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Original Article Özgün Araştırma

EVALUATION OF THE EFFECT OF THE ANCONEUS EPITROCHLEARIS MUSCLE ON THE ULNAR NERVE IN HEALTHY SUBJECTS WITH ELBOW MAGNETIC RESONANCE IMAGING

Sağlıklı Bireylerde Anconeus Epitrochlearis Kasının Ulnar Sinire Etkisinin Dirsek Manyetik Rezonans Görüntüleme ile Değerlendirilmesi

Esra ÇIVGIN[1] Muhammed Said BEŞLER[2]

[1] *Department of Radiology, Ankara Bilkent City Hospital, ANKARA, TÜRKİYE*
[2] *Department of Radiology, Kahramanmaraş Necip Fazıl City Hospital, KAHRAMANMARAŞ, TÜRKİYE*

ABSTRACT

Objective: To determine the effect of anconeus epitrochlearis muscle on the ulnar nerve area and signal intensity in patients without cubital tunnel syndrome by magnetic resonance imaging.

Material and Methods: The elbow magnetic resonance images between January 2020 and December 2022 were evaluated retrospectively. Twenty patients with anconeus epitrochlearis muscle who were clinically and electromyographically shown not to have cubital tunnel syndrome were included in the study. The control group consisted of 20 age, gender and side-matched elbow magnetic resonance images without bone, ligament, and tendon pathology. The ulnar nerve area and intensity, anconeus epitrochlearis muscle area were measured in the axial slice where the anconeus epitrochlearis muscle area was the largest and the findings were statistically compared with the control group.

Results: The mean age in the anconeus epitrochlearis muscle group was 42.1±14.1 years (20-68 years). No significant difference in ulnar nerve area between the groups with and without anconeus epitrochlearis muscle was observed (Anconeus epitrochlearis group:10.3±3.4 mm^2, control:9.4±2.7 mm^2 p=0.376). There was no correlation between the ulnar nerve area and the anconeus epitrochlearis muscle area (r=-0.026, p=0.912). No significant difference in ulnar nerve signal intensity between the two groups was noted (p=0.317).

Conclusion: The anconeus epitrochlearis muscle had not a significant effect on the ulnar nerve area and intensity.

Keywords: *Elbow, magnetic resonance imaging, muscles, ulnar nerve*

ÖZ

Amaç: Kubital tünel sendromu olmayan hastalarda anconeus epitrochlearis kasının ulnar sinir alanı ve sinyal yoğunluğuna etkisini manyetik rezonans görüntüleme ile belirlemek.

Gereç ve Yöntemler: Ocak 2020 ile Aralık 2022 tarihleri arasında dirsek manyetik rezonans görüntüleme yapılan hastalar retrospektif olarak değerlendirildi. Anconeus epitrochlearis kası olan, klinik ve elektromiyografi ile kubital tünel sendromu olmadığı gösterilen, 20 hasta çalışmaya dahil edildi. Yaş, cinsiyet ve taraf eşleştirmeli, kemik, bağ ve tendon patolojisi olmayan 20 dirsek manyetik rezonans görüntülemesi ile kontrol grubu oluşturuldu. Anconeus epitrochlearis kas alanının en geniş olduğu aksiyal kesitte ulnar sinir alanı ve intensitesi, anconeus epitrochlearis kas alanı ölçüldü ve bulgular istatistiksel olarak kontrol grubu ile karşılaştırıldı.

Bulgular: Anconeus epitrochlearis kas grubundaki hastaların yaş ortalaması 42.1±14.1 yıl (20-68 yıl) idi. Anconeus epitrochlearis kası olan ve olmayan grup arasında ulnar sinir alanı açısından istatistiksel olarak anlamlı fark saptanmadı (Anconeus epitrochlearis grubu:10.3±3.4 mm^2, kontrol:9.4±2.7 mm^2 p=0.376). Anconeus epitrochlearis kas alanı ile ulnar sinir alanı arasında korelasyon yoktu (r=-0.026, p=0.912). Ulnar sinir sinyal intensitesinde, iki grup karşılaştırıldığında anlamlı fark saptanmadı (p=0.317).

Sonuç: Anconeus epitrochlearis kasının ulnar sinir alanı ve intensitesi üzerinde etkisi yoktur.

Anahtar Kelimeler*: Dirsek, manyetik rezonans görüntüleme, kaslar, ulnar sinir*

Correspondence / Yazışma Adresi: **Dr. Esra ÇIVGIN**
Department of Radiology, Ankara Bilkent City Hospital, ANKARA, TÜRKİYE
Phone / Tel: +905053727860 **E-mail** / E-posta: esrayurduseven@gmail.com
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INTRODUCTION

Accessory muscles are additional separate muscles, present with the normal complement of muscles (1,2). The anconeus epitrochlearis (AE) is an anatomical variant muscle that was first described in 1867 by Gruber (3). Anconeus epitrochlearis muscle is atavistic in humans and presents as a result of failure in the timely regression of the AE muscle along the embryological period (4). Its prevalence ranged from 0% to 34% in humans (3,5). Anconeus epitrochlearis muscle is varied in shape, usually ellipsoid or oval (6). It extends from the inferior aspect of the humeral medial epicondyle to the ulnar olecranon process. The cubital tunnel retinaculum is theorized to be a remnant of the AE muscle (1).

There are studies in the literature that have searched for the association between AE muscle and cubital tunnel syndrome, also known as ulnar compression neuropathy (7-11). There is however no agreement about the effect of AE muscle on ulnar nerve compression in these studies.

The effect of the AE muscle on the ulnar nerve area (NA) and ulnar nerve signal intensity (NI) in patients without cubital tunnel syndrome is undetermined. We aimed to explore the effect of AE muscle on ulnar NA and NI in a population without cubital tunnel syndrome by magnetic resonance imaging (MRI).

MATERIALS AND METHODS

Institutional review board approval was obtained from Ankara Bilkent City Hospital Ethics Committee (E2-23-5043, Date 9.27.2023) prior to the study. Informed consent could not be provided from the patients, since this was a retrospective study. This study was conducted according to the tenets of the Declaration of Helsinki.

Study design

The elbow MRIs between January 2020 and December 2022 were retrospectively assessed. Exams of patients with an evident muscle injury, a preliminary diagnosis of ulnar neuritis, tumor or had history of previous surgery or placement of osteosynthesis, or had artifacts in MRI images that made evaluation impossible were excluded. Twenty patients with AE muscle who were clinically and electromyographically shown not to have cubital tunnel syndrome were included in the study. A control group was made up of the same number (n=20) of elbow MRIs without bone, ligament, and tendon pathology and matched to the AE muscle group in terms of side, gender, and age.

MRI protocol

Magnetic resonance imaging scans were obtained in the extension position with a 1.5 Tesla MRI (Signa Explorer, GE Healthcare Systems) equipped with a 16–channel flexible coil. Table 1 shows the standard elbow MRI protocol and sequence parameters at our institution. No contrast material was used in MRI examinations.

Table 1: Standardized elbow MRI protocol in our institution

Pulse sequence	TR/TE (ms)	Matrix	Field of view (cm)	Slice thickness (mm)
Sagittal T1-weighted FSE	313/7.6	256x256	20x20	3
Sagittal FS PD weighted FSE	1454/69.5	256x256	20x20	3
Coronal T1-weighted FSE	420/13.8	288x288	28x28	3
Coronal FS T2-weighted FSE	6896/42	288x288	28x28	3
Axial T1-weighted FSE	548/10.7	224x224	20x20	2
Axial FS T2-weighted FSE	6338/68	224x224	20x20	2

FSE: Fast spin echo, FS: Fat-suppressed, PD: Proton-density, TR: Repetition time, TE: Echo time, ms: Millisecond, cm: Centimeter, mm: Millimeter

Analysis of MRI images

All MRI’s were assessed by a single observer with 12 years’ experience in musculoskeletal radiology made the measurements using electronic calipers. The accessory muscle originating from the inferior region of the medial epicondyle, passing through the cubital tunnel and inserting to the olecranon was accepted as the AE muscle. There was no signal difference in the AE muscle compared to other muscles in the elbow MRI examinations included in the study. Ulnar NA, and AE muscle area (MA) measurements were taken on an axial T1-weighted fast spin-echo image using an electronic caliper covering the outermost border of the measured anatomical structure (Figure 1). Ulnar NI was measured at the level of the cubital tunnel, where the area of the AE muscle was widest, with a region of interest of 3 mm^2, on axial fat-suppressed T2-weighted fast spin-echo image (Figure 2). The second measurements were conducted by the same observer three months after the initial measurements.

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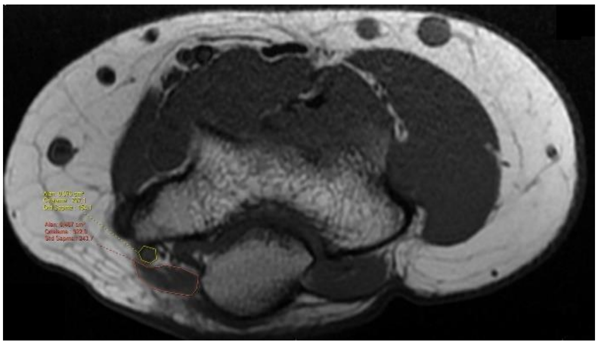

Figure 1: Axial T1-weighted fast spin-echo image showing the measurement of the ulnar nerve area anteriorly (small hexagon) and the area of the anconeus epitrochlearis muscle posteriorly (large ellipse).

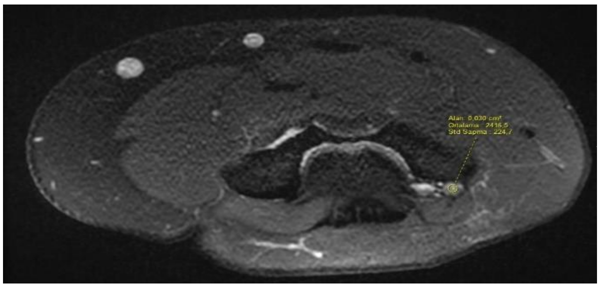

Figure 2: Measurement of ulnar nerve intensity (small ellipse) on axial fat-suppressed T2-weighted fast spin echo image at the level of the cubital tunnel where the area of the anconeus epitrochlearis muscle is the widest.

Statistical analysis

SPSS vs. 22.0 (IBM) was used for statistical analyses. The normality of continuous data was determined with the Kolmogorov–Smirnov test. The Student's t test and Mann-Whitney-U test were used for the analysis of the differences in numerical data. Spearman’s correlation test was performed for correlation analyses. Intra-observer reliability for measurements of the ulnar NA, ulnar NI, and AE MA was assessed using the intraclass correlation coefficient (ICC).

RESULTS

The AE muscle group consisted of 19 patients (10 females and 9 males [6 left, and 14 right elbow MRIs]). One female patient had a bilateral elbow MRI with AE muscle. The control group was formed of 20 elbow MRIs (11 females and 9 males), 6 of them were left, and 14 of them were right elbow. The patients' mean age was 42.1±14.1 years (20-68 years) in the AE muscle group and 41.8±12.7 years (22-67 years) in the control group (p=0.953).

No significant difference in ulnar NA between patients with and without AE muscle was shown (AE:10.3±3.4 mm^2, control:9.4±2.7 mm^2 p=0.376) (Table 2).

Table 2: Ulnar nerve area and signal intensity of anconeus epitrochlearis muscle and control group

	Anconeus epitrochlearis	Control	p
Mean ulnar nerve area (mm^2)	10.3±3.4	9.4±2.7	0.376
Median ulnar nerve intensity [IQR]	1788 [1509-2311.5]	1697 [1129-1895.5]	0.317

IQR: Interquartile range

The median AE MA was 40.2 mm^2 [IQR:28.5-52.5] and there was no significant correlation between the AE MA and ulnar NA (r=-0.026, p=0.912). Ulnar NI was slightly higher in the AE muscle group than the control group (1788 [IQR:1509-2311.5] versus 1697 [IQR:1129-1895.5]), but not statistically significant (p=0.317). Intra-observer reliability was excellent for the ulnar NA (ICC, 0.948; 95% CI:0.904-0.972, p<0.001), ulnar NI (ICC, 0.990; 95% CI:0.981-0.995, p<0.001), and AE MA (ICC, 0.966; 95% CI:0.916-0.986, p<0.001).

DISCUSSION

Magnetic resonance imaging allows high-resolution, multi-planar evaluation of soft tissues in a single examination, does not use ionizing radiation, provides detailed anatomical information, and is one of the first imaging modalities utilized to investigate the presence of AE muscle.

Although there are many studies reporting that AE muscle is related to cubital tunnel syndrome because it compresses the ulnar nerve along its course in the cubital tunnel (8,12-14). There are also publications reporting that AE is found incidentally and is not associated with cubital tunnel syndrome in most cases (15). Furthermore, AE muscle may even be protective against cubital tunnel syndrome development through the mechanism of reducing the stiffness of the cubital tunnel entrance (10,16).

High muscle volume can be a cause of cubital tunnel syndrome in people with AE muscle (2,5). Many studies included in the literature are about patients with cubital tunnel syndrome and there is limited information upon patients without ulnar neuritis.

The current study found that the AE muscle had no effect on the ulnar NA or NI. Eng et al. reported no significant difference (p=0.23) in ulnar NA between patients with and without AE muscle (15). There was no significant correlation between AE MA and ulnar NA (r=0.14; p=0.44) and larger AE MA was not associated with increased ulnar NA which is a secondary sign of ulnar nerve compression (15). In the present study, as the AE MA increases ulnar NA decreases, however, there was no statistically significant correlation (r=-0.026, p=0.912). The fact that the correlation was not statistically significant may be attributed to the limited number of the study population.

Fluid-sensitive MRI sequences are valuable in evaluating the ulnar nerve signal. Ulnar nerves can have increased signal intensity in 60% of fluid-sensitive MRI images of asymptomatic subjects, 23% of whom had AE muscle (17). Elderly patients had significantly increased ulnar NI than younger patients (p=0.03), but the underlying reason had not been discussed (17). The current study showed an increase in ulnar NI in the AE muscle group compared to the control group even if this was not statistically significant (1788 [IQR:1509-2311.5] versus 1697 [IQR:1129-1895.5], p=0.317). This finding supports Husaric et al., but we could not evaluate the impact of age on ulnar NI, since we did not categorize them into age groups (17).

Ulnar NI may differ with elbow movements, NI can increase during flexion in normal elbows depending on the nerve movement degree during flexion. The anconeus epitrochlearis muscle may restrict ulnar nerve movement during elbow flexion (16). Since our study was not dynamic, we could not assess the impact of elbow joint movements on ulnar NA and NI. Large clinical prospective studies are required to correlate MRI images taken in extension and flexion positions of these patients with clinical findings.

Limitations of our study are the dominant hand information of the patients was unknown, and the elbow MRIs were taken only in the extension position.

In conclusion, this study presents that AE muscle had not a significant effect on the ulnar nerve area and intensity.

Researchers' Contribution Rate Statement: Concept/Design: EÇ; Analysis/Interpretation: EÇ, MSB; Data Collection: EÇ; Writer: EÇ; Critical Review: EÇ, MSB; Approver: EÇ, MSB.

Conflict of Interest: The authors declared that there is no conflict of interest.

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Ethics Committee Approval: The study protocol was approved by the Ankara Bilkent City Hospital Clinical Research Ethics Committee (Date: 9.27.2023, Number: E2-23-5043).

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