*Medical Ultrasonography*
*2009, Vol. 11, no. 2, 31-36*

# Bilateral cubital tunnel syndrome. Case report with review of the literature

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## Abstract

Cubital tunnel syndrome is the second most common entrapment neuropathy of the upper extremity after carpal tunnel syndrome. However, bilateral compressive ulnar neuropathy is a rare condition. We report the case of a 19 year old woman, a sewing machine worker, who presented with typical symptoms of ulnar nerve entrapment. The diagnosis was confirmed by electrophysiological studies and ultrasound imaging of the ulnar nerve. The patient fully recovered with conservative medical treatment and physical rehabilitation procedures.

**Key-words:** ulnar nerve, cubital tunnel syndrome, ultrasound, electromyography.

## Rezumat

Sindromul de canal carpian este, ca şi frecvenţă a sindroamelor compressive neurologice de la nivelul membrelor superioare, al doilea după sindromul de canal carpian dar, neuropatia ulnară compresivă bilaterală, este o situație rară. Prezentăm cazul unei paciente de 19 ani, lucrătoare la maşina de cusut, care s-a prezentat cu simptomatologie tipică de sindrom de canal cubital. Diagnositcul a fost confirmat prin studiul electrofiziologic şi ecografia nervului ulnar. Recuperarea a fost completă după tratament conservativ.

**Cuvinte cheie:** nerv ulnar, sindrom de canal cubital, ecografie, electromiografie

### Introduction

Cubital tunnel syndrome (CTS) is the most common form of ulnar neuropathy and the second most common entrapment neuropathy of the upper limbs following carpal tunnel syndrome.

The term "cubital tunnel syndrome" was described by Feindel and Stratford in the late 50's, but the entrapment of the ulnar nerve has been recognized for more than 100 years [1]. Initially the CTS was associated with the arcuate ligament of Osborne, but over the years the term was broadened to encompass ulnar nerve entrapment at the elbow. Mondelli et al. reported an incidence of 24.7/100 000 person-year in a general population. [2].

The diagnosis is based on clinical symptoms, physical examination, electrodiagnostic studies, and latterly on ultrasound and MRI imaging. However, diagnosis based only on physical examination and electromyography is difficult, because the ulnar nerve can be involved at any level of the upper limbs. The sensitivity of electrodiagnostic studies ranges from 37 to 86% [3]. Since MRI is an expansive examination, ultrasonography of peripheral nerves becomes a valuable diagnostic tool. The development of high frequency transducers with a range of 5–15 MHz, sophisticated focusing technology in the near field, and sensitive color and power Doppler technology have improved the quality of the images and the ability of ultrasound examination to evaluate peripheral nerve entrapment in osteofibrous tunnels [4] Also ultrasound technique allows static and dynamic examination which is very helpful for the diagnosis.

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All authors agreed on the content of the paper.
None of the authors have any commercial interests or financial disclosures to be made regarding this paper.

**Case report**

A 19 year old women was examined for bilateral paresthesias of the upper limbs radiating distally in the hand over the fifth finger and ulnar side of the forth finger. She also reported progressive clumsiness and loss of dexterity in both hands. The patient had no significant medical history and no history of previous trauma injury. She had been a seamstress for 1 year.

Physical examination revealed positive Tinel signs and diminished sensation to fifth and fourth digits and hypotenar eminence at monofilament testing. The vibratory discrimination test was also positive in the same territory. The froment test (full flexion of thumb interphalangeal joint on forced adduction against radial border of index finger) was also positive.

The case was clinically interpreted as bilateral ulnar nerve entrapment neuropathy.

Neurophysiological examination included electromyography (EMG) and nerve conduction studies of the ulnar nerve. Motor conduction velocity (MCV) across the elbow was diminished as well as the amplitude of motor response. The sensory conduction velocity was determined orthogromically from the fifth finger to the wrist. Sensory response was absent bilateral, indicating a severe injury of the ulnar nerve. Distal motor latency measured at 7 and 14 cm between the stimulation point of the nerve at the wrist and the *abductor digiti mini* and *first dorsal interosous* muscle was normal, thus allowing the differentiation of cubital tunnel syndrome from Guyon syndrome (fig 1).

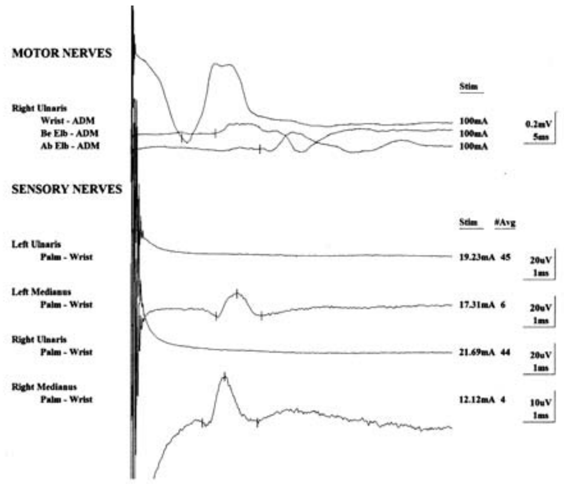


**Fig 1.** The electromyographic study of the ulnar nerve. Diminished motor conduction velocity and the absence of sensory response

The ultrasound (US) examination was performed using a 5–10 MHz linear array transducer (Aloka Prosound α 10). The cross-sectional area (CSA) of the ulnar nerve was measured on transverse scans within the cubital tunnel. The landmarks used to define the cubital tunnel were the medial epicondyle medially and the olecranon laterally. The CSA of the ulnar nerve was 10 $mm^2$ both on the left and right sides, over the normal upper limit of 7.5 $mm^2$ (fig 2).

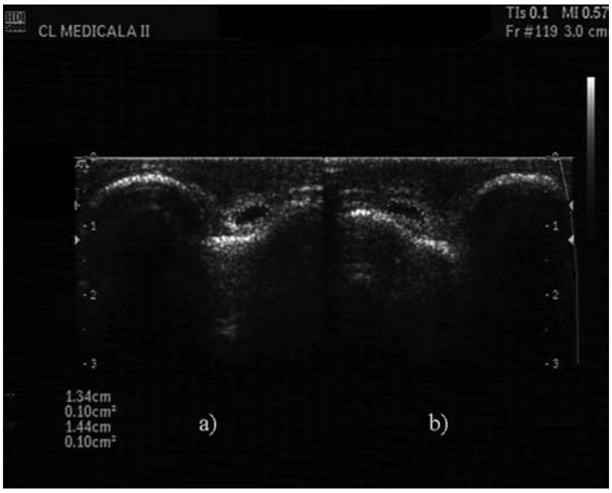


**Fig 2.** Transverse scan of the cubital groove: a) left side, b) right side. CSA of the ulnar nerve of 10 $mm^2$ , bilaterally.

The patient was diagnosed with severe work-related bilateral CTS.

The first therapeutic attitude was to change the patient's way of working. She was advised to avoid resting the elbows on hard surfaces and she was given an elbow pad to wear over the medial aspect of the elbow to protect the ulnar nerve from direct pressure or trauma. Anti-inflammatory drugs were administrated for two weeks together with gastric protection. Thiogamma 600 mg/day was administered for 3 months together with Lyrica 600 mg/day. The patient was re-evaluated at 6 months and 1 year. After one year, the patient had fully recovered.

**Discussion and review of literature**

**Etiology and physiopathology**

CTS is the second most common nerve entrapment in the upper extremity after carpal tunnel syndrome, and is caused mainly by pressure on or stretch of the ulnar nerve near the elbow at the cubital tunnel.

The reported prevalence of CTS varies from 2.8% in workers whose occupations require repetitive work to 6.8% in those working as floor cleaners. Also employees working with flexed elbows and direct pressure on the ulnar nerve are at risk for the development of CTS [5].

The ulnar nerve arises as a terminal branch of brachial plexus from the C8 and T1 nervous roots. At the elbow, the ulnar nerve lies in the cubital tunnel delimitated by the olecranon process of the ulna and the medial epicondyle of the humerus and bridged by the cubital tunnel retinaculum also known as Osborne fascia. During the elbow flexion at 45°, this aponeurotic bridge streches with approximately 5 mm, closing down and further narrowing the cubital tunnel [6] These anatomical considerations are of extreme importance in order to explain the etiology and physiopathology of cubital tunnel syndrome, one of the most common etiological factors in ulnar neuropathy involving the compression of the ulnar nerve due to entrapment.

There are 4 sites of compression of the ulnar nerve at the elbow [6]: medial intermuscular septum, ulnar groove, humeroulnar arcade (cubital tunnel), and the exit point between the two heads of *flexor carpi ulnaris*.

The main conditions that lead to ulnar nerve compression are:

Trauma (acute trauma– fracture of medial epicondyle or supracondylar fracture or repetitive microtrauma that leads to fibrosis– baseball pitchers, violinists [7])

External pressure: leaning the elbows on hard surfaces: wheelchairs, working on sewing machines, resting the elbows on car windows frames (taxi drivers) [8]

Soft tissue masses: ganglia, lipomas, synovium proliferation (rheumatoid arthritis), tophaceus gout

General disease: acromegaly

Other: osteophytes, calcium pyrophosphate dehydrate deposition disease [9]

A systematic review of the literature regarding the association between work-related factor and specific disorders of the elbow, found that cubital tunnel syndrome was associated with the factor "handling a tool in a position", while handling loads, high hand grip forces, repetitive movements and working with vibrating tools were associated with medial epicondylitis [5]

**Diagnostic tools in cubital tunnel syndrome**

The diagnosis of cubital tunnel syndrome lies on clinical presentation (symptoms and signs), electrophysiological tests and imagistic modalities (ultrasound and magnetic resonance imaging techniques).

The symptoms of cubital tunnel syndrome include paresthesias (cubital side of forearm and 4$^{th}$ and 5$^{th}$ fingers), pain and tenderness over the medial epicondyle and cubital tunnel, weakness and atrophy of ulnar nerve innervated intrinsic hand muscles

The clinical tests used in the diagnosis of cubital tunnel syndrome are designed to evaluate the motor and sensory function of the ulnar nerve (Table I) [10].

**Table I.** Clinical tests for evaluation the motor and sensory function of the ulnar nerve

| **Testing for ulnar motor function** | |
|---|---|
| Fromen test | Full flexion of thumb interphalangeal joint on forced adduction against radial border of index finger |
| Wartenberg sign | Extension of fingers leads to abduction of fifth digit |
| Finger flexion test | Hold paper between ring finger and middle finger, there is an abnormal flexion of the metacarpophalangeal joint |
| **Testing for ulnar motor function** | |
| Elbow flexion test | Elbow is placed in maximal flexion with full supination and wrist is kept in the neutral position |
| Monofilament test | Diminished sensation along ulnar nerve distribution |
| Vibratory discrimination test | Diminished sensation along ulnar nerve distribution |

Based on the severity of the clinical symptoms, McGowan [11] proposed a classification for the severity of the ulnar neuropathy (Table II).

According to the American Association of Electrodiagnostic in Medicine (AAEM) the electrodiagnostic diagnosis criteria for cubital tunnel syndrome are [12]: absolute nerve conduction velocity (NCV) above the elbow less than 50m/s, decrease of NCV of more than 10m/s across the elbow, decrease in amplitude of compound muscle action potential (CMAP) greater than 20%, absent ulnar sensory responses, signs of denervation in muscles inervated by ulnar nerve at needle electromyography.

**Table II.** McGowan classification of the severity of the ulnar neuropathy

| Grade | Clinical features |
|---|---|
| I | Exclusively sensory symptoms (paresthesias and numbness) |
| II | Muscle weakness with mild wasting of intrinsic hand muscles, with or without accompanying sensory symptoms |
| III | Severe paralysis with a crippled and often clawed hand |

There is a 5 grade scale used for the evaluation of the neurophysiological severity for CTS [13]:

1. Negative CTS: normal findings on all tests
2. Mild CTS: slowing of ulnar motor nerve conduction velocity (MNCV) across elbow and normal ulnar sensory nerve action potentials (SNAP)
3. Moderate CTS: slowing of ulnar MNCV across elbow and reduced amplitude of ulnar SNAP
4. Severe CTS: absence of ulnar SNAP (fifth digit-wrist segment) and slowing of MNCV across elbow;
5. Extreme CTS: absence of hypothenar motor (and sensory) response

In recent years, with the development of high resolution, electronic broadband transducers, ultrasonography is considered the optimal technique to evaluate the normal anatomy and disorders of the peripheral nerves. Usually, for optimal examination of peripheral nerves linear transducers with a frequency of 5–13 MHz are used.

To obtain a full probe contact with the curvilinear osseous surface of the elbow joint, a flexible standoff pad may facilitate scanning. If not available, a thick layer of gel and a minimal probe pressure can be helpful. The patient is examined in a supine position with the arm abducted and transversal scans are performed to follow the nerve.

The ulnar nerve is identified as an ovoid structure located close to the medial epicondyle; due to its curvilinear course, the nerve appear less echogenic at this level than elsewhere in the upper limb (fig 3).


**Fig 3.** Normal appearance of the ulnar nerve in the cubital tunnel, as an ovoid hipoechoic structure, close to the medial epicondyle (between arrows).

Sometimes the ulnar nerve is divided in two fascicles separated by a septum (fig 4, fig 5).

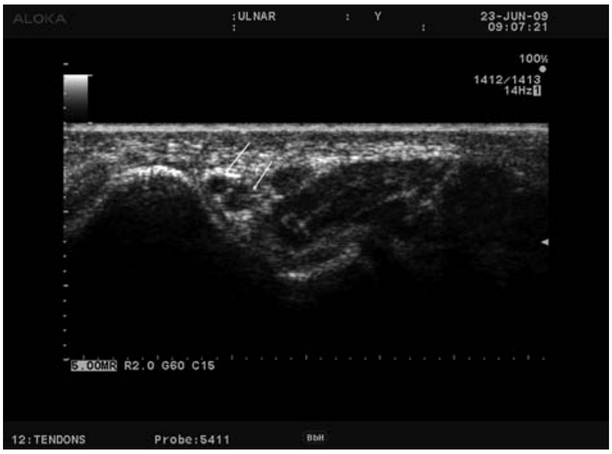


**Fig 4.** The ulnar nerve divided into two fascicles which are separated by an hyperechoic septum (arrows)

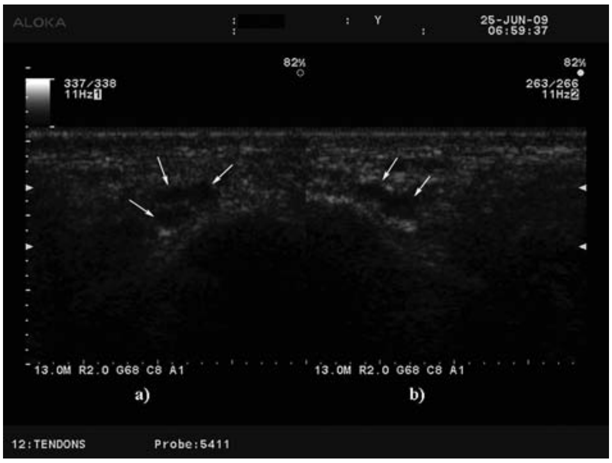


**Fig 5.** A particular case in a patient with ulnar nerve with three fascicles in the right (a) and two fascicles in the left (b) (arrows)

In entrapment neuropathies, proximal to the compression site, the nerve appears swollen, with loss of the fascicular pattern, with a cross-sectional area significantly larger than in healthy subjects and than the cross-sectional area of the contralateral nerve. A cross-sectional area (CSA) of the ulnar nerve of more than 7.5 mm$^2$ in the cubital tunnel is considered pathological. Also an increase of more than 2 mm of the shorter diameter of the ulnar nerve in the transversal scan is pathological [4].

In a recent study analyzing 212 elbows, the mean CSA of the ulnar nerve was 6.6+/-1.7 mm$^2$ in elbow extension [15], which is similar with the results obtained in another study by Cartwright et al which reported a mean CSA of the ulnar nerve within the cubital tunnel at 6.5+/-0.9 mm$^2$ [16]. In full flexion of the elbow, the volume of the cubital tunnel decreased, and the CSA of the ulnar nerve decreased as well, with 11% up to 39% (fig 6) [15,17].


**Fig 6.** CSA of the ulnar nerve in the cubital tunnel with the elbow in extension (area 0.06 $cm^2$) (a), and in flexion (area 0.07 $cm^2$) (b).

The swelling ratio, defined as the ratio between the nerve CSA at the site of maximal swelling and at an unaffected site, may improve the diagnostic accuracy in ulnar neuropathy at the elbow. This was demonstrated by Yoon et al [18] in a study performed on 26 patients with CTS and 30 healthy volunteers. In individuals with CTS, the ratio was 2.9:1 when the site of maximal swelling was compared with a distal ulnar nerve site and 2.8:1 when compared with a proximal site and it was significantly increased when compared with controls (the ratio of 1.1:1).

The CSA values are well correlated with across elbow MCV (motor conduction velocity), sensory action potential amplitude and the electrophysiological severity scale score, as demonstrated by Mondelli et al [19] in a prospective study evaluating the relationship between ultrasonography and clinical and electrophysiological findings in 33 patients with CTS.

It is important to perform a dynamic evaluation of the changes in the position of the ulnar nerve in flexion and in extension, because the nerve may be dislocated out of the cubital tunnel during flexion of the arm and overlap the epicondyle, which leads to symptoms mimicking cubital tunnel syndrome [14,15].

Recently, the technique of magnetic resonance imaging (MRI) neurography has greatly increased the ability to visualize peripheral nerves and their pathology, due to the development of specially designed phased array coils with improved high signal-to-noise ratio and a higher resolution, which has brought MRI to the forefront of peripheral nerve imaging [20]. The current indications for MRI neurography include masses involving a peripheral nerve, traumatic nerve injury, unexplained neuropathy or plexopathy, entrapment neuropathy, and posttreatment evaluation. MR imaging findings of the nerve in cubital tunnel syndrome are enlargement and hyperintense signal around the cubital tunnel compared with a normal segment [21]. Britz et al [22] found MRI to be more sensitive and specific for cubital tunnel syndrome than for carpal tunnel syndrome.

**Treatment options in cubital tunnel syndrome**

Conservative treatment is indicated in cases with mild or moderate symptoms. In those patients, as reported by Dellon et al [23] the conservative treatment proved to be beneficial in 90% of cases. The goal of conservative treatment is to eliminate or reduce the frequency of external compression on the nerve and to minimize flexion at the elbow joint [6].

There are four stages of the conservative treatment: 1) Reduction of overload, pain and inflammation: the patient should avoid resting the elbows on hard surfaces, night or daytime splints, elbow pads, anti-inflammatory drugs, ice, ultrasounds or pulsed signal therapy to reduce the pain; 2) Promotion of total arm strength and normal joint arthrokinematics; 3) Interval return to full activity; 4) Maintenance [24, 25].

If the symptoms persist for more than 3 weeks, and the patient still has pain at rest or mild activity and the inability to perform submaximal exercises, the clinician should consider reevaluating the patient and the therapeutic options [6].

The surgical treatment of CTS includes simple decompression, anterior transposition, subcutaneous and submuscular transposition, medial epicondylectomy, and more recently, the endoscopic approach.

## Conclusion

The diagnosis of CTS is based on clinical tests, electrophysiological studies, and imaging examinations.

High resolution ultrasonography is a noninvasive, safe, and reliable modality for imaging the ulnar nerve at the elbow and provides a valuable adjunct to nerve conduction studies in the diagnosis of CTS.

Our case has the particularity of bilateral professional related CTS, with full recovery after conservative treatment.

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