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Quantitative magnetic resonance imaging analysis of the cross-sectional areas of the anconeus epitrochlearis muscle, cubital tunnel, and ulnar nerve with the elbow in extension in patients with and without ulnar neuropathy

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Background: The purpose of this study was to assess the cross-sectional area of the anconeus epitrochlearis muscle (AEM), cubital tunnel, and ulnar nerve with the elbow in extension in patients with and without ulnar neuropathy.

Methods: We performed a retrospective, level IV review of elbow magnetic resonance imaging (MRI) studies. Elbow MRI studies of 32 patients with an AEM (26 men and 6 women, aged 18-60 years), 32 randomly selected patients without an AEM (aged 16-71 years), and 32 patients with clinical ulnar neuritis (22 men and 10 women, aged 24-76 years) were reviewed. We evaluated the ulnar nerve cross-sectional area proximal to, within, and distal to the cubital tunnel; AEM cross-sectional area; and cubital tunnel cross-sectional area.

Results: We found no significant difference in the nerve caliber between patients with and without an AEM. No correlation was found between the AEM cross-sectional area and ulnar nerve cross-sectional area within the cubital tunnel ($r = 0.14$). The mean cubital tunnel cross-sectional area was larger in patients with an AEM. Only 4 of the 32 patients with an AEM had findings of ulnar neuritis on MRI. Of the 32 patients with a clinical diagnosis of ulnar neuritis, only 2 had an AEM.

Conclusions: With the elbow in extension, the presence or cross-sectional area of an AEM does not correlate with the area of the ulnar nerve or cubital tunnel. Only a small number of individuals with MRI evidence of an AEM had clinical evidence of ulnar neuropathy. Likewise, MRI evidence of an AEM was found in only a small number of individuals with clinical evidence of ulnar neuropathy.

Level of evidence: Level IV; Case-Control Design; Diagnostic Study

Keywords: Anconeus epitrochlearis muscle; cubital tunnel; ulnar compression neuropathy; elbow; MRI; ulnar nerve; retrospective review

Institutional review board approval was obtained (IRB 15-0002X) with a waiver of informed consent, within the Icahn School of Medicine and the Mount Sinai Health System.

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Ulnar neuropathy is a condition that can arise from multiple etiologies such as inflammatory, infectious, neoplastic, and traumatic causes. It occurs most frequently at the cubital tunnel.[10] Suggested risk factors include regularly leaning on a hard surface,[12] recurrent elbow flexion, repetitive work,[9] prior

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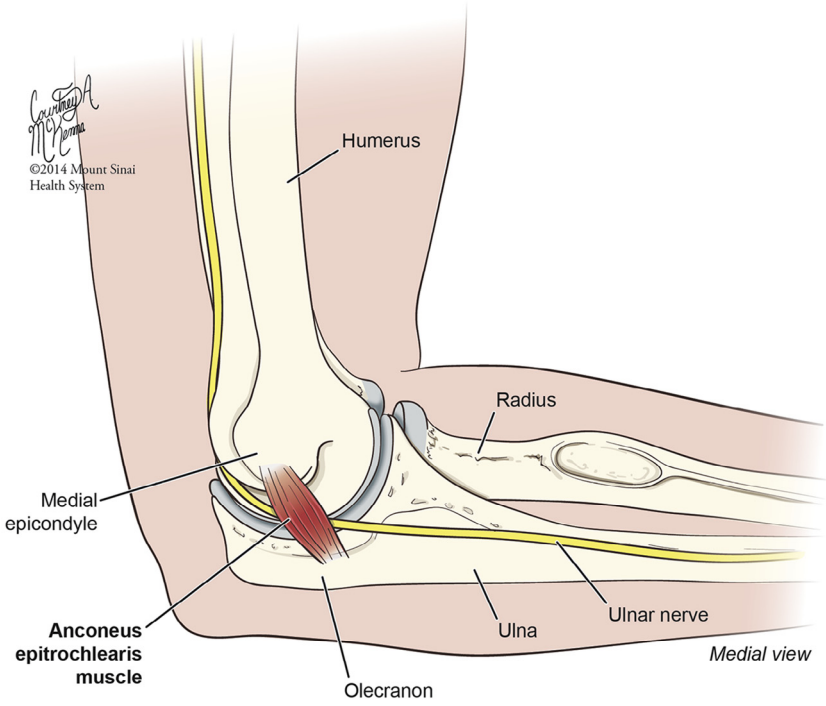

Figure 1 Diagram of anconeus epitrochlearis muscle crossing ulnar nerve in cubital tunnel of elbow.

trauma, systemic disorder, obesity, heavy work, smoking,[1] male sex, and old age.[19] The 2 most common mechanical reasons for ulnar neuropathy are (1) compression of the nerve within the cubital tunnel by space-occupying lesions or by prolonged elbow flexion with tethering of the nerve against the medial epicondyle and (2) transient anteromedial nerve subluxation from the cubital tunnel with repetitive friction injury of the nerve. On magnetic resonance imaging (MRI), ulnar neuropathy typically manifests as nerve thickening and/or increased T2-weighted signal within the nerve.[16]

The cubital tunnel is a fibro-osseous space that constrains the motion of the ulnar nerve. The olecranon, ulnar collateral ligament, and elbow joint capsule form the floor of the tunnel,[17] while the roof is formed by the cubital retinaculum or Osborne band proximally and by the deep layer of the flexor carpi ulnaris aponeurosis distally.[18] When the elbow flexes, the olecranon process moves forward, the space between the olecranon process and medial epicondyle increases, the cubital retinaculum becomes taut, and the cubital tunnel area decreases by up to 50%,[4] while the intraneural pressure increases by 45%.[11] In some patients, an additional muscle, the anconeus epitrochlearis muscle (AEM), is visualized at the location of the cubital retinaculum.

The AEM is an atypical accessory muscle in the human elbow that is commonly found in mammals, reptiles, and amphibians.[8] Several cases in the literature have suggested an association between this muscle and ulnar compression neuropathy.[7] The prevalence among humans has ranged from 4% to 34% in cadaveric studies.[2,13] The AEM courses from the medial olecranon to the medial humeral epicondyle in the cubital tunnel and intersects with the ulnar nerve posteriorly in the epicondylar groove[21] (Fig. 1). The morphology of this muscle varies, although it is usually ellipsoid or oval.[2] When present, the AEM is usually seen bilaterally.[15]

The AEM's function is unknown and is likely atavistic in nature.[6] It has been observed that the muscle contracts during elbow extension and therefore may function as part of the medial head of the triceps.[8,20] Given that the cubital tunnel area decreases with elbow flexion, several cases in the literature have reported that the AEM compresses the ulnar nerve.[15] Ulnar nerve compression can give rise to ulnar neuritis. On MRI, the ulnar nerve demonstrates focal T2 hyperintensity and/or thickening of the nerve at the cubital tunnel, as well as at a short segment proximal to the tunnel if ulnar neuritis is present.

Most of the literature on the AEM consists of clinical reports on cases of ulnar neuritis in the setting of the accessory muscle, suggesting that there may be an association between the 2 entities.[7] The purpose of this study was to assess the cross-sectional area of the AEM, cubital tunnel, and ulnar nerve with the elbow in extension in patients with and without ulnar neuropathy.

Materials and methods

We performed a retrospective, level IV review of elbow MRI studies within our institution. This study was compliant with Health Insurance Portability and Accountability Act guidelines. There was no overlap in subjects from prior publications.

We retrospectively reviewed 32 non-contrast elbow MRI studies of patients with an AEM seen from 2012 to 2014 at all our clinics through a report keyword search. There were 26 male and 6 female