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The prevalence of the anconeus epitrochlearis muscle in a Central European population

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Abstract

Background: An anconeus epitrochlearis muscle (AE) is a common anatomical variant in the upper extremity, located at the medial aspect of the elbow. Its anatomical position contributes to the roof of the cubital tunnel. While it plays a role in protecting the ulnar nerve, it may also pose a risk for ulnar nerve compression. This study aimed to determine the true prevalence of AE in a Central European population.

Materials and methods: The presence of AE was evaluated in 115 cadaveric upper extremities from an undetermined number of subjects. The limbs for dissection were assumed to be healthy, and AE identification involved anatomical description and measurements. Data analysis aimed to determine the true prevalence, considering 95% confidence intervals (CI).

Results: AE was present in 5 of the 115 cadaveric limbs (4.3%). Specimens lacking AE were observed, depicting normal cubital tunnel roof anatomy. When present, AE replaced the proximal part of the cubital tunnel roof, superficially coursing to the ulnar nerve. Morphological variations were noted.

Conclusions: The true prevalence of AE was 4.3% (95% CI = 0.2–8.4%), consistent with recent cadaveric studies. Historical reports indicate varying true prevalence up to 26%, possibly linked to manual labour changes. AE's association with cubital tunnel syndrome is complex, with both protective and potentially compressive roles.

Keywords: anconeus epitrochlearis prevalence, cadaveric study, cubital tunnel syndrome, ulnar nerve entrapment

INTRODUCTION

An anconeus epitrochlearis muscle (AE) is a frequently encountered anatomical variation in the upper extremity [7]. It is a small, triangular or quadrangular accessory muscle located at the medial aspect of the elbow [16]. AE originates from the medial epicondyle of the humerus and inserts at the olecranon of the ulna, contributing to the proximal structure of the roof over the cubital tunnel [19, 28]. This muscle plays a role in protecting the ulnar nerve as it travels through the cubital tunnel of the elbow and helps prevent subluxation of the ulnar nerve, but it can also be viewed as a potential cause of ulnar nerve compression [27, 36]. Some have considered the AE to be an independent muscle at times, and at other times, an extension of the medial head of the triceps muscle [16, 40]. However, it is always innervated by the ulnar nerve [7, 15–17]. AE is also referred to as the accessory anconeus muscle or epitrochleoanconeus muscle or anconeus sextus [11], and should not be confused with the anconeus muscle, which is present at the lateral aspect of the elbow [40].

In animals, including certain primates, the AE may exhibit variations in its presence or size [11, 16, 28]. AE is usually absent in hominoids except chimpanzees [9]. It is consistently present in early human ontogeny as a distinct muscle and is derived from the primordium that also gives rise to the flexor carpi ulnaris [8]. The presence of AE is observable in human embryos of sizes between 25–33.5 mm, suggesting its existence until the latter stages of embryonic development. AE serves as an illustration of an atavistic muscle found in the initial stages of human development but becomes lost as development progresses [8]. AE remnant potentially being represented by the fibrous band with the same attachments and fibres run in the same course [7, 30].

The aim of this study was to determine the true prevalence of the AE in a sample of 115 cadaveric upper limbs from a Central European population.

MATERIALS AND METHODS

We evaluated the presence of the AE in 115 cadaveric upper extremities (57 right and 58 left) from an undetermined number of subjects. Out of the total limbs, 67 were formalin-embalmed and 48 were fresh or fresh frozen. The dissection of anonymized specimens of the upper limbs from our anatomical repository was conducted at the Institute of Anatomy, Faculty of Medicine, University of Ljubljana. There is no requirement for ethics committee approval for such a cadaveric study at our institution. Subjects in these cadaveric studies were assumed to be healthy. The limbs underwent dissection to reveal the AE, identified by its anatomical description and its location near the medial aspect of the elbow. The presence or absence of the muscle was recorded for each limb. The width and thickness of the identified AE muscles were also measured.

The gathered data was analysed to determine the prevalence of the muscle within the sample. The primary objective of this study was to ascertain the true prevalence of the AE, defined as the number of limbs with AE compared to the total number of limbs [38]. Additionally, a 95% confidence interval (CI) was calculated. The crude prevalence of AE cannot be calculated because of an undetermined number of subjects in this study. Crude prevalence is defined as the number of subjects with AE unilaterally or bilaterally compared to the total number of subjects [38].

RESULTS

In the sample, AE was present in 5 out of the 115 cadaveric upper limbs (4.3%), with two found on the right limbs and three found on the left limbs. The muscle was absent in 110 of the 115 limbs (95.7%). Therefore, the true prevalence of AE is 4.3%, with a calculated 95% confidence interval of 0.2% to 8.4%. Figure 1A displays a specimen lacking the AE muscle and also illustrates the normal anatomy of the roof of the cubital tunnel. When AE was present, it replaced the proximal part of the roof over the cubital tunnel (Figure 1B, 1C). AE originates from the medial epicondyle of the humerus and courses superficially to the ulnar nerve before inserting onto the medial olecranon of the ulna (Figure 1B). In one of the five cases, AE partially inserts on the olecranon and partially on the end of the medial head of the triceps brachii muscle (Figure 1C). The AE muscles were generally flat, with an irregular quadrangular shape, measuring 7–12 mm wide and 2–4 mm thick. However, in one case, the AE was notably wider (20 mm) and thicker (6 mm) without signs of ulnar nerve compression.

DISCUSSION

Dr. W. Gruber from St. Petersburg first described the muscle originating from the medial epicondyle of the humerus (Epitrochlea), coursing over the ulnar nerve, and inserting onto the olecranon (Ancon) in his original German article in 1866 [16]. He named the muscle “Musculus epitrochleo–anconeus” based on its location, origin, and insertion [16, 17]. Gruber examined 100 cadavers (200 limbs) and discovered the muscle in 34 cadavers (15 unilateral and 19 bilateral), which amounts to 53 limbs. Therefore, Gruber found the muscle in roughly one-third of the cadavers (34%), or in every fourth limb (with a true prevalence of 26.5%). A high true prevalence of the AE in cadaveric studies was also reported in the 19th century by Macalister from Dublin (1875) at 25.4%, by Testut from Paris (1884) at 25.8%, and Le Double from Paris (1897) at 25.7% [28, 29, 39]. The only exception from the aforementioned studies was Wood’s three studies conducted between 1866 and 1868 in London, showing a much lower true prevalence of AE at 3.9% when all his data are combined [42–44]. Wood concluded, based on the comparison between his statistics and those of Gruber, that the AE is more common in Slavonic population than in Anglo-Saxon population [44]. In the 20th century, Mumenthaler, Campbell, and O'Driscoll, as well as Green reported a moderate-to-high true prevalence of the AE in cadaveric studies, ranging from 10.5% to 22% [5, 14, 33, 35]. However, in cadaveric studies conducted in different parts of the world in the 21st century (from 2000 to 2021), the reported true prevalence has been much lower, ranging from 0% to 9% [3, 13, 15, 20, 23, 25, 32, 38]. The relatively low true prevalence of 4.3% (95% CI = 0.2–8.4%) in the present study is consistent with these recent findings.

The observation that the true prevalence of AE in cadaveric studies has decreased in the 20th century and last decades could potentially be linked to a decrease in manual labour. Although evolution cannot occur so rapidly, the muscle may be less pronounced and therefore overlooked in analyses. Indeed, Gruber, Testut, and Mumenthaler reported that the muscle is often very thin, consisting primarily of connective tissue interspersed with a few muscle fibers [16, 33, 39].

It's important to note that the prevalence of the AE can vary widely across different populations and regions worldwide [27, 38]. These differences may arise from genetic and environmental factors, as well as variations in the methods used to identify the muscle in each study. Recent imaging-based studies mostly indicate a higher prevalence of AE compared to the findings from cadaveric studies conducted during the same period. Husarik et al. from Zürich reported a high true prevalence of AE in healthy volunteers' elbows using magnetic resonance imaging (MRI), measured at 23% [21]. Subsequent MRI studies in healthy adults by Kawahara et al. from Nagasaki and Nascimento and Ruiz from Sao Paulo reported moderate true prevalence rates, measuring 11% and 13%, respectively [26, 34]. Duran et al. from Ankara found a slightly lower prevalence of the AE in an MRI study, estimating it at approximately 8% [10]. In Schertz et al.'s study from Paris on ulnar neuropathy using high-resolution ultrasound, the AE was identified in 16% (23 out of 145) of healthy control elbows [37].

Cubital tunnel syndrome (CuTS) caused by compression on the ulnar nerve is the second most common compression neuropathy in the upper extremity, after carpal tunnel syndrome [2, 20, 31, 36]. Several studies have investigated the association between the AE and ulnar nerve entrapment [12, 27, 30, 36]. In a study by Yoon et al., the AE was identified as a cause of ulnar nerve entrapment in 34 out of 326 patients (10.4%) who were subjected to surgery because of CuTS [46]. Park et al. (2018) reported that the AE was present in 12 out of 142 patients who underwent surgery for CuTS (8.5%). The presence of AE was more common in patients who were younger and had involvement of their dominant hand. However, all patients showed improvement after the surgery [36]. Other smaller studies and case reports have reported similar findings, suggesting that the presence of the AE may contribute to the development of ulnar nerve compression [1, 4, 6, 12, 18, 19, 24, 30, 45]. However, it is important to note that the presence of the AE is not always associated with ulnar nerve entrapment. In fact, many individuals with the muscle are asymptomatic [21]. Wilson et al. hypothesized that a normal AE may provide a protective role against the development of cubital tunnel syndrome [41]. The authors suggested that the more forgiving muscular structure of the AE may serve as a replacement for the more rigid fibrous roof of the cubital tunnel (Osborne’s ligament), thereby reducing the risk of cubital tunnel syndrome. However, if an AE is secondary hypertrophic (such as in weightlifters), it may contribute to ulnar nerve entrapment [19, 41]. Additionally, not all cases of ulnar nerve entrapment involve the AE, as there are several other potential compression sites along the nerve’s path [2]. The impact of AE on the development of cubital tunnel syndrome is an area of ongoing research.

CONCLUSIONS

In conclusion, this study contributes to the existing knowledge regarding the prevalence of AE within a Central European population. Given its propensity to compress the ulnar nerve while traversing the cubital tunnel, the AE has been associated with ulnar nerve entrapment. Further research is essential to comprehensively comprehend the influence of this muscle on the onset of cubital tunnel syndrome and ascertain the actual prevalence of AE in various global regions.

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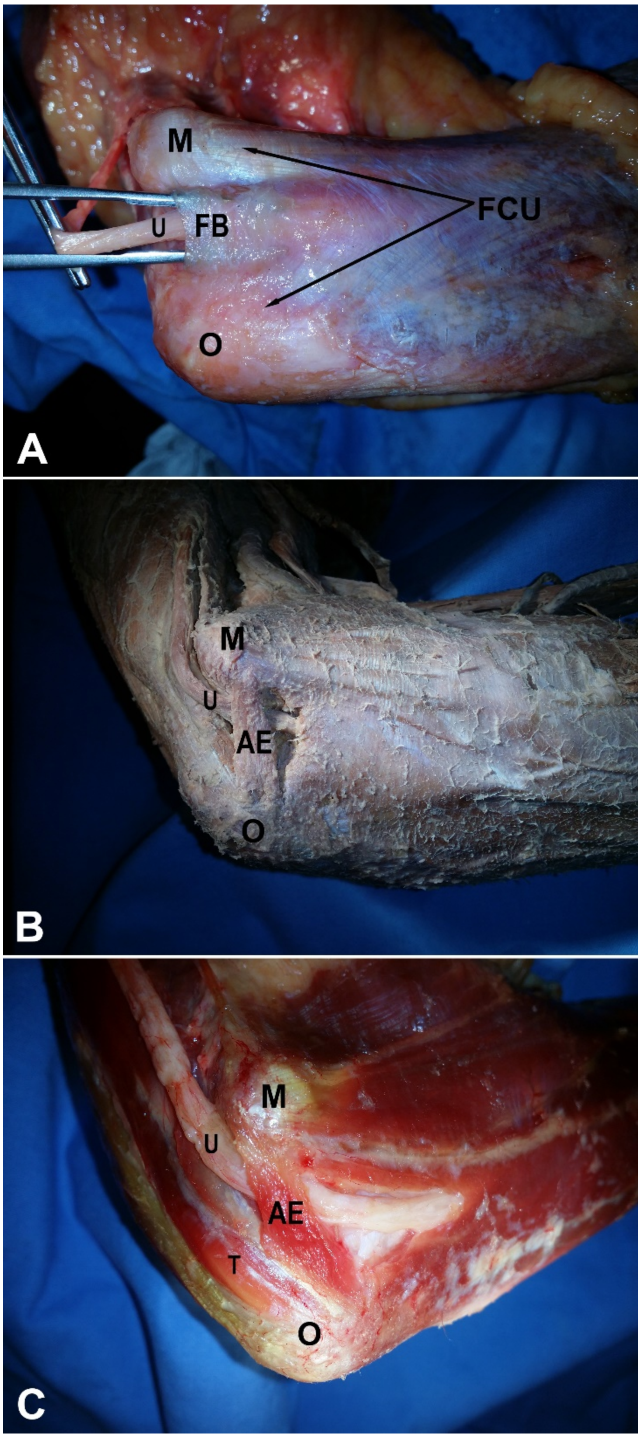

Figure 1. Cadaveric left elbow in a flexed position, medial view; A. An anconeus epitrochlearis muscle is absent. The normal anatomy of the roof of the cubital tunnel is shown. Its proximal part is a thin fibrous band (FB) connecting the medial epicondyle of the humerus (M) and the olecranon (O). The distal part consists of a V-shaped connective tissue between the two heads of the flexor carpi ulnaris (FCU); U – ulnar nerve; B. The anconeus

epitrochlearis muscle (AE) is present and isolated in a formalin-embalmed specimen; C. The AE is present and isolated in a fresh specimen. The removal of the connective tissue between the two heads of the FCU reveals the ulnar nerve; T – medial head of the triceps.