SCIENTIFIC ARTICLE

Relative Contribution of the Subsheath to Extensor Carpi Ulnaris Tendon Stability: Implications for Surgical Reconstruction and Rehabilitation

Andrew C. Ghatan, MD,* Sameer G. Puri, MD,* Kyle W. Morse, BS,* Krystle A. Hearns, MA,* Caroline von Althann, MS,* Michelle G. Carlson, MD*

Purpose To identify the varying contributions of the proximal and distal portions of the subsheath of the extensor carpi ulnaris (ECU) to its stability, evaluate the correlation of ulnar groove depth and ECU subluxation, and observe the effect of forearm and wrist positions on ECU stability.

Methods Extensor carpi ulnaris tendon position relative to the ulnar groove was measured in 10 human cadaveric specimens with the subsheath intact, partially sectioned (randomized to distal or proximal half), and fully sectioned. Measurements were obtained in 9 positions: forearm supinated, neutral, and pronated and wrist extended, neutral, and flexed. Ulnar groove depth was measured on all specimens.

Results In 7 of 10 specimens with an intact subsheath, the ECU tendon subluxated out of the groove in at least 1 forearm-wrist position. We noted the subluxation of the ECU tendon in all wrist-forearm positions with the exception of pronation-extension in at least 1 specimen. For partial subsheath sectioning, tendon displacement markedly increased after distal subsheath sectioning but not after proximal sectioning. For full subsheath sectioning, wrist flexion produced subluxation in all forearm positions, and forearm supination produced subluxation in all wrist positions. Maximum displacement occurred in supination-flexion. There was no correlation between ulnar groove depth and ECU subluxation.

Conclusions Mild tendon subluxation occurred in the intact specimens in most tested positions. Two positions were remarkable for their consistency in maintaining the tendon within the groove: pronation-neutral and pronation-extension. In fully sectioned specimens, the greatest subluxation occurred in supination-flexion, with supination and flexion independently producing subluxation. Partial sectioning demonstrated that the distal portion of the subsheath played a more important role than the proximal portion in stabilizing the ECU.

Clinical relevance Subsheath repair or reconstruction should target the distal portion of the subsheath. During postinjury rehabilitation or following surgical reconstruction, combined forearm supination and wrist flexion should be avoided. *(J Hand Surg Am. 2016;41(2):225–232. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Extensor carpi ulnaris, ECU, ligament, subsheath, wrist.

*From the *Hospital for Special Surgery, New York, NY.*

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Corresponding author: Michelle G. Carlson, MD, Hospital for Special Surgery, 523 East 72nd St., 4th Floor, New York, NY 10021; e-mail: carlsonm@hss.edu.

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Subluxation of the extensor carpi ulnaris (ECU) tendon can be a source of ulnar-sided wrist pain and loss of athletic performance. Athletes participating in racquet and stick sports are more commonly affected owing to the required wrist and forearm motions.[1] Forceful forearm supination, wrist flexion, and ulnar deviation have been implicated in cases of acute traumatic ECU subluxation.[2–7] Patients may be able to reproduce symptoms of a painful click or snapping sensation through supination and ulnar deviation against resistance, causing the tendon to sublux over the ulnar peak of the groove.[2,8]

A precise understanding of the anatomy of the ECU subsheath and its contribution to ECU tendon stability in the ulnar groove is relevant to surgical reconstruction and to rehabilitation following injury and ECU stabilization procedures. The sixth extensor compartment is unique because of the separate fibro-osseous subsheath through which the ECU courses. This subsheath plays an important role in restraining the ECU tendon within the groove, particularly on its ulnar border where the insertion of the subsheath acts as an ulnar labrum.[1,9]

Many approaches for the operative stabilization of an unstable ECU tendon have been described, and most have aimed to restore stability of the tendon by reconstructing or repairing the subsheath.[2,4,10] Other recommended approaches have included the creation of a retinacular sling[8] or deepening the ulnar groove.[4] Immobilization for the injured or surgically reconstructed subsheath is routinely recommended without agreement on the optimum position.

The purpose of this study was to identify the portion of the subsheath most responsible for stability of the ECU tendon, to evaluate the correlation of ECU groove depth and subluxation, and to identify the position of the wrist and forearm that most consistently maintained the ECU tendon within the ulnar groove.

MATERIALS AND METHODS

Ten fresh-frozen cadaveric upper limbs were dissected. There were 8 male and 2 female specimens (mean age, 58 years; range, 50–65 years). The skin was incised over the sixth dorsal compartment from the midshaft of the small finger metacarpal to the mid-forearm. Full-thickness flaps were elevated off the extensor retinaculum of the wrist. The extensor retinaculum was elevated and excised as a single layer starting at the ulnar side of the wrist approximately 2 mm dorsal to the tendon of the flexor carpi ulnaris (Fig. 1). The ECU subsheath was maintained and its length measured. This measurement was used to define the proximal and distal halves of the subsheath. A second longitudinal incision was made through skin in the proximal forearm at the musculotendinous junction of the ECU where it was divided and sutured with a running locking stitch. Two external fixation pins were placed in the ulnar shaft. The forearm was then mounted vertically using an external fixation apparatus assembled with a bar inserted vertically into a plastic baseboard. A hole drilled through the baseboard allowed a 2.7-kg weight suspended from the ECU tendon to hang below the apparatus. The radial peak of the ulnar groove was marked with a 1.6-mm Kirschner wire. The position of the ECU tendon was recorded using electronic calipers to measure the distance from the Kirschner wire marking the radial edge of the ulnar groove to the ulnar-most edge of the ECU tendon. The ulnar groove width was then subtracted from this distance to calculate ECU tendon subluxation (the distance between the ulnar edge of the groove and the ulnar-most edge of the tendon). This measurement was performed in 9 forearm-wrist position combinations: forearm supinated, neutral, and pronated and wrist extended, neutral, and flexed. The displacement relative to the neutral rotation and neutral flexion position was measured. Radial displacement was defined as negative, and ulnar subluxation was defined as positive. Neutral wrist position was defined as a neutral third metacarpal angle. Maximal passive flexion and extension were defined for each specimen and re-created for each measurement. Any specimen with obvious limitations of motion was discarded. A portable ultrasound device (Sonosite, Inc., Bothell, WA) was used to measure depth of the ulnar groove at its deepest point. The wrist was maintained in ulnar deviation owing to the unopposed pull of the loaded ECU tendon. This replicated a provocative position known to predispose to ECU tendon subluxation.[2–6] Baseline measurements were taken prior to subsheath division in all wrist positions. Specimens were randomly assigned to have the proximal or distal half of the subsheath divided first. The subsheath was divided longitudinally and centrally, parallel to its margin (Fig. 1). Measurements of tendon position were then repeated. Lastly, the remaining intact portion of the subsheath was divided, and the same measurements were repeated (Fig. 1).

Statistical analyses

Hierarchical mixed models were used to assess the effect of wrist and forearm position on tendon displacement outside the ulnar groove. Wrist position was defined as extension, neutral, or flexed. Forearm position was defined as pronation, neutral, or supination.