

# Both-Bone Forearm Fracture With Distal Radioulnar Joint Dislocation

Michael K. Ryan, MD, Brendan J. MacKay, MD, and Nirmal C. Tejwani, MD

## Abstract

Both-bone forearm fractures, also known as concomitant diaphyseal radius and ulna fractures, and distal radioulnar joint (DRUJ) dislocations are each uncommon injuries in adult upper extremity trauma. DRUJ dislocations are more often associated with radial shaft (Galeazzi) fractures. In this article, we report the case of a patient who sustained a both-bone forearm fracture and DRUJ dislocation, and we review the literature on this unique injury pattern.

Diaphyseal forearm fractures are relatively rare in orthopedic trauma, accounting for only 0.9% of all fractures.<sup>1</sup> Both-bone forearm fractures, also known as concomitant diaphyseal radius and ulna fractures, are even more uncommon, comprising 21.7% of diaphyseal forearm fractures.<sup>1</sup> Distal radioulnar joint (DRUJ) dislocations occur infrequently as well. Investigators have cited a 6% to 55% incidence of DRUJ dislocations associated with diaphyseal radius fractures, and the rate is higher for fractures closer to the distal radial articular surface.<sup>2,3</sup>

Both conditions have similar mechanisms of injury including falls, blunt trauma, sports, and motor vehicle accidents. Independently, the 2 injury patterns have been thoroughly described in the literature, but there are only isolated reports—most recently in 1975<sup>4</sup>—of concomitant both-bone forearm fractures and ipsilateral DRUJ dislocations. In these reports, the information on fracture patterns, treatments, and functional outcomes is limited.

In this article, we report the case of a both-bone forearm fracture

and a concomitant ipsilateral DRUJ dislocation, and we review the literature on this uncommon injury pattern.

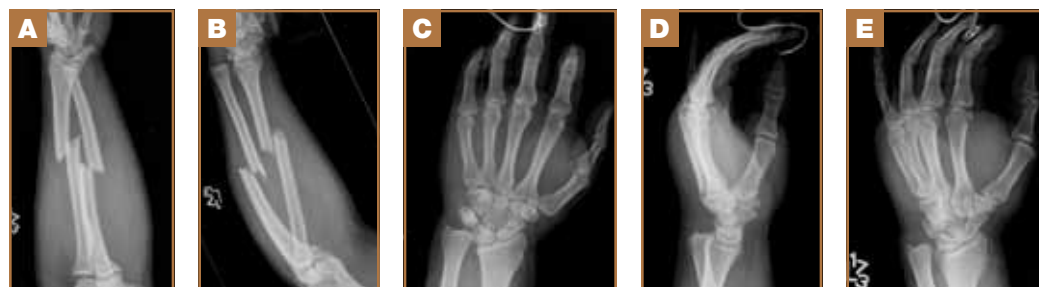
The patient provided written informed consent for print and electronic publication of this case report.

## Case Report

A 38-year-old man with no past medical history presented to the emergency department after being thrown from a motorcycle. On arrival, he reported bilateral upper extremity pain. Physical examination revealed closed deformities of the left forearm and right wrist. Radiographs of the left upper extremity showed mid-diaphyseal radius and ulna fractures and a DRUJ dislocation (Figure 1). Radiographs of the right upper extremity showed a comminuted radial styloid fracture and widening of the scapholunate interval with dorsal intercalated segment instability deformity of the carpus. Both upper extremity injuries were acceptably reduced and splinted. The patient also had a left-side subarachnoid hematoma, which was stable on serial computed tomography without contrast.

After the patient was medically stabilized, the fractures were surgically repaired. Radius and ulna were reduced and compression-plated through separate incisions. After stable fixation was achieved, intraoperative elbow range of motion (ROM) was full, with 90° of supination and pronation. On physical examination, the DRUJ was stable with the forearm in neutral, pronation, and supination. Postoperative radiographs showed well-reduced radius, ulna fractures, and DRUJ. A long arm splint was placed with the wrist in supination.

Figure 1. Lateral (A) and oblique (B) radiographs of left forearm show shortened, rotated, and displaced diaphyseal fractures of radius and ulna. (C) Posteroanterior radiograph of left wrist shows distal radioulnar joint dislocation, joint widening, and distal displacement of ulna. (D) Lateral radiograph of left wrist shows dorsal dislocation of distal ulna. (E) Oblique radiograph of left wrist.



**Authors' Disclosure Statement:** The authors report no actual or potential conflict of interest in relation to this article.

For 6 weeks, the patient wore a functional brace on forearm and elbow to keep the forearm in supination. Eleven weeks after surgery, radiographs showed healing fractures and a well-reduced DRUJ. At most recent follow-up (6 months), forearm and wrist had limited ROM, elbow had full ROM, and there was radiographic evidence of fracture healing and a stable DRUJ (Figure 2).

## Discussion

DRUJ dislocations co-occurring with diaphyseal radius fractures have been recognized for nearly 200 years, but it was not until 1949 that Knight and Purvis<sup>5</sup> first described a both-bone forearm fracture co-occurring with an ipsilateral DRUJ dislocation. The authors reported on 100 cases of both-bone forearm fractures—41 managed with closed reduction and splinting in supination and the other 59 managed with open reduction and different internal fixation techniques—and found unsatisfactory outcomes in 71% of those treated closed and in 40% to 85% of those treated with open reduction internal fixation (ORIF). They also noted that, though axial subluxation of the DRUJ was common in both-bone forearm fractures secondary to radial shortening, DRUJ instability and pain seldom occurred, unless there was volar or dorsal dislocation of the radius or ulna.

In 1963, Albert and colleagues<sup>6</sup> reported DRUJ dislocation in association with a 1- or 2-bone diaphyseal fracture in 7 of 60 forearm fracture cases, but gave no other pertinent details.

In 1967, Vesely<sup>7</sup> conducted a comprehensive review of the DRUJ and identified 201 cases of forearm injuries managed over a 5-year period. These included distal radius fractures and isolated joint dislocations without fracture. Thirteen of these injuries were mid-diaphyseal both-bone fractures, and 6 of these 13 had associated ipsilateral DRUJ dislocations. The authors did not report details regarding management or outcomes.

In 1975, Mikić<sup>4</sup> evaluated 125 Galeazzi or Galeazzi-type fractures managed over a 10-year period. Mikić coined the term *Galeazzi-type fracture* to describe a both-bone forearm fracture with an associated ipsilateral DRUJ dislocation. Twenty-five of these injuries were both-bone forearm fractures with concomitant ipsilateral DRUJ dislocations. Four of these 25 were unsuccessfully managed with closed reduction and casting, and the other 21 were managed with a variety of surgical techniques. Forty-five percent of the surgical cases had poor outcomes (ie, pain, deformity, nonunion, shortening, or angulation of the radius; DRUJ dislocation; pronation or supination limitation of >45°; and excessively restricted elbow or wrist function). The authors reported 3 excellent outcomes, all in cases managed with radioulnar transfixation using Kirschner wires. Excellent outcomes were defined as osseous union,

perfect alignment, no loss of length, no DRUJ subluxation, no limitation in elbow or wrist function, and no limitation in pronation or supination.

There is no definitive explanation for the low incidence of both-bone forearm fractures concomitant with ipsilateral DRUJ dislocations. DRUJ dislocations in Galeazzi fractures occur more often when the radial shaft fracture occurs within 7.5 cm of the radial articular surface (55%), compared with fractures proximal to this point (6%).<sup>3</sup> Both-bone forearm fractures occur most often in the proximal and middle thirds of the forearm (82% and 72%, respectively).<sup>8</sup> Therefore, the proximal-to-distal decrease in the incidence of diaphyseal shaft fractures is accompanied by an increase in the incidence of DRUJ dislocations. This may be the result of biomechanical differences in these injury patterns.

Mikić<sup>4</sup> and Hughston<sup>9</sup> separately described the path of force transmission in Galeazzi fractures as originating in the hand, traveling through the radius, continuing through the interosseous membrane, and exiting at the triangular fibrocartilage complex. Mikić used a variation of this theory to explain both-bone forearm fractures concomitant with ipsilateral DRUJ dislocations. He postulated that the same force causing Galeazzi fractures also propagates through the ulna, causing mechanical failure.

However, Rettig and Raskin<sup>2</sup> stated that different mechanisms are involved in diaphyseal fractures of the distal third of the radius and diaphyseal fractures of the middle and proximal thirds. Fractures of the distal third (ie, within 7.5 cm of the midarticular surface) are “high-impact hyperextension fractures [resulting] in a direct continuum of injury through the triangular fibrocartilage complex and the interosseous membrane,” whereas forearm fractures beyond 7.5 cm from the midarticular surface (moving more proximally) result from an “indirect pronation force with incomplete soft-tissue disruption.” Independent of the mechanism involved in these injury patterns, the interosseous membrane plays a vital role in the function, stability, and force dissipation of the forearm. Any disruption in this membrane places excessive loads on either the DRUJ or the proximal radioulnar joint and makes it vulnerable.

Both-bone forearm fractures and Galeazzi fractures historically have been managed with a variety of methods. Initially, the technique of closed manipulation and immobilization was advocated for management of both-bone forearm fractures, as surgical intervention often yielded high rates of infection, delayed union, malunion, and residual DRUJ instability.<sup>5,10</sup> When surgical techniques and implants improved, attitudes shifted toward making operative fixation the primary treatment, as it restores bony length and contour and provides immediate

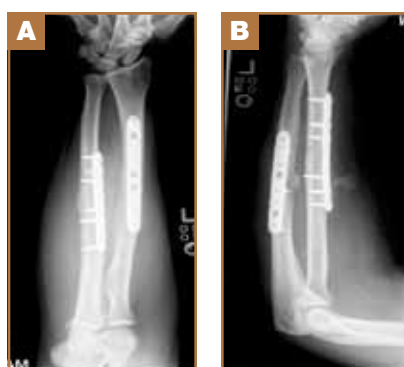


Figure 2. Six months after surgery, posteroanterior (A) and lateral (B) radiographs of left forearm show interval healing of radius and ulna fractures.

stability. More importantly, the functional outcomes achieved with ORIF are superior to those with closed reduction and immobilization.<sup>4,8</sup> Yet, ORIF of both-bone and Galeazzi fractures does not guarantee DRUJ stability, and temporary DRUJ immobilization with splinting or Kirschner wires may be required.<sup>2,4</sup> Immobilizing the DRUJ to allow healing prevents long-term instability and subsequent redislocation, pain, and arthritis.

These principles were applied in the surgical treatment described in our case report. Rigid fixation of the patient's forearm fractures stabilized his DRUJ, and additional fixation was not needed. Yet, the forearm was initially splinted in a stable position (supination) to promote DRUJ healing. This treatment resulted in a functional, relatively pain-free outcome, and a stable DRUJ.

Both-bone forearm fracture with ipsilateral DRUJ dislocation is uncommon, and this injury pattern has been sparsely characterized in the literature. Reported outcomes are mostly poor, but the data are outdated. This injury seems to represent a biomechanically unique failure of forearm stability, and further analysis is needed to elucidate the pattern. Despite the current lack of understanding, we believe that surgical fixation can yield good functional outcomes for these injuries, given restoration of proper forearm anatomy and biomechanics. Thorough examination and radiographic evaluation of elbow, forearm, and wrist in patients with both-bone forearm injuries are needed to identify concomitant DRUJ injuries that may require fixation at time of surgery. We hope that this case report will increase awareness of possible DRUJ injury with both-bone forearm fracture, and that it will thereby reduce the number of missed injuries that could have detrimental effects on outcomes.

Drs. Ryan and MacKay are Resident Physicians, and Dr. Tejwani is Professor, Department of Orthopaedic Surgery, New York University Hospital for Joint Diseases, New York.

Address correspondence to: Nirmal C. Tejwani, MD, Department of Orthopaedic Surgery, New York University Hospital for Joint Diseases, New York, NY 10003 (tel, 212-598-6599; fax, 212-598-6015; e-mail, nirmal.tejwani@nyumc.org).

*Am J Orthop.* 2013;42(5):E30-E32. Copyright Frontline Medical Communications Inc. 2013. All rights reserved.

## References

1. Ruch DS, McQueen MM. Distal radius and ulna fractures. In: Rockwood CA, Bucholz RW, Green DP, Heckman JD, eds. *Rockwood and Green's Fractures in Adults*. Vol 2. 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010:829-880.
2. Rettig ME, Raskin KB. Galeazzi fracture-dislocation: a new treatment-oriented classification. *J Hand Surg Am.* 2001;26(2):228-235.
3. Ring D, Rhim R, Carpenter C, Jupiter JB. Isolated radial shaft fractures are more common than Galeazzi fractures. *J Hand Surg Am.* 2006;31(1):17-21.
4. Mikić ZD. Galeazzi fracture-dislocations. *J Bone Joint Surg Am.* 1975;57(8):1071-1080.
5. Knight RA, Purvis GD. Fractures of both bones of the forearm in adults. *J Bone Joint Surg Am.* 1949;31(4):755-764.
6. Albert SM, Wohl MA, Rechtman AM. Treatment of the disrupted radio-ulnar joint. *J Bone Joint Surg Am.* 1963;45:1373-1381.
7. Vesely DG. The distal radio-ulnar joint. *Clin Orthop.* 1967;(51):75-91.
8. Chapman MW, Gordon JE, Zissimos AG. Compression-plate fixation of acute fractures of the diaphyses of the radius and ulna. *J Bone Joint Surg Am.* 1989;71(2):159-169.
9. Hughston JC. Fractures of the forearm—anatomical considerations. *J Bone Joint Surg Am.* 1962;44(8):1664-1667.
10. Evans EM. Fractures of the radius and ulna. *J Bone Joint Surg Br.* 1951;33(4):548-561.