal radioulnar joint leads to decreased pronation while a dorsally malunited ulnar head will lead to decreased supination compared to normal alignment [4]. Up to 16 % of patients may develop a synostosis between the radius and ulna in these fracture patterns [3].

Classification of ulnar head and neck fractures uses a Q modifier within the Comprehensive Classification of Fractures. Type Q1 fractures involve the base of the ulnar styloid; ulnar neck fractures are type Q2 without comminution or Q3 with comminution; Q4 are ulnar head fractures; combination ulnar head and neck fractures are Q5, and more proximal shaft fractures are type Q6 [2].

Fractures of the distal radius with ulnar head or shaft may be stabilized by a variety of methods. Fixation of the distal radius utilizes standard techniques, such as external fixation or open reduction and internal fixation (ORIF), while fixation of the distal ulna can be accomplished by a variety of methods. Kirschner wire (K-wire) fixation of the ulnar fragment to the shaft secures the fracture, but may be associated with pin site irritation or increased risk of infection (Fig. 14.2a, b). K-wire fixation is also limited by bone quality and has the best chance of maintaining fracture reduction in patients with fracture patterns that have minimal to no comminution [5].

The outcome of plate fixation was reported by Ring et al. in 2004 using a subcutaneous condylar plate along the ulnar border for stabilization of the ulnar fracture [2]. While this method produced good to excellent results in 21 of 24 patients, seven patients required removal of the ulnar plate due to irritation. Functional range of motion of the wrist was recovered with an average of 50° flexion, 52° extension, 76° supination, and 64° pronation, with no incidence of DRUJ instability.

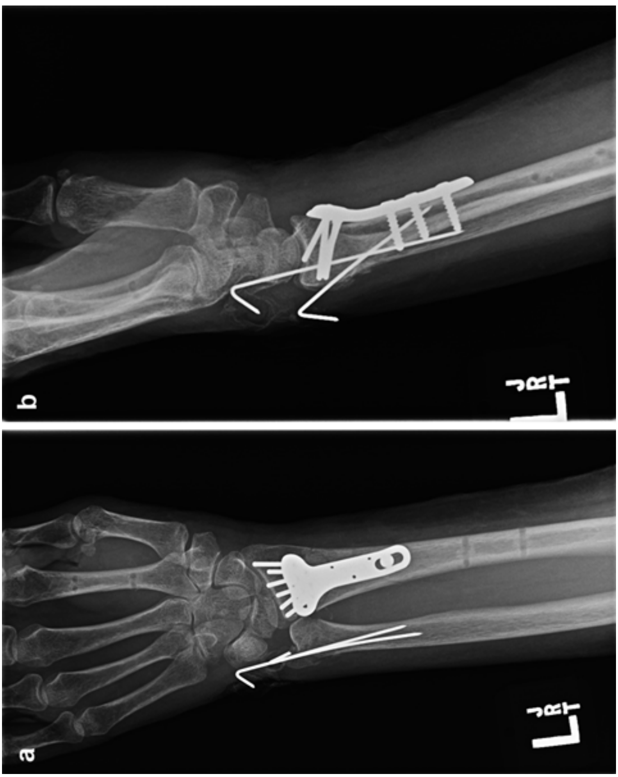

Fig. 14.2 PA (**a**) and lateral (**b**) radiograph demonstrating fixation of a distal radius fracture and ulnar styloid and neck fracture utilizing a locking, volar, distal radius plate and crossed K-wires

One other small series reported upon plate fixation utilizing locked, lower profile plates. All patients healed with a functional range of motion similar to Ring et al. [2], while two patients sustained a transient ulnar sensory neuropraxia which both resolved completely and no patients required hardware removal [5]. Comminuted ulnar fractures may be treated with dual plating utilizing a two-column method as described by Bessho et al. [6].

Specific plating systems for the distal ulna have been developed and evaluated. In a series of 25 patients with an average follow-up of 15 months, Lee et al. treated concomitant fractures of the distal radius and ulnar head/neck with a volar distal radius plate and a distal ulnar hook plate. The range of motion at final follow-up was 72° flexion, 69° extension, 77° pronation, 82° supination, 24° radial deviation, and 35° ulnar deviation. Grip strength measured between 80 and 91 % of the contralateral side. There were no wrists with DRUJ instability; however, four patients needed secondary bone graft placement for delayed union. Average DASH scores were reported at 14 with a modified Mayo wrist score of 87 [7]. Geissler reported his technique with a volarly placed distal ulnar plate to decrease irritation at the subcutaneous ulnar border in noncomminuted fractures with good results [8]. The plate must be placed proximally to the distal radioulnar joint with the screws projecting distally into the ulnar head fragment to avoid impingement at the sigmoid notch during supination and pronation, as the articular cartilage of the distal ulna covers a 270° arc [2, 8]. When considering the volar placement of the plate, the length of the screws should be measured carefully to avoid leaving the screw tip in the ECU groove, which may irritate the ECU tendon.

A direct comparison of patients with distal radius and distal ulnar fractures treated with ORIF of the distal radius and either ORIF versus closed reduction with or without pinning of the distal ulna was performed by Gschwentner et al. In this series, patients had improved flexion–extension arcs of 114° and pronation–supination arcs of 162° in the closed reduction group versus 77° and 107° in the ORIF group, respectively. There was no significant difference in grip strength or pain [9]. Methods to combine the lower profile pins and the stability of plating involve the usage of an intrafocal pin plate in the ulnar head or within subcapital fractures of the ulna [10].

Fractures with extensive levels of comminution may not be amenable to ORIF given the size or number of fracture fragments. In these cases, arthroplasty or resection may be necessary. While the data for arthroplasty is present [11], the literature demonstrates support for primary ulnar head resection [12–15]. In a case series of 15 patients followed for an average of 5.8 years, fractures of the distal radius and ulna were treated with external fixation with or without ORIF of the distal radius and simultaneous excision of the ulnar head. A “watertight” repair of the periosteal sleeve and TFCC complex provided stability to the DRUJ and ulnar carpus. Compared to the uninjured side, range of motion was equal or greater than 85 %, grip strength was 88.6 %, and there were no cases of DRUJ instability or ulnocarpal subluxation [14].

Treatment of the distal ulnar fracture with excision and a simultaneous extensor carpi ulnaris tenodesis through a dorsal ulnar incision was described in 11 patients with an average age of 62 and an average follow-up of 42 months. There were no cases of instability and results were graded as excellent in seven patients and good in four patients. Grip strength averaged 90 % of the contralateral side with range of motion of 105° in the flexion–extension arc and 158° in the pronation–supination arc. Immediate resection in elderly patients greater than 70 years of age yielded similar results with slightly reduced grip strength of 69 % compared to the contralateral side [15].

The level of the distal radius and ulna fracture may also predict instability at the DRUJ. The distal interosseous ligament and the variable presence of the distal oblique bundle also influence stability. Orbay has proposed a classification of instability based upon these anatomical factors and the observation that fractures of the radius and ulna can occur proximal, distal, or in variable levels relative to these structures [16]. While we may not know what soft tissue anatomy the patient has or exactly what is injured, we can reduce the fractures accurately and stabilize the DRUJ. In the operating room, the radius should be reduced anatomically. This includes correcting the coronal plane deformity to appropriately tension all soft tissue attachments. The ulna is also reduced and stabilized. If instability of the DRUJ persists, then TFC repair or ulnar styloid repair is necessary. Alternatively, the radius and ulna may be stabilized with cross pinning or a radioulnar external fixator in supination for 4–6 weeks [17].

Decision Making

The patient was brought urgently to the operating room, where an irrigation and debridement of the fracture was performed. The wound was clean and there was sufficient skin for primary closure so the surgical plan was to proceed with primary open reduction and internal fixation. The distal radius was approached through a trans-FCR approach and was reduced and then stabilized with a volar locking plate placed as a “bridging plate” to span the metadiaphyseal comminution.

After establishing the correct length and alignment by fixing the radius, the distal ulna was addressed. The traumatic laceration was extended proximally and distally along the subcutaneous ulnar border. The dorsal cutaneous branch of the ulnar nerve was identified and protected. The interval between the flexor carpi ulnaris (FCU) and ECU was developed. The ulnar head was reduced and stabilized with an ulnar hook plate with a simultaneous retrograde bicortical screw placed through the ulnar styloid. Interfragmentary compression was obtained and the plate was secured with nonlocking screws in the proximal ulnar shaft. The DRUJ was stable when tested in neutral, pronation, and supination.

The implants were chosen given the size of the fracture fragments and the bone quality. As the distal fragment was one piece, secure distal fixation could be achieved and therefore the fracture did not require primary arthroplasty or resection. Given the presence of the open wound, the traumatic soft tissue injury, as well as the size of the fragment, percutaneous pins potentially increase the risk of post-operative complications, such as perioperative infection. While the distal fracture fragment was large enough to allow for primary fracture fragment fixation, it was also too small for multiple screws to be placed within the ulnar head fragment. Therefore, the distal ulnar hook plate was selected and fixation was supplemented with a retrograde bicortical screw placed through the plate at the ulnar styloid.

Postoperatively, the patient was placed within a sugar-tong long arm splint for 2 weeks. At the first post-operative visit, the sutures were removed. The patient was placed into a removable Munster splint and received occupational therapy for active and active

Fig. 14.3 PA (**a**) and lateral (**b**) radiograph demonstrate a well-healed distal radius and ulna fracture

assisted range of motion. At 6 weeks, the splint was discontinued and the patient was allowed more aggressive range of motion with progression to strengthening. Final evaluation 5 months after injury demonstrated a well-healed distal radius and ulna fracture (Fig. 14.3a, b), a stable distal radioulnar joint, and full composite fist formation. Final pronation/supination was 50/50° compared to 60/60° of the contralateral wrist with flexion of 50°, extension of 40°, radial deviation of 20°, and ulnar deviation of 38°.

Tips and Tricks

Establishing the length and alignment of the radius and ulna is paramount for adequate function postoperatively. We generally prefer to complete an anatomic reduction of the radius and the sigmoid notch first. The reduction of the volar-ulnar radius helps correct the length of the radius, the coronal plane alignment, and at least a portion of the sigmoid notch. Following reduction and fixation of the radius, the elbow can be flexed to 90° while maintaining the forearm in neutral rotation. This position can be maintained by use of finger-trap traction in a wrist arthroscopy tower which can allow simultaneous use of fluoroscopy as well. This will allow exposure of the ulnar head and neck through a medial subcutaneous approach between the FCU and ECU tendons. During the surgical dissection, identify and protect the dorsal cutaneous branch of the ulnar nerve, as injury to this structure could result in postoperative numbness or a painful neuroma.

Exposure through the FCU/ECU interval allows fixation of the styloid, head, or neck of the ulna and can be extended for fixation of fractures that extend more proximally. This incision allows placement of the plate in a volar position if desired, as described by Geissler [8]. If the decision is made to resect the ulnar head or perform a primary arthroplasty, the distal incision may be curved dorsally if required. If the articular surface requires reduction, a dorsal exposure can be made through the floor of the fifth extensor tendon compartment. The proximal capsule is incised between the radius and ulna preserving the dorsal radioulnar ligament. The distal capsular incision continues 90° in the ulnar direction and just proximal to the dorsal radioulnar ligament and stops before the ECU tendon. This will allow wide exposure to the ulnar head, TFC, and sigmoid notch.

Kirschner wires may also be used for fixation to aid in both the reduction and stabilization of the individual fragments. After exposure, a K-wire may be inserted distal to the ulnar styloid to identify the most distal plate position. Also, utilization of a K-wire in the distal ulnar fragment as a joystick can assist with reduction and restoration of the correct rotation of the ulnar head. As a reference, the ulnar styloid and the olecranon should be palpable roughly within the same plane. After proper reduction and alignment are obtained, the K-wire may be advanced into the proximal ulna or the distal radius to stabilize the ulnar head fragment in its reduced position. If instability is noted with the proximal ulnar shaft fracture fragment, a temporary K-wire maybe driven from ulnar shaft into the radial shaft to help stabilize the fragment from excessive volar and dorsal translation, allowing for easier reduction of the distal ulnar head to the stabilized ulnar shaft. Cross pinning the radius and ulna can be helpful intra-operatively to obtain a reduction, but we prefer to then attempt to provide stable fixation and remove the cross pins if possible. If plate fixation of the ulnar head is to be utilized, remember that these are to be unicortical screws. A plate/screw construct that allows these screws to be locking is advantageous.

Digital range of motion and edema control are begun immediately in the post-operative period. When the ulna and DRUJ are rigidly stabilized, flexion, extension, pronation, and supination of the wrist may begin at about 10–14 days or at the first post-operative visit after evaluation of the radiograph and surgical wounds. With rigid fixation of the radius, if there is concern for stability of the DRUJ or the distal ulna, 3–4 weeks in a neutral forearm cast is usually sufficient to provide comfort and allow early healing of the distal ulna and radius. Following initial splint or cast immobilization a splint is typically provided for patient comfort until range of motion normalizes. Once the patient achieves pain-free rotation of 45° of pronation and 45° of supination, the splint is discontinued. Strengthening may progress as the patient becomes more comfortable within a functional range of motion.

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