The Distal Interosseous Membrane: Current Concepts in Wrist Anatomy and Biomechanics

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The distal interosseous membrane (DIOM) of the forearm acts as a secondary stabilizer of the distal radioulnar joint (DRUJ) when the dorsal and palmar radioulnar ligaments of the triangular fibrocartilage complex are cut. Recent anatomical studies revealed that thickness of the DIOM varies widely among specimens and the distal oblique bundle (DOB) exists within the DIOM in 40% of specimens. The DOB originates from the distal one-sixth of the ulnar shaft and runs distally to insert on the inferior rim of the sigmoid notch of the radius. The mean thickness of the DIOM without a DOB was 0.4 mm, which was significantly thinner than 1.2 mm with a DOB. Biomechanical studies have shown that the DOB is an isometric stabilizer of the forearm during pronosupination. The presence of a DOB was shown to have a significant impact on DRUJ stability. Innate DRUJ laxity in the neutral forearm position was greater in the group without a DOB than in the group with a DOB. Ulnar shortening with the osteotomy performed proximal to the attachment of the DIOM had a more favorable effect on stability of the DRUJ compared with the effect of distal osteotomy, especially in the presence of a DOB. The longitudinal resistance to ulnar shortening was significantly greater in proximal shortening than in distal shortening. It also suggested that the DIOM is of great importance in the management of concomitant ulnar-side injuries in distal radius fracture. *(J Hand Surg 2012;37A:1501–1507. Copyright © 2012 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Interosseous membrane, distal radioulnar joint, anatomy, biomechanics, instability.

The interosseous membrane (IOM) of the forearm is a stout ligamentous complex linking the radius to the ulna. The IOM reportedly consists of distal membranous, middle ligamentous, and proximal membranous portions. Each portion includes several ligamentous components. Some investigators have reported that the distal membranous portion stabilizes the distal radioulnar joint (DRUJ). Watanabe et al[1] and Kihara et al[2] performed a biomechanical cadaver study to determine the role of the stabilizing structures of the DRUJ, and indicated that the distal membranous portion of the IOM acted as a secondary stabilizer of the DRUJ when the dorsal and palmar radioulnar ligaments of the triangular fibrocartilage complex (TFCC) were cut. Recently, anatomical variation of the distal IOM (DIOM) and the exact fiber responsible for its function have been described.

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ANATOMY OF THE DIOM

The DIOM is on the distal side of the middle ligamentous complex, spanning the radius and ulna under the region of the pronator quadratus muscle. A hole exists in that portion, through which the interosseous artery passes. Noda et al[3] reported anatomical variation of the DIOM. The authors found that thickness of the DIOM varied widely among specimens, and identified the distal oblique bundle (DOB) in 12 of 30 specimens (40%) (Figs. 1, 2). The DOB is an obvious thick fiber running within the DIOM that originates from the distal one-

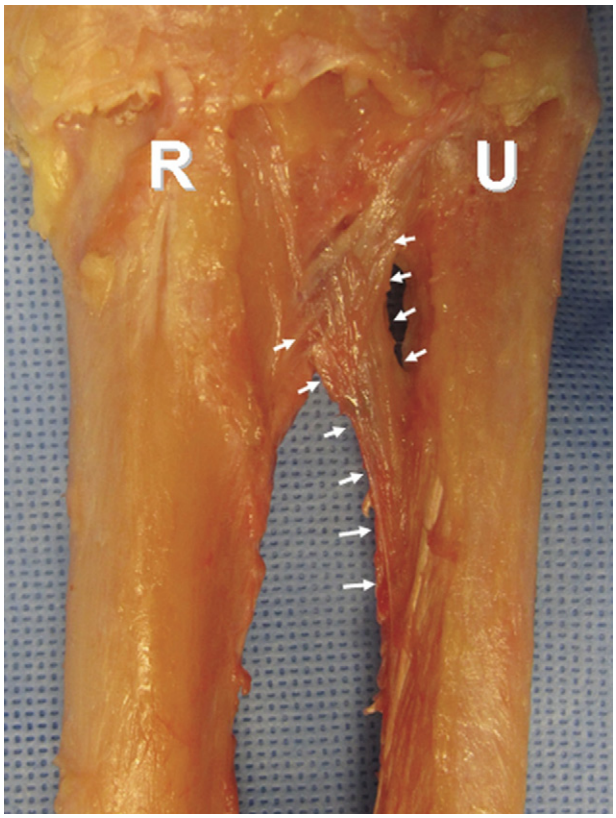

FIGURE 1: An obvious thick fiber bundle of the DOB from the DIOM (white arrows). R, radius; U, ulna. (From Kitamura T, Moritomo H, Arimitsu S, Berglund LJ, Zhao KD, An KN, et al. The biomechanical effect of the distal interosseous membrane on distal radioulnar joint stability. J Hand Surg 2011;36A:1626–1630. Reprinted with permission of Elsevier.)

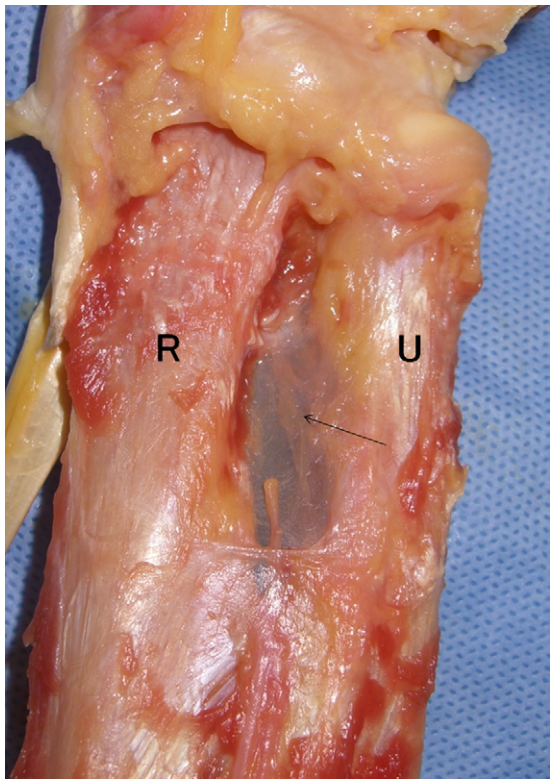

FIGURE 2: Thin DIOM (arrow). Obvious DOB does not exist. R, radius; U, ulna.

sixth of the ulnar shaft and runs distally to insert on the inferior rim of the sigmoid notch of the radius. The mean width is 4.4 mm (range, 2–6 mm) and mean thickness is 1.5 mm (range, 0.5–2.6 mm). The fibers blend into the capsular tissue of the DRUJ. Furthermore, some fibers extend more distally along the anterior and posterior ridges of the sigmoid notch, so the DOB shows continuity with the dorsal and palmar radioulnar ligaments of the TFCC. Kitamura et al[4] reported that the dimensions of the DIOM varied widely among 10 fresh specimens. In 4 specimens, an obvious thick fiber bundle that was the DOB existed within the DIOM, whereas in 6 specimens an obvious thick fiber was not evident within the DIOM. They reported that the DOB originated from the distal ulna 54 mm (on average; range, 50–57 mm) proximal to the ulnar head, which was 21% of the total ulnar length from the ulnar styloid. The DOB inserted on the dorsal inferior rim of the sigmoid notch of the radius, approximately 35 mm from the radial styloid, which was 15% of the total radial length from the radial styloid. They reported that the DOB showed variations (Fig. 3). In 2 of the 4 specimens in which a DOB was present, the DOB was linear and clearly separate from the membrane portion of the DIOM. In another specimen with a DOB, a thick fiber bundle was visible only in the proximal portion of the DIOM and spread in a fan shape distally. In another specimen, the DOB was wide and occupied almost the whole DIOM. The mean thickness of the DIOM among the 10 specimens was 0.7 mm (range, 0.5–1.3 mm). The mean thickness of the 6 specimens without a DOB was 0.4 mm (range, 0.3–0.5 mm), whereas the mean thickness of the 4 specimens with a DOB was 1.2 mm (range, 1.0–1.3 mm). There was a statistically significant difference in the thickness of the DIOM between the groups with and without a DOB.

Another variation in the anatomy of the DIOM is the distal radioulnar tract, described by Gabl et al[5] (Fig. 4). The distal radioulnar tract extends from the radial shaft proximally to the dorsal capsule of the distal radioulnar joint distally. The distal radioulnar tract is located dorsal to the DOB, which extends from the ulnar shaft proximally to the distal radius distally; therefore, these 2 fibers run opposite each other. The tract originates from the radius 22 mm proximal to the distal dorsal corner of