SCIENTIFIC ARTICLE

The Impact of Coronal Alignment on Distal Radioulnar Joint Stability Following Distal Radius Fracture

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Purpose Shift of the distal fragment of a distal radius fracture (DRF) in the coronal plane (coronal shift) may compromise the contributions of the distal oblique bundle (DOB) of the interosseous membrane to distal radioulnar joint (DRUJ) stability. The purpose of the study was to test our hypothesis that coronal shift of the distal fragment would increase dorsal-volar DRUJ displacement in response to applied load.

Methods A distal radius osteotomy was performed proximal to the sigmoid notch base and the ulnar styloid was cut (to simulate triangular fibrocartilage complex detachment) in 10 cadaveric specimens. A volarly placed plate was used to shift the distal radius fragment radially in 2-mm increments. A mechanical testing apparatus applied a 20 N load to the distal fragment perpendicular to the volar cortex with the forearm in neutral, 60° pronation, and 60° supination. Dorsal-volar displacement of the radius relative to the fixed ulna was measured in the control state (DRF and ulnar styloid anatomically fixed) and in 3 positions (anatomical reduction, 2-mm coronal shift, 4-mm coronal shift) with ulnar styloid displacement. The specimens were dissected post hoc to evaluate for a distinct DOB (thickness, > 0.5 mm). Dorsal-volar DRUJ displacement was compared among testing and control states using analysis of variance.

Results In specimens with a distinct DOB, 2-mm coronal shift significantly increased dorsal-volar DRUJ displacement. However, there was no difference in DRUJ displacement between 4-mm coronal shift and control state. Coronal shift did not affect dorsal-volar DRUJ displacement in specimens without a distinct DOB.

Conclusions In the setting of an ulnar styloid fracture, a 2-mm (but not a 4-mm) coronal shift of the DRF is associated with increased dorsal-volar DRUJ displacement in specimens with a distinct DOB, but not in specimens without a distinct DOB.

Clinical relevance Awareness of the importance of coronal shift may aid in prevention of DRUJ instability associated with DRF, especially in patients with a DOB. *(J Hand Surg Am. 2014;39(7):1264–1272. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Distal interosseous membrane, distal oblique bundle, coronal shift, distal radioulnar joint, distal radius.

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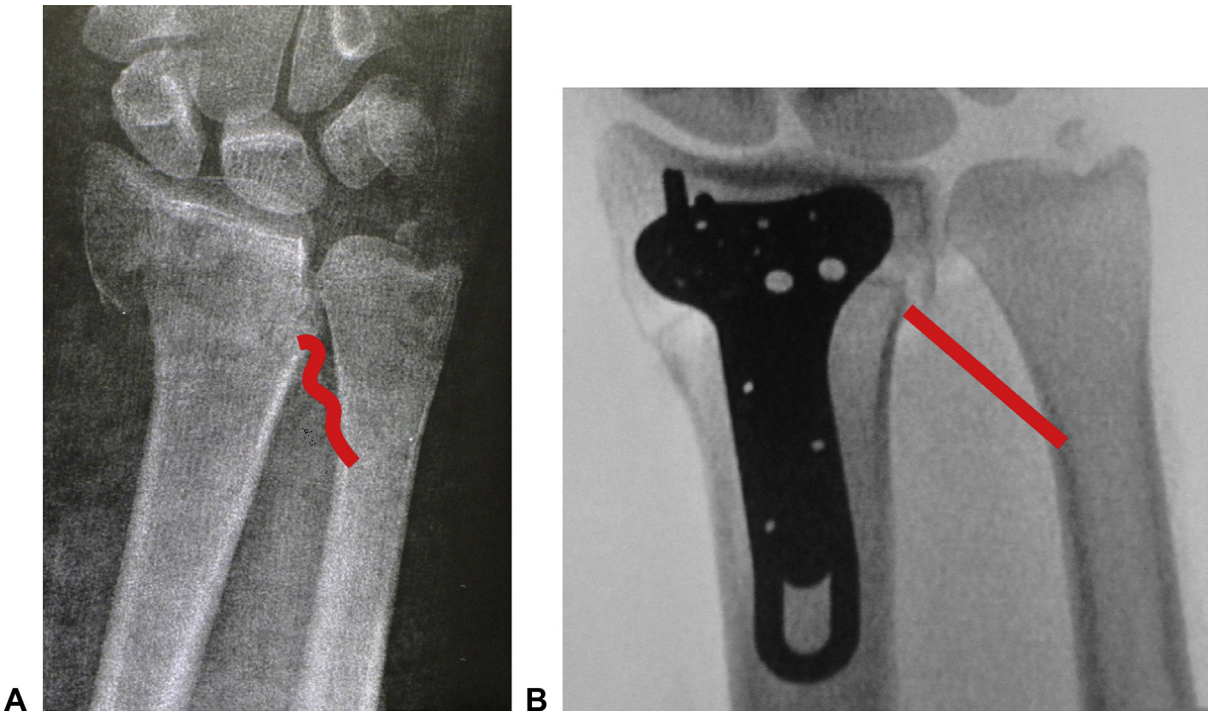

FIGURE 1: A Coronal shift of the distal fracture fragment, with the red line simulating laxity in the DOB. **B** Intraoperative radiograph following anatomical reduction and internal fixation of the coronal shift, with the red line indicating simulated restoration of tension in the DOB.

Instability of the distal radioulnar joint (DRUJ) can result in pain, weakness, and loss of forearm rotation following treatment of distal radius fractures (DRF).[1–3] Owing to the incongruence of its articular surfaces,[4] the DRUJ relies on the triangular fibrocartilage complex, interosseous membrane (IOM), and the other surrounding soft tissues (such as the pronator quadratus, the extensor carpi ulnaris and its subsheath, and the DRUJ capsule) to provide stability.[5] Anatomical investigations have revealed that 40% of subjects have an additional distally based stabilizing structure known as the distal oblique bundle (DOB), which has variations in thickness, width, and breadth of attachment.[6–8] The contributions of the DOB to dorsal-volar DRUJ stability have been confirmed in recent biomechanical[9] and radiographic[10] studies, but these contributions are sensitive to anatomical variations in the position of the DOB's bony attachments.[11] Moritomo[12] has suggested that the DOB loosens in Galeazzi fractures. Orbay[13] has classified concomitant fractures of the distal radius and ulna in 3 stages and theorizes that the DOB plays an important stabilizing role in highly displaced fractures that have disrupted the primary stabilizers of the DRUJ.

In the case of a displaced extra-articular DRF, the distal fragment may translate radially in the coronal plane (coronal shift) (Fig. 1). The coronal shift can rarely be seen as an isolated displacement, but more frequently, it is accompanied by typical features of dorsal angulation, dorsal comminution, and radial shortening. Large coronal shifts are generally accompanied by a fracture at the base of the ulnar styloid or fracture of the ulnar head/neck.[13] The coronal shift results in narrowing of the radioulnar distance proximal to the fracture site, which slackens the IOM.[13]

In the setting of an ulnar styloid fractured at its base with disruption of the insertions of the dorsal and volar radioulnar ligaments, the coronal shift unseats the ulnar head from the sigmoid notch. This decreases the resting tension of the surrounding soft tissue stabilizers and potentially affects their contributions to dorsal-volar DRUJ stability[14] (Fig. 2). Conversely, correction of the coronal shift should tension these structures, especially when present as a distinct DOB, and seat the ulnar head into the sigmoid notch, providing some degree of stability through contact pressure alone. The amount of subsequent tension in all components of the triangular fibrocartilage complex cannot be directly verified, but Hagert and Hagert[15] have emphasized the importance of simultaneous compression at the articular surfaces and tension in the surrounding soft tissues in providing dorsal-volar stability of the DRUJ.