SCIENTIFIC ARTICLE

# The Biomechanical Stability of Salvage Procedures for Distal Radioulnar Joint Arthritis

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**Purpose** To test distal forearm stability after 3 surgical procedures for distal radioulnar joint (DRUJ) arthritis.

**Methods** We tested 11 cadaver limbs with the DRUJ intact, after distal ulna–matched hemiresection, after Darrach distal ulna resection, and after unlinked total DRUJ arthroplasty. We evaluated distal forearm stability in neutral rotation, full pronation, and full supination in unweighted and 1-kg–weighted conditions. We measured dorsal/palmar translation and convergence/divergence of the distal radius relative to the ulna.

**Results** Under neutral rotation, whether weighted or unweighted, matched hemiresection and Darrach specimens demonstrated significant radioulnar convergence relative to intact specimens. Weighted and unweighted, DRUJ arthroplasty demonstrated similar radioulnar convergence to intact. Weighted and unweighted, only Darrach specimens showed significant radius-palmar translation compared with intact, hemiresected, and DRUJ arthroplasty. In pronation, no testing scenario, either weighted or unweighted, demonstrated statistically significant radioulnar convergence relative to intact state. In unweighted pronation, palmar translation of the radius was significantly different from the intact state for all surgical scenarios and the Darrach was significantly worse than the other procedures. In weighted pronation, palmar translation of the radius was significantly different from the intact state for all surgical scenarios and the matched hemiresection was significantly better than the other procedures. In supination, weighted and unweighted, Darrach specimens had significant radioulnar convergence relative to intact. Either weighted or unweighted, the hemiresection and arthroplasty groups demonstrated similar radioulnar convergence relative to intact. Unweighted, all scenarios demonstrated similar dorsal translation of the radius. Weighted, the Darrach group showed significant radius-dorsal translation relative to intact specimens.

**Conclusions** For tested procedures, DRUJ arthroplasty overall was biomechanically superior to the other conditions except that we found greater stability in the hemiresected group in weighted pronation.

**Clinical relevance** Knowledge of baseline biomechanical characteristics of DRUJ arthritis procedures will aid surgical decision-making and patient counseling. *(J Hand Surg Am. 2014;39(7):1274–1279.* 

**Key words** Arthroplasty, Darrach, distal radioulnar joint, hemiresection, stability.

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Arthritis at the distal radioulnar joint (DRUJ) can be osteoarthritic, inflammatory, congenital, or post-traumatic in nature. Stiffness, loss of grip strength, and pain exacerbated by rotation of the forearm are typical.[1,2] When conservative measures with or without joint-sparing procedures fail, hand surgeons have several operations at their disposal including Darrach resection, hemiresection of the distal ulna, the Sauvé-Kapandji procedure, and arthroplasty, with many reported modifications of each technique. The potential for each operation to destabilize the DRUJ and general forearm mechanics must be considered, among other factors, when selecting one procedure over another.

In its intact state, the radioulnar joint with its proximal and distal components permits rotation of the forearm and augments positioning of the hand in space. The sigmoid notch in the distal radius has a notably greater radius of curvature than the distal ulna and provides little bony restraint for the DRUJ.[3] The joint is stabilized primarily by soft tissue, particularly the triangular fibrocartilage complex (TFCC), and motion is a combination of rotation and translation.[1,3,4]

All surgical procedures for DRUJ arthritis compromise the joint's tenuous bony constraint and supporting soft tissues. Surgery may disrupt normal load-bearing at the DRUJ and create pathological motion in the mediolateral and dorsal-palmar planes.[5–9] Several authors have used a cadaver model to test stability of the DRUJ in different positions after various surgical procedures.[10–13] However, these studies have not evaluated the postsurgical stability of the DRUJ subjected to simulated lifting with the hand. These studies have also not included an investigation of the relative stability of an unlinked total DRUJ arthroplasty. Our null hypothesis was that radioulnar convergence and dorsal-palmar translation would be unchanged between the intact, the hemiresected, the Darrach, and the unlinked total DRUJ testing scenarios.

## MATERIALS AND METHODS

We used 11 fresh frozen cadaver upper limbs. Each specimen was examined for signs of trauma; for functional stable range of motion of the elbow, forearm, and wrist; and for gross instability with manual palmar-dorsal stress test of the radius relative to the ulna. Each DRUJ was examined fluoroscopically to ensure the absence of traumatic deformities or arthrosis.

Small incisions were made in the cadaver forearms, permitting suture fixation of the biceps brachii and pronator teres tendons with size-0 Ethibond (Ethicon, Somerville, NJ) Krackow stitches. Native tendon insertions were left intact. Each wrist was transfixed in neutral flexion/extension and neutral radioulnar deviation with a 2.0-mm Kirschner wire to prevent wrist motion during testing. We ensured that the wire was sufficiently lateral to avoid interference with eventual placement of DRUJ implants. An additional 2.0-mm Kirschner wire was driven across the midshaft of the finger metacarpals to facilitate simulated lifting with the hand. All specimens were transected at the midhumerus and secured at the humerus and ulna with an external fixator. The external fixator held the cadaver elbows at 90° of flexion, facilitated incorporation of the limbs into the testing apparatus, and allowed for controlled motion of the forearm (Fig. 1).

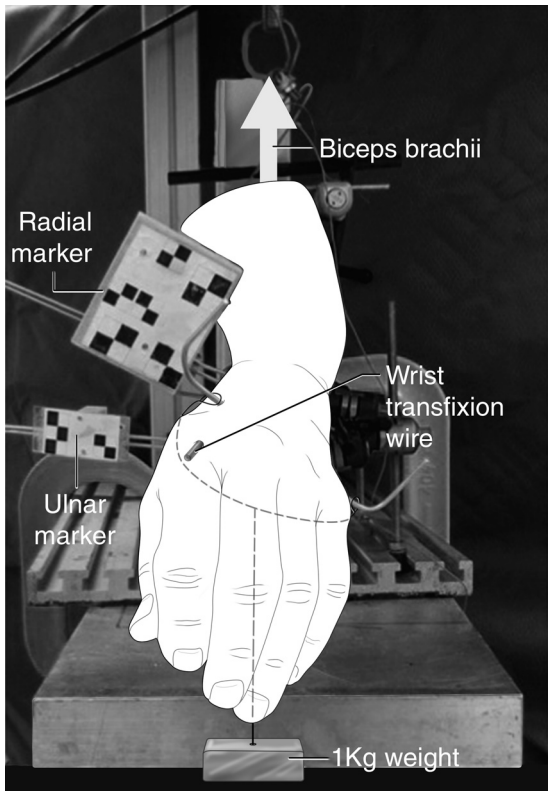


**FIGURE 1:** Testing apparatus. The external fixator held the cadaver elbows at 90° of flexion, facilitated incorporation of the limbs into the testing apparatus, and allowed for controlled motion of the forearm.

The testing apparatus was arranged in a servohydraulic load frame (MTS Systems Corporation, Eden Prairie, MN) with the distal biceps tendon insertion directly beneath the frame's vertical actuator. Suture in the distal biceps tendon was connected to the vertical actuator, facilitating controlled supination of each specimen. Sutures in the pronator teres tendon were run over a pulley, permitting attachment of a 1.8-kg weight sufficient to produce full pronation.