FUNCTION OF THE DISTAL RADIO-ULNAR AND ULNO-CARPAL WRIST LIGAMENTS: AN IN-VITRO BIOMECHANICAL STUDY

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INTRODUCTION: The distal radio-ulnar joint allows supination and pronation of the hand around a nearly fixed ulna. In order to maintain stability, Ekerenstam (1) stated that the dorsal and palmar radio-ulnar ligaments become tight during supination and lax during pronation. Alternatively, Acosta (2) and others (3,4) describe the opposite. Since the goal of surgical repair of radius or ulna styloid fractures is to restore stability along with normal motion to the joint, the biomechanical function of these structures must be well understood. The goal of this study therefore was to directly measure the tension in these ligaments in an intact cadaveric model of the upper extremity in supination, neutral and pronated positions, in order to define the ligamentous structures most important in limiting hand supination-pronation range of motion.

METHOD: Specimen preparation: After radiographic screening for pathology, each of 8 intact fresh cadaveric upper extremities was dissected to reveal the volar distal radioulnar (VDRU) volar ulno-lunate (VULL) volar ulno-triquetral (VUTL) ulno-carpal-collateral (UCCL) including the sheath of the extensor carpi ulnaris, the dorsal ulno-carpal (DUCCL), and the dorsal distal radio-ulnar ligament (DUDR). Fig 1. The flexor tendons of the hand were cut and reflected distally to allow access to the ligaments but none of the joints was divided. A k wire was passed medial to lateral through the metacarpals to attachment to a loading frame.

Ligament tension measurements: A device described previously (5) was used. The device consists of a loading frame, with the elbow at 90 o of flexion, and the metacarpals facing downwards with the radiocarpal joint in neutral position for each ligament of a specimen. A repeated measures ANOVA with Fisher’s PLSD was used to test for significant differences.

RESULTS: All ligaments tested had some pretension in neutral position. Pronation: The DUDR, Fig 2, had significantly greater tension than either the VUTR or the VDRU. Its tension in maximum pronation increased by 2.1 times that measured in neutral position (sd = 0.73). The other ligaments showed numerical increases in tension ratio compared to neutral but were not significantly greater than the VUTR or the VDRU. Supination: In contrast, Fig 3, four ligaments, the UCCL (at 2.62 times neutral tension), the VUTR (2.63 times), the VULL (3.12 times), and the VDRU (2.61 times) all had significantly greater tension ratios than the DUDR.

CONCLUSIONS: In pronation, the dorsal ulno-collateral (DUDR) is the most tensioned structure resisting further motion of the hand about the forearm. In supination, a number of volar structures show significantly increased tensions. The structure showing the least change in resisting both supination and pronation is the dorsal part of the distal radio-ulnar joint, possibly because it lies on the axis of rotation of the forearm.


Fig 1, left dorsal and right palmar views of the wrist showing the ligaments tested in this study. (adapted from Netter FH, CIBA Collection of Medical Illustrations, Vol 8, Musculoskeletal System, part 1, 1987)