# Velocity Drop in Anconeus Epitrochlearis–Associated Cubital Tunnel Syndrome

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## Abstract

The anconeus epitrochlearis (AE) muscle is a common anatomical variation in the cubital tunnel retinaculum of the elbow with an incidence of up to 28%; it is one cause of compressive ulnar neuropathy.

In this study, we report the significance of preoperative recognition of AE-associated cubital tunnel syndrome, based on the grade of velocity drop of the compressed ulnar nerve in electrophysiological studies. Twenty-two cases with idiopathic cubital tunnel compression (CTC) were retrospectively analyzed; AE was present in 6 cases. Velocity drop of the ulnar nerve was calculated by dividing the difference in velocity (m/s) by distance (cm); the results were classified into the following grades: + (0-2.99 m/s per cm) and ++ (> 3.00 m/s per cm). Categorical data were compared using Fisher's exact test; the Mann-Whitney U test was used to determine statistical significance of ordinal data. In patients with AE-associated CTC, 3 of the 6 (50%) cases had grade ++ velocity drop. In comparison, only 1 patient of the 16 non-AE cases (6%) had grade ++ velocity drop ($P = .046$).

Preoperative nerve velocity conduction studies that show grade ++ velocity drop (> 3.00 m/s per cm) in ulnar nerve are highly suggestive of the presence of AE.


A common site of ulnar nerve compression is at the level of the cubital tunnel. Cubital tunnel compression (CTC) is the second most common compressive peripheral neuropathy of the upper extremity.[1] Anatomically, the roof of the cubital tunnel is formed by a retinaculum that spans the medial epicondyle of the humerus and the tip of the olecranon. The retinaculum becomes taut during elbow flexion and lax at extension. O'Driscoll[2] classified the retinaculum into 4 categories—Type 0: no retinaculum present; Type Ia: presence of a thin retinaculum, which becomes taut in full flexion but does not compress the ulnar nerve; Type Ib: retinaculum is pathologically thick and becomes taut between 90° to 120° flexion; Type II: retinaculum is replaced by an anconeus epitrochlearis (AE) muscle.

The AE muscle is a common anatomical variation in the cubital tunnel retinaculum of the elbow with an incidence of 28% or less.[2,3] While some investigators consider the AE to be part of the triceps and to contribute to elbow extension,[2,4,5] others consider the AE to be atavistic.[3] The presence of this muscle can be associated with compressive ulnar neuropathy.[6,7] The mechanical compression of the ulnar nerve against the belly of the muscle in the cubital tunnel is a possible mechanism of compressive ulnar neuropathy.[6] In comparison with idiopathic CTC, patients with AE-associated CTC may have different characteristics (eg, younger age, male gender) and a more rapid disease progression.[8]

We report on our study of AE-associated cubital tunnel disease preoperatively, based on the grade of velocity drop of the compressed ulnar nerve in electrophysiological studies. The null hypothesis is that AE-associated and idiopathic CTC have the same velocity drop.

## Materials and Methods

The study was approved by the institutional review board at our hospital. Billing records were used to identify patients with cubital tunnel release that Dr. Mudgal treated at a single institution between 2005 and 2011. The 3 authors retrospectively analyzed the charts and reviewed a total of 44 patients. The inclusion criteria were idiopathic or AE-associated CTC and complete preoperative electromyographic (EMG) evaluation. Cases of CTC with obvious underlying pathology, such as osteoarthritis, fracture, lupus, and cervical radiculopathy, were excluded. Twenty-two patients with a mean age of 51 years (range, 23 to 67 years) and a postoperative diagnosis of idiopathic or AE-associated CTC met inclusion criteria and were included in this study.

The study group consisted of 4 women (mean age, 42 years; range, 33 to 55 years) and 18 men (mean age, 53 years; range, 23 to 67 years); all had complete preoperative and follow-up data. Preoperative motor-nerve conduction test results from the symptomatic cohort were analyzed and grouped post-hoc into 2 comparative groups: AE-associated CTC and idiopathic

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CTC. Motor-conduction velocity values were obtained for the ulnar nerve (abductor digiti minimi). Velocity drop of the ulnar nerve (abductor digiti minimi) was calculated by dividing the difference in velocity (m/s) by distance (cm). The velocity drop was arbitrarily classified into the following grades: + (0-2.99 m/s per cm) and ++ (> 3.00 m/s per cm).

The indication for cubital tunnel release was based on clinical and electrophysiological signs of CTC; the procedure was standardized in all patients. Decompression of ulnar nerve with anterior subcutaneous transposition with a dermofascial sling was performed in all cases.

The presence or absence of an AE muscle was determined by its mention in the operative notes. In patients who had an AE, the muscle was carefully divided and hemostasis attained. Mean follow-up was 6.5 months (range, 0.5 to 45 months).

Demographic, clinical, and nerve conduction data were analyzed. Categorical data, presented as absolute numbers and percentages, were compared using Fisher's exact test; the Mann-Whitney U test was used to determine statistical significance of ordinal data. Continuous data were presented as mean, range, and standard error (SE), where indicated.

## Results

The mean age ± SE at the time of ulnar nerve release was 50 ± 3.8 years (range, 23 to 65 years) in patients with AE-associated CTC and 53 ± 4.0 years (range, 41 to 67 years) in patients with idiopathic CTC ($P = .65$; **Table I**). All but 1 patient presented with tingling and/or numbness over the distribution of the ulnar nerve, and along the ulnar aspect of the little finger, hand, and forearm. One patient presented with hyperesthesia over the medial part of the forearm. Ten of 16 (62%) patients with idiopathic CTC had symptoms for less than 1 year; 5 of 6 (83%) patients with AE-associated CTC had symptoms for less than 1 year ($P = .62$). All patients underwent decompression of

**Table I. Patient Demographics**

| Patient | Sex | Age, y | Symptoms/Duration | Follow-up time, mo | Anconeus epitrochlearis | Velocity drop m/s/cm | Grade |
|---|---|---|---|---|---|---|---|
| 1 | M | 59 | TN/years | 13 | Absent | 0.76 | + |
| 2 | F | 33 | N/2 months | 2.5 | Absent | 1.11 | + |
| 3 | F | 35 | TN/years | 13 | Absent | 1.68 | + |
| 4 | M | 31 | N/Few months | 2 | Absent | 0.43 | + |
| 5 | M | 56 | TN/months | 12 | Absent | 0.71 | + |
| 6 | F | 55 | N/1 month | 12 | Absent | 3.46 | ++ |
| 7 | M | 23 | TN/2 months | 1.25 | Absent | 1.12 | + |
| 8 | M | 64 | N/3 months | 6.5 | Absent | 1.30 | + |
| 9 | M | 64 | N/months | 1 | Absent | 0.85 | + |
| 10 | M | 56 | TN/years | 0.75 | Absent | 2.30 | + |
| 11 | M | 40 | TN/months | 0.5 | Absent | 0.49 | + |
| 12 | M | 66 | TN/1 year | 18 | Absent | 1.99 | + |
| 13 | M | 64 | Hyperesthesia medial forearm/1 year | 45 | Absent | 1.01 | + |
| 14 | M | 60 | T/2 months | 2.5 | Absent | 1.83 | + |
| 15 | M | 65 | TN/years | 9 | Absent | 2.72 | + |
| 16 | M | 30 | TN/2 weeks | 2 | Absent | 2.04 | + |
| 17 | M | 55 | TN/months | 5.5 | Present | 3.26 | ++ |
| 18 | M | 67 | TN/2.5 months | 0.5 | Present | 3 | ++ |
| 19 | M | 60 | TN/2 months | 0.5 | Present | 1.31 | + |
| 20 | F | 44 | TN/months | 0.5 | Present | 3.5 | ++ |
| 21 | M | 41 | TN/1 year | 0.5 | Present | 1 | + |
| 22 | M | 52 | TN/1 month | 1.5 | Present | 0.88 | + |

Abbreviations: T, tingling; mo, months; N, numbness; y, years.

the ulnar nerve with anterior transposition. No intraoperative complications were encountered. At latest follow-up, all patients reported relief from preoperative symptoms. The follow-up duration in AE-associated CTC patients was significantly shorter (mean, 1.5 months; range, 0.5 to 5.5 months) when compared with idiopathic CTC patients (mean, 8.8 months; range, 0.5 to 45 months; $P = .015$). Complications in both groups included persistence of mild numbness of the little finger in 6 patients and pain over the medical epicondyle in 3 patients, statistically independent of the presence of AE. No hematoma or reoperations were encountered.

Anconeus epitrochlearis was found during surgery in 6 of the 22 study patients (27.2%). Among the 6 AE-associated CTC cases, 3 patients had grade + and 3 patients had grade ++ velocity drop. However, only 1 of the 16 cases of non-AE-associated, idiopathic CTC showed grade ++ velocity drop ($P = .046$).

Three of the 4 cases (75%) having grade ++ velocity drop were associated with AE (**Table II**). The case with a grade ++ velocity drop and no AE was diagnosed with fibromyalgia. Fifteen of the 18 (83%) patients with grade + velocity drop had no associated AE (**Table I**). Fisher's exact test was statistically significant comparing the presence of AE and the grade of velocity drop ($P = .046$). Specificity of the distinction was 0.94, and sensitivity was 0.5 in our small case series.

## Discussion

The aim of this study was to compare electrophysiological findings in patients with either idiopathic CTC or AE-associated CTC. We rejected our null hypothesis that AE-associated and idiopathic CTC have the same velocity drop. Preoperative motor velocity conduction studies showing grade ++ velocity drop (more than 3 m/s per cm) in the ulnar nerve were highly specific and less sensitive of being associated with the presence of AE in our small case series. This arbitrary method to classify velocity drop helps the surgeon to anticipate the presence of AE by simple calculation of velocity drop in electrophysiological reports. These findings, plus other supportive evidence of low amplitude of compound motor action potential, evidence of conduction block, abnormal prolongation of mean motor conduction latency (more than 0.5 msec), and prolongation of latency (largely at the segment between the medial epicondyle and 2 cm proximal to the medial epicondyle), help predict the presence of AE preoperatively with a high degree of certainty.[8]

We found no demographic/characteristic differences between the 2 study groups. Although the average age in both idiopathic and AE-associated groups was clinically and statistically similar, the range in the former was wider compared with the latter. This contrasted with a study by Byun and colleagues[8] which suggested that AE-associated CTC is more common in a younger age group. Nor was there a statistically significant difference between groups when duration of symptoms were categorized as chronic (> 1 year) and subacute (< 1 year), The shorter duration of follow-up for the AE-associated CTC group in this study can indicate a better prognosis with faster resolution of preoperative symptoms.

**Table II. Data Correlating Anconeus Epitrochlearis and Grade of Velocity Drop**

| Anconeus Epitrochlearis | Present | Absent |
|---|---|---|
| Grade + (0-2.99 m/s per cm) | 3 | 15 |
| Grade ++ (> 3 m/s per cm) | 3 | 1 |

The limitations of this study include its retrospective design and the small sample size of AE-associated CTC. Information pertaining to the EMG machine, position of elbow, and quality and technique of EMG technicians could not be evaluated after group comparison. Although magnetic resonance imaging helps diagnose the presence of AE, electrophysiological studies provide a cost-efficient indication of its presence. Further studies are needed to evaluate sensitivity and specificity of AE identification through electrophysiological studies and the clinical consequences.

## Conclusion

Grade ++ motor conduction velocity drop (> 3 m/s per cm) in the ulnar nerve on electrophysiological studies in patients with idiopathic CTC suggests the presence of anconeus epitrochlearis.

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