Exposures of the Wrist and Distal Radioulnar Joint

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KEYWORDS

• Wrist • DRUJ • Surgical exposure • Technique • Trauma reconstruction

KEY POINTS

- The wrist consists of the 8 carpal bones and their articulations with the distal surfaces of the radius and ulna, as well as the proximal articular surfaces of the metacarpals.
- The distal radioulnar joint (DRUJ) contributes to the stability and function of the wrist.
- The 3 major nerves to the hand—the median, ulnar, and radial nerves—traverse the wrist as they enter the hand. Key anatomic landmarks identify their positions for protection during exposure.
- Standard and alternative exposures of the wrist joint and DRUJ are discussed, with case examples illustrating their use.

ANATOMY OF THE WRIST AND DISTAL RADIOULNAR JOINT

The wrist consists of the 8 carpal bones and their articulations with the distal surfaces of the radius and ulna, as well as the proximal articular surfaces of the metacarpals. The distal radioulnar joint (DRUJ) contributes to the stability and function of the wrist, as well, with stabilization of the ulnar carpus via the triangular fibrocartilage complex (TFCC) and creation of a rotational moment for pronation and supination of the forearm at the DRUJ. The wrist and DRUJ form a highly complex structure, maintained by intrinsic interosseous ligaments between each of the carpal bones, extrinsic radiocarpal and ulnocarpal ligaments, intracapsular ligaments, and the TFCC. The median, ulnar, and radial nerves traverse the wrist and must be protected during surgical exposures. The flexor and extensor tendons to the digits and the wrist surround the joints and also need to be managed carefully to prevent injury during exposures and maintain mobility during healing after surgery. An understanding of these relationships is essential to safe and effective surgical access for the treatment of carpal pathology, ligament injuries, and fracture care.

Skeletal Anatomy

Distal radius and ulna

The distal articular surfaces of the radius and ulna form the pedestal of support for the carpus and the distal locus of rotation during pronation and supination of the forearm. The radius has a series of concavities in its distal articular surface, known as fossae, for support of the scaphoid and lunate. The rim of the radius serves as the site of origin of the extrinsic radiocarpal and radioulnar ligaments (TFCC). The ulnar margin of the radius is concave, with a variable-radius curvature that forms the sigmoid notch for articulation with the distal head of the ulna. This articulation forms the skeletal basis for the DRUJ. The DRUJ is stabilized by the concavity of the sigmoid notch, the dorsal and volar radioulnar ligaments forming the TFCC, the joint capsule, and the distal aspect of the interosseous membrane (Fig. 1).

Carpal bones

There are 8 carpal bones, the scaphoid, lunate, triquetrum, pisiform, hamate, capitate, trapezoid, and trapezium. The pisiform is the only carpal bone that does not contribute to articular motion

The author has nothing to disclose.

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Hand Clin 30 (2014) 435–444
http://dx.doi.org/10.1016/j.hcl.2014.07.003

Fig. 1. Cadaveric dissection of the DRUJ stabilizers, the dorsal and volar limbs of the TFCC inserting at the ulnar fovea, and the dorsal capsular attachment of the TFCC. (*Courtesy of* A. Gupta, MD, Louisville, KY.)

of the wrist. It lies palmar to the triquetrum and forms a distal pulley beneath the flexor carpi ulnaris tendon. Each of the 7 articulating carpal bones is connected by a series of intrinsic interosseous ligaments. The bones are contained in 2 rows, a proximal and a distal row. The proximal row (scaphoid, lunate, and triquetrum) articulates with the radius, and indirectly with the distal ulna through the gliding surface of the TFCC central disc. The distal row (hamate, capitate, trapezoid, and trapezium) articulates with the proximal cartilaginous surfaces of the metacarpals. The proximal and distal rows articulate with one another via very complex articular surfaces that contribute significantly to motion of the wrist in both the flexion–extension and the radial–ulnar arcs.

Ligamentous Anatomy

Intrinsic ligaments

Each of the carpal bones has an intrinsic ligamentous connection to the adjacent carpal bones via intrinsic ligaments. The crucial intrinsic ligaments with respect to support and stability are the scapholunate (SLIL) and lunotriquetral interosseous ligaments. The scapholunate (SL) ligament is divided into dorsal, membranous (proximal), and volar segments. The dorsal segment is the primary stabilizer of the SL joint during motion and loading. Disruption of the SLIL may lead to rotational instability of the SL joint, midcarpal joint adaptive instability (dorsal intercalary segment instability), and secondary arthrosis of the radiocarpal and intercarpal joints, (SL advanced collapse). Surgical repair or reconstruction of injuries to the dorsal SLIL is the primary focus of exposure used in treating SL dissociation.

The lunotriquetral interosseous ligament is a shorter and less robust ligament than the SLIL. It has less distinct dorsal, proximal, and volar segments. Treatment of lunotriquetral interosseous ligaments injuries can be direct, via dorsal wrist exposures, or indirect, via the ulnocarpal ligaments affected by altering radioulnar variance.

Extrinsic ligaments

The extrinsic radiocarpal and ulnocarpal ligaments play an important role in maintaining carpal alignment and stability during wrist motion. The volar radiocarpal ligaments—the radioscaphoid, radioscaphocapitate, long radiolunate, and short radiolunate ligaments—and the volar ulnocarpal ligaments—the ulnocapitate, ulnolunate, and ulnotriquetral ligaments—form a strong, V-shaped sling that maintains radiocarpal alignment during motion and loading of the wrist (Fig. 2). These ligaments originate on the volar rim of the radius and ulna, an important end-terminus to any volar exposure of the wrist that must be maintained if radiocarpal stability is to be preserved. The radioscaphoid and radioscaphocapitate ligaments provide a radial tether to the carpus, preventing ulnar shift during weight-bearing and load. They originate from the volar surface of the styloid of the radius and insert on the distal scaphoid and capitate, respectively. The radioscaphocapitate ligament, in particular, acts as a fulcrum for the palmar-dorsal rotation of the scaphoid that occurs with radial and ulnar deviation. This can be a strong deforming force, contributing to flexion

Fig. 2. Cadaveric dissection illustrating the volar extrinsic ligaments of the wrist. The inverted V configuration of the radiocarpal and ulnocarpal ligaments as shown provides a strong ligamentous sling for the carpus, preventing dorsovolar subluxation. (*Courtesy of* A. Gupta, MD, Louisville, KY.)