Ulnar Neuropathy at the Elbow, an overview

**Learning Objectives:**

Ulnar nerve compression at the elbow is the second most common mononeuropathy seen in the electrodiagnostic laboratory. Because of the way the fascicles are arraigned the clinical and the electrodiagnostic findings can be puzzling and complex.

In this paper will review ulnar nerve anatomy, clinical features of ulnar neuropathy at the elbow (UNE), differential diagnosis, nerve conduction findings, techniques and case studies. The reader will gain insight to this common entrapment as well as the importance of the nerve conduction studies used to confirm the diagnosis of UNE.

**Anatomy of the Ulnar Nerve:**

Understanding ulnar nerve anatomy is important to help sort out the various conditions in that make up the differential diagnosis, whether it is a cervical radiculopathy or brachial plexopathy.

The ulnar nerve, a mixed nerve, arises from cervical roots C8-T1, continuing through the lower trunk and medial cord. Unlike the median and radial nerve the motor and sensory portions of the ulnar nerve travel together through the brachial plexus. The ulnar nerve is essentially an extension of the medial cord.

The medial brachial and the medial antebrachial cutaneous nerve come directly off the medial cord and the MABC is an important nerve when separating brachial plexus lesions with ulnar nerve lesions.

<table>
<thead>
<tr>
<th>Roots</th>
<th>Trunks</th>
<th>Cords</th>
<th>Branches/Nerves</th>
</tr>
</thead>
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<tr>
<td>C5</td>
<td>Upper</td>
<td>Lateral</td>
<td>Musculocutaneous</td>
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<td></td>
<td></td>
<td></td>
<td>Axillary</td>
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<tr>
<td>C6</td>
<td>Middle</td>
<td>Posterior</td>
<td>Radial</td>
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<td></td>
<td></td>
<td>Median</td>
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<tr>
<td>C7</td>
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<td></td>
<td>MABC</td>
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<tr>
<td>C8</td>
<td>Lower</td>
<td></td>
<td>Ulnar</td>
</tr>
</tbody>
</table>

There are no ulnar nerve innervations in the upper arm. At the elbow the ulnar nerve continues through the retroepicondylar groove which is
formed by medial epicondyle of the humerus and the olecranon process of the ulna. This is the most common of the compression sites.

Slightly distal to the elbow, the ulnar nerve dives beneath a tendon that connects the heads of the flexor carpi ulnaris muscle, known as the humeral-ulnar aponeurosis (HUA) or cubital tunnel. This is the second most common entrapment site of the ulnar nerve at the elbow.

In this area, the ulnar nerve gives off branches to the FCU and the flexor digitorum profundus muscles.

The ulnar nerve continues in the forearm, but does not give off any additional muscle branches until the wrist.

Five to eight centimeters proximal to the wrist the dorsal ulnar cutaneous sensory branch comes off to supply sensation to the dorsal medial hand, dorsal fifth and dorsal medial fourth digits. A little more distally the palmar cutaneous sensory branch exits to supply sensation to the proximal medial palm.

At the level of the wrist, the ulnar nerve enter Guyon’s canal. In the canal the ulnar nerve divides into the deep palmar motor branch and the superficial sensory branch. At the end of Guyon’s canal, motor fibers for the hypothenar muscles are given off. Finally, after the canal, the superficial sensory branch to the palmar 5th and medial palmar 4th digits and the palmar motor branches are given off. Ulnar nerve compression at Guyon’s canal will be addressed in a subsequent paper.

**Clinical Features of Ulnar Neuropathy at the Elbow**

There is a great deal of variability of the signs and symptoms depending on the location and severity of the compression. Early in the course of the compression, symptoms include sensory loss and paresthesias over digits 4 and 5. In more advanced cases, weakness of the interosseous muscles of the hand becomes apparent and the patient may complain of worsened grip and clumsiness. Pain in the region of the elbow also is common, although not universal. Involvement of ulnar innervated forearm muscles leads to weakness in finger and wrist flexion. A positive Tinel's sign (pain with tapping over the nerve) in the region of the elbow also may be present.

Ulnar neuropathy at the elbow can be broken into two distinct sites of compression.

1. The most common location is the nerve at the epicondylar groove. This specific problem is often attributed to prolonged inadvertent compression of the nerve by leaning on the elbows while at a desk or table. Repeated subluxation of the nerve with elbow flexion over the medial epicondyly also may contribute. Studies show this location accounts for 62% - 69% of the elbow compressions.

2. Entrapment of the nerve as it enters the cubital tunnel is the next most common site. The cubital tunnel consists of the two heads of...
the flexor carpi ulnaris muscle and the aponeurosis between them. In some individuals, this tunnel is small and compression of the nerve occurs with repeated elbow flexion. Studies show this location accounts for 23% - 28% of the elbow compressions.

**Differential Diagnosis**

The differential diagnosis for ulnar neuropathy at the elbow includes:

a. Ulnar neuropathy at the wrist – ulnar neuropathy at the wrist will spare the dorsal ulnar cutaneous nerve, so if the patient has intact sensation to the medial dorsal portion of their hand, consider a lesion at the wrist instead of the elbow.

b. Medial cord/Lower trunk plexopathies – lower trunk or medial cord lesions would include median motor signs (e.g. weakness on thumb abduction) and medial forearm sensory loss. If the patient has these symptoms, consider a plexopathy lesion. If index finger extension is spared you would tend to think lower trunk, not medial cord.

c. C8-T1 radiculopathy – C8-T1 radiculopathies would include neck pain and median motor symptoms (e.g. weakness on thumb abduction and flexion)

**Nerve Conduction Findings**

Although it appears straight forward, the electrophysiological findings vary and can be confusing because of the fascicular arrangement inside the nerve. We sometimes see the dorsal ulnar cutaneous branch may paradoxically escape injury with lesions at the elbow. The fibers to the first dorsal interosseous (FDI) seem more susceptible to injury than those to the abductor digiti minimi (ADM). Different fascicles may exhibit different pathophysiology, with conduction block affecting fibers to the FDI while those to the ADM display a pure axon loss picture. For these reasons careful nerve conduction studies of the ulnar nerve are required.

Full technique descriptions follow the introductions:

1. Ulnar sensory study digit V – wrist at 11-13 cm is standard. Many laboratories use antidromic stimulation, while others prefer orthodromic stimulation. While the actual technique is not important it is necessary to be consistent. Use standard sensory amplifier and stimulator settings as noted.

2. Median sensory study Digit II or III – wrist at 12-14 cm is considered standard for comparison. Many laboratories use antidromic stimulation, while others prefer orthodromic
stimulation. While the actual technique is not important it is necessary to be consistent. Use standard sensory amplifier and stimulator settings as noted.

3. Ulnar motor study to the hypothenar muscle is a standard. Place the arm at 90° and carefully examine both below and above the elbow. Be sure the below elbow stimulation is not more than 3 cm distal to the medial epicondyle as the nerve buries quite deep there. A more proximal stimulation (i.e. axilla may be necessary as well) Use standard motor amplifier and stimulator settings as noted. Abnormalities to look for are as follows:
   a. An above elbow (AE) to below elbow (BE) segment greater than 10 m/s slower than the below elbow to wrist segment.
   b. A decrease CMAP amplitude from BE to AE greater than 20%; suggests conduction block or temporal dispersion indicative of focal demyelination. Assuming anomalies such as Martin-Gruber anastamosis are not present.
   c. A significant change in CMAP configuration at the AE site compared to the BE site. Again, assuming anomalies are not present.
   d. Antidromic sensory nerve action potential (SNAP) recordings may be useful, especially in patients with only sensory symptoms. However, SNAP studies have pitfalls and limitations, so use caution if slowing of the sensory CV is your only abnormality.

4. Median motor study to the thenar muscles is a standard and will be used as a comparison. Use standard motor amplifier and stimulator settings as noted.

5. Additional studies if above are equivocal or as the clinical picture dictates.
   a. Motor studies to the first dorsal interosseous. Due to differential fascicular involvement, fibers to the FDI may show abnormalities not evident when recording from the abductor digiti minimi. Perform this study using the same stimulation sites as the study to the ADM. (see case study later in this paper)
   b. Inching study to look for changes in the latency, CMAP amplitude, area or configuration over precisely measured 1 or 2 cm increments from BE to AE. Latency changes in isolation are significant, but it is more convincing if the abnormality involves both a change in latency and a change in either amplitude, area, or configuration.
   c. Comparing the BE to AE segment with the AE to axilla segment is useful when there is wallerian degeneration and the distal low CMAP amplitude hinders localization.
   d. When the dorsal ulnar sensory study shows reduced SNAP
amplitude it helps confirm a lesion at the elbow as this nerve is spared in wrist lesions. Caution should be exercised however, as the DUC sensory study can be normal in elbow lesions because of differential fascicular involvement.

e. Recording the medial antebrachial cutaneous nerve is useful to exclude lesions of the lower trunk and medial cord, if clinically indicated.

6. F-waves can be performed; however they are of little value when the lesion is at the elbow.

7. Needle EMG as performed by the physician is useful to gauge severity when the clinical signs indicate.

Specific Nerve Conduction Techniques

**Ulnar nerve (C8-T1, lower trunk, medial cord)**

*Ulnar motor study to the ADM*

Patient Position: Supine, or on their side with arm supinated and abducted 70-90 degrees

Skin Prep: Clean area with alcohol, temperature check

Recording site:

Active: Placed on the belly of the Abductor Digiti Minimi (ADM) ½ distance between the distal wrist crease and the base of the fifth digit

Reference: Placed on the proximal phalanx of the fifth digit

Ground: Placed between the stimulating and recording electrodes

Stimulation: (cathode distal)

Wrist: Applied 2 cm proximal to the distal wrist crease, anterior to the flexor carpi ulnaris tendon

Below elbow(BE): Applied 2-4 cm distal to the ulnar groove on the medial side of the forearm

Above elbow(AE): Applied at least 10 cm proximal to the below elbow site on the medial aspect of the arm

Measurements: Between the active recording electrode and wrist following a straight line

Wrist to BE following contour of the medial aspect of the arm

Between BE and AE though the ulnar groove following contour of the medial aspect of the arm

Latency and amplitude for CMAP recordings
Calculations:  
Motor conduction velocity wrist to BE and wrist to AE
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Ulnar motor study to the FDI

Patient Position: Supine, or on their side with arm supinated and abducted 70-90 degrees

Skin Prep: Clean area with alcohol, temperature check

Recording site:
Active: Placed on the belly of the First dorsal interosseous (FDI) in the web space between the thumb and forefinger. Have the patient make a peace sign.

Reference: Placed on the proximal phalanx of the digit II

Ground: Placed between the stimulating and recording electrodes

Stimulation: (cathode distal)

Wrist: Applied 2 cm proximal to the distal wrist crease, anterior to the flexor carpi ulnaris tendon

Below elbow (BE): Applied 2-4 cm distal to the ulnar groove on the medial side of the forearm

Above elbow (AE): Applied at least 10 cm proximal to the below elbow site on the medial aspect of the arm

Measurements: Between the active recording electrode and wrist following a straight line
Wrist to BE following contour of the medial aspect of the arm
Between BE and AE though the ulnar groove following contour of the medial aspect of the arm
Latency and amplitude for CMAP recordings

Calculations: Motor conduction velocity wrist to BE and wrist to AE (or BE to AE)
Antidromic sensory study to the fifth digit

**Patient Position:** Supine, or on their side with arm supinated and abducted 70-90 degrees

**Skin Prep:** Clean area with alcohol, temperature check

**Recording site:**
- **Active:** Ring electrode placed on the midportion of the proximal phalanx of the 5th finger
- **Reference:** Ring electrode placed on the midportion of the middle phalanx of the 5th finger

**Ground:** Placed between the stimulating and recording electrodes

The amplitude of antidromic recordings tend to be larger, but they tend to have more motor artifact that can obscure the waveforms. This is even more pronounced as we move to proximal recordings, as in the BE and AE sites. Reduced amplitude at the wrist does not localize a lesion, but slowed CV from BE to AE does show the focus.
Stimulation: (anode is 2.5 cm proximal to cathode)

Wrist: Applied 2 cm proximal to the distal wrist crease anterior to the flexor carpi ulnaris tendon – many labs record only from the wrist

Below elbow (BE): Applied 2-4 cm distal to the ulnar groove on the medial side of the forearm

Above elbow (AE): Applied at least 10 cm proximal, but not more than 13 cm to the below elbow site on the medial aspect of the arm

Measurements: Between active recording electrode and wrist

Latency and amplitude for SNAP

Calculations: Conduction velocity, from baseline, of the Wrist – BE and the BE – AE segments

Remember the amplitude of antidromic sensory responses may drop as much as 50% as you move proximal because of phase cancellation.

Phase cancellation occurs because the different fibers travel at different speeds, so over the long distance the repolarization of the fast fibers cancel some of the slow fibers.
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Orthodromic sensory study to the wrist

Patient Position: Supine with arm supinated and extended at side

Skin Prep: Clean area with alcohol, temperature check

Recording site:
Active: Placed 11 cm proximal to the stimulating cathode in the wrist crease anterior to the flexor carpi ulnaris tendon

Reference: Placed 3 or 4 cm proximal to the active recording electrode along the ulnar nerve

Ground: Placed between the stimulating and recording electrodes

Stimulation:
Cathode: Applied with a ring electrode on the proximal phalanx of the 5th digit
Anode: Applied with a ring electrode on the distal phalanx, 3cm from the cathode

Measurements: Between active recording electrode and cathode
Latency and amplitude

Calculations: None required

Orthodromic stimulation gives lower amplitude than the equivalent antidromic recording. In theory this is because the recording electrodes over the wrist are farther from the actual nerve than recording electrodes over the digit.

Ulnar sensory – orthodromic
Inching technique

Patient Position: Supine, or on their side with arm supinated and abducted 70-90 degrees

Skin Prep: Clean area with alcohol, temperature check

Recording site: Active: Placed on the belly of the ADM ½ the distance between the distal wrist crease and the base of the fifth digit, or the FDI in the web space between the thumb and forefinger.

Reference: Placed on the proximal phalanx of the fifth digit

Ground: Placed between the stimulating and recording electrodes

Stimulation: (cathode distal)

Start at the “zero” mark in the epicondylar groove and make a mark, then mark 3, 2 cm increments both proximal and distal to this “zero” mark. Stimulate these 7 positions, starting distal and moving proximal.

Measurements: Look for segmental changes in latency or amplitude that is asymmetrical as compared to the others segments.
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**Median nerve (C6-T1, all trunks, lateral and medial cords)**

*Median motor study to the APB*

**Patient Position:** Supine with arm supinated and extended at side

**Skin Prep:** Clean area with alcohol, temperature check

**Recording site:**
- **Active:** Placed over the belly of the Abductor Pollicis Brevis (APB), $\frac{1}{2}$ distance between metacarpophalangeal (MCP) joint of thumb and midpoint of the distal wrist crease
- **Reference:** Placed on the distal phalanx of the thumb
- **Ground:** Placed between the stimulating and recording electrodes
- **Stimulation:** (cathode distal)

**Wrist:** Applied 2 cm proximal to the distal wrist crease between the flexor carpi radialis (FCR) and the palmaris longus (PL) tendons

**Elbow:** Applied at the elbow crease, just medial to biceps tendon

**Measurements:** Between active recording electrode and wrist
- Between wrist and elbow
- Latency and amplitude for CMAP recordings

**Calculations:** Conduction velocity wrist to elbow

The median nerve is used as a comparison study.
Antidromic sensory study to the index finger

Patient Position: Supine with arm extended at side

Skin Prep: Wipe with alcohol, temperature check

Recording site:
Active: Ring electrode placed on midportion of the proximal phalanx of the index finger
Reference: Ring electrode placed on the midportion of the middle phalanx of the index finger

Ground: Placed between the stimulating and recording electrodes

Stimulation: (anode is 2.5 cm proximal to cathode)

Wrist: Applied 2 cm proximal to the distal wrist crease between the flexor carpi radialis (FCP) and palmaris tendons (PL)

Measurements: Between active recording electrode and wrist
Latency and amplitude for SNAP

Calculations: Sensory conduction velocity
Dorsal ulnar cutaneous nerve (C8-T1, lower trunk, medial cord)

Patient Position: Supine with arm pronated and extended at side

Skin Prep: Clean area with alcohol, temperature check

Recording site:
Active: In the web space between the 4th and 5th metacarpal.

Reference: 3-4 cm distal

Ground: Placed between the stimulating and recording electrodes

Stimulation: 10 cm proximal along the ulna bone. Anatomically the nerve curves around the ulna so the best response may be found on either side of the ulna.

Measurements: Between active recording electrode and wrist
Latency and amplitude for SNAP

Calculations: None required, although some may calculate the CV from cathode to recording electrode. Side-to-Side comparison is often necessary
Medial antebrachial cutaneous nerve (C8-T1, lower trunk, medial cord)

Patient Position: Supine with arm supinated and extended at side

Skin Prep: Clean area with alcohol, temperature check

Recording site:

Active: Placed 10 cm along a line extending from 3 cm proximal to the medial epicondyle to the ulnar styloid

Reference: Placed 3-4 cm distal along the nerve course

Ground: Placed between the stimulating and recording electrodes

Stimulation: At the tip of the measurement point 3 cm above the medial epicondyle. Use a soft touch; too much pressure or too much stimulus will cause extensive motor artifact.

Measurements: Between active recording electrode and wrist

Latency and amplitude for SNAP

Calculations: None required, although some may calculate the CV from cathode to recording electrode.

Some believe the MABC is a difficult nerve to record, but after a little practice it becomes easier. One key is using a light touch with low intensity. Pressing hard or strong stimulation activates the median and/or the ulnar nerves, which, because they are mixed nerves, will obliterate your response with motor artifact.
**Case Study 1:**

Age: 27  
Gender: Female  
Temperatures: Left wrist: 31.5°C

For your convenience values outside the normal range are **bolded**. Normal values for this age are stated below the tables. Note: Normal waveform screen shots of the left radial SNC and the right ulnar SNC were omitted for space considerations.

**REASON FOR STUDY:** Patient with numbness and tingling in the 4th and 5th fingers of the left hand. There is no neck pain. Evaluate for underlying neuropathic process.

**Motor Nerve Conduction:**

<table>
<thead>
<tr>
<th>Nerve and Site</th>
<th>Segment</th>
<th>Distance</th>
<th>Latency</th>
<th>Amplitude</th>
<th>Conduction Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Left Median</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrist</td>
<td>Abductor pollicis brevis-Wrist</td>
<td>60 mm</td>
<td>3.0 ms</td>
<td>7.14 mV</td>
<td></td>
</tr>
<tr>
<td>Elbow</td>
<td>Wrist-Elbow</td>
<td>230 mm</td>
<td>7.0 ms</td>
<td>7.00 mV</td>
<td>57.5 m/s</td>
</tr>
<tr>
<td><strong>Left Ulnar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrist</td>
<td>ADM-Wrist</td>
<td>60 mm</td>
<td>2.8 ms</td>
<td>12.33 mV</td>
<td></td>
</tr>
<tr>
<td>Below elbow</td>
<td>Wrist-Below elbow</td>
<td>220 mm</td>
<td>6.8 ms</td>
<td>11.22 mV</td>
<td>55.0 m/s</td>
</tr>
<tr>
<td>Above elbow</td>
<td>Below elbow-Above elbow</td>
<td>100 mm</td>
<td>10.8 ms</td>
<td>3.28 mV</td>
<td>25.0 m/s</td>
</tr>
</tbody>
</table>

**Left Ulnar - Inching**

<table>
<thead>
<tr>
<th></th>
<th>Segment</th>
<th>Distance</th>
<th>Latency</th>
<th>Amplitude</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>D6</td>
<td>Abductor digiti minimi (manus)-D6</td>
<td>6.3 ms</td>
<td>6.3 ms</td>
<td>12.64 mV</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>D6-D4</td>
<td>6.7 ms</td>
<td>6.7 ms</td>
<td>12.42 mV</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>D4-D2</td>
<td>7.2 ms</td>
<td>7.2 ms</td>
<td>12.54 mV</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>D2-P</td>
<td>7.5 ms</td>
<td>7.5 ms</td>
<td>12.90 mV</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>P-P2</td>
<td>7.8 ms</td>
<td>7.8 ms</td>
<td>11.47 mV</td>
<td></td>
</tr>
<tr>
<td>P4</td>
<td>P2-P4</td>
<td>10.8 ms</td>
<td>10.8 ms</td>
<td>3.24 mV</td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>P4-P6</td>
<td>11.0 ms</td>
<td>11.0 ms</td>
<td>3.24 mV</td>
<td></td>
</tr>
<tr>
<td>D6-P6</td>
<td></td>
<td>120 mm</td>
<td></td>
<td></td>
<td>25.5 m/s</td>
</tr>
</tbody>
</table>
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**Sensory Nerve Conduction:**

<table>
<thead>
<tr>
<th>Nerve and Site</th>
<th>Segment</th>
<th>Distance</th>
<th>Amplitude</th>
<th>Peak Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Left Median</strong></td>
<td>Wrist-Digit II (index finger)</td>
<td>130 mm</td>
<td>35.35 μV</td>
<td>2.5 ms</td>
</tr>
<tr>
<td><strong>Left Ulnar</strong></td>
<td>Wrist-Digit V (little finger)</td>
<td>110 mm</td>
<td>15.63 μV</td>
<td>2.4 ms</td>
</tr>
<tr>
<td><strong>Left Transcarpal, Med-Uln Comparison</strong></td>
<td>Wrist-Mid palm (Median)</td>
<td>80 mm</td>
<td>79.20 μV</td>
<td>1.7 ms</td>
</tr>
<tr>
<td></td>
<td>Wrist-Mid palm (Ulnar)</td>
<td>80 mm</td>
<td>49.75 μV</td>
<td>1.9 ms</td>
</tr>
<tr>
<td><strong>Left Radial</strong></td>
<td>Anatomical snuff box-Forearm</td>
<td>100 mm</td>
<td>35.28 μV</td>
<td>2.0 ms</td>
</tr>
<tr>
<td><strong>Right Ulnar</strong></td>
<td>Wrist-Digit V (little finger)</td>
<td>110 mm</td>
<td>17.33 μV</td>
<td>2.4 ms</td>
</tr>
</tbody>
</table>

Left ulnar inching study – note the amplitude drop and prolonged latency between 2 and 4 cm proximal to the “zero” point.
Normal values:

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor (MNC)</th>
<th>Sensory (SNC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>DML ≤ 4.2, Amp ≥ 4, CV ≥ 49</td>
<td>Peak Lat ≤ 3.2, Amp ≥ 12</td>
</tr>
<tr>
<td>Ulnar</td>
<td>DML ≤ 3.8, Amp ≥ 6, CV ≥ 49</td>
<td>Peak Lat ≤ 2.8, Amp ≥ 10</td>
</tr>
<tr>
<td>CV across elbow may slow ≤ 10</td>
<td>Palmar diff ≤ 0.4</td>
<td></td>
</tr>
</tbody>
</table>

NERVE CONDUCTION STUDIES:

1. Motor conduction study of the left ulnar nerve revealed normal distal latency and amplitude. There was an amplitude drop of 71% upon stimulation above the elbow with marked slowing of conduction velocity across the elbow. An inching study of the left ulnar nerve revealed a 79% amplitude drop with a 3 ms delay between the epicondylar groove and 2 cm proximal to the groove. Motor conduction study of the left median nerve was within normal limits.

2. Sensory nerve conduction studies of the left median, left radial and both ulnar nerves were within normal limits. The ulnar sensory nerve amplitude was symmetric upon side to side comparison.

DISCUSSION:

There is electrical evidence to suggest the presence of a left ulnar neuropathy that localizes to the region of the retroepicondylar groove. The segmental slowing in conduction velocities and partial conduction block suggests a focus of demyelination, which usually corresponds to a good prognosis for recovery. The symmetry in ulnar sensory amplitudes and the lack of denervation changes on needle exam argue against axonal loss injury. This is an example of sparing to some fascicles (the fascicles going to the sensory innervations) while others are affected (the fascicles going to the ADM).
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Case Study 2:

Age: 63
Gender: Male

Temperatures:
Right wrist: 33°C
Left wrist: 33°C

For your convenience values outside the normal range are bolded. Normal values for this age are stated below the tables.

REASON FOR STUDY: Numbness in the fifth digit in the left hand for the past three months. Symptoms began in the tip of the fifth digit and have spread to the left wrist. He denies left hand weakness. He also notes tingling in the left shoulder that does not radiate further down the arm. He denies neck pain, symptoms involving the right hand or the feet. His exam today shows weakness in ulnar distribution bilaterally. This study is to evaluate for a left ulnar mononeuropathy versus a left lower cervical radiculopathy.

Motor Nerve Conduction:

<table>
<thead>
<tr>
<th>Nerve and Site</th>
<th>Segment</th>
<th>Distance</th>
<th>Latency</th>
<th>Amplitude</th>
<th>Conduction Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Median</td>
<td>Rec: APB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrist</td>
<td>Abductor pollicis brevis-Wrist</td>
<td>60 mm</td>
<td>3.6 ms</td>
<td>9.95 mV</td>
<td></td>
</tr>
<tr>
<td>Elbow</td>
<td>Wrist-Elbow</td>
<td>250 mm</td>
<td>8.3 ms</td>
<td>8.56 mV</td>
<td>53.1 m/s</td>
</tr>
<tr>
<td>Left Ulnar</td>
<td>Rec: ADM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrist</td>
<td>ADM-Wrist</td>
<td>60 mm</td>
<td>2.8 ms</td>
<td>5.53 mV</td>
<td></td>
</tr>
<tr>
<td>Below elbow</td>
<td>Wrist-Below elbow</td>
<td>225 mm</td>
<td>7.1 ms</td>
<td>5.09 mV</td>
<td>52.3 m/s</td>
</tr>
<tr>
<td>Above elbow</td>
<td>Below elbow-Above elbow</td>
<td>100 mm</td>
<td>11.1 ms</td>
<td>0.38 mV</td>
<td>25.2 m/s</td>
</tr>
</tbody>
</table>

Normal Left Median Motor Study

Left Ulnar Motor Study shows reduced distal amplitude with additional amplitude reduction and slowed CV in the across elbow.
Ulnar Neuropathy at the Elbow, an Overview

### Right Median

<table>
<thead>
<tr>
<th>Nerve and Site</th>
<th>Segment</th>
<th>Distance</th>
<th>Amplitude</th>
<th>Peak Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist</td>
<td>Abductor pollicis brevis-Wrist</td>
<td>60 mm</td>
<td>3.8 ms</td>
<td>11.43 mV</td>
</tr>
<tr>
<td>Elbow</td>
<td>Wrist-Elbow</td>
<td>245 mm</td>
<td>8.3 ms</td>
<td>10.25 mV</td>
</tr>
</tbody>
</table>

### Right Ulnar

<table>
<thead>
<tr>
<th>Nerve and Site</th>
<th>Segment</th>
<th>Distance</th>
<th>Amplitude</th>
<th>Peak Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist</td>
<td>ADM-Wrist</td>
<td>60 mm</td>
<td>2.7 ms</td>
<td>8.82 mV</td>
</tr>
<tr>
<td>Below elbow</td>
<td>Wrist-Below elbow</td>
<td>205 mm</td>
<td>6.5 ms</td>
<td>8.35 mV</td>
</tr>
<tr>
<td>Above elbow</td>
<td>Below elbow-Above elbow</td>
<td>115 mm</td>
<td>9.9 ms</td>
<td>7.21 mV</td>
</tr>
</tbody>
</table>

### Sensory Nerve Conduction:

<table>
<thead>
<tr>
<th>Nerve and Site</th>
<th>Segment</th>
<th>Distance</th>
<th>Amplitude</th>
<th>Peak Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Median (Orthodromic)</td>
<td>Rec: Wrist</td>
<td>Digit II (index finger)</td>
<td>130 mm</td>
<td>25.55 μV</td>
</tr>
<tr>
<td>Left Ulnar (Orthodromic)</td>
<td>Rec: Wrist</td>
<td>Digit V (little finger)</td>
<td>110 mm</td>
<td>2.27 μV</td>
</tr>
</tbody>
</table>
Ulnar Neuropathy at the Elbow, an Overview

NERVE CONDUCTION STUDIES:

1. Motor conduction studies of both median nerves are normal. The left ulnar motor conduction revealed low amplitude with conduction block upon proximal stimulation and conduction velocity slowing across the elbow. The right ulnar motor conduction was of normal distal latency and amplitude, however, there was conduction velocity slowing across the elbow.

2. Sensory nerve conduction studies of the median nerves were normal on both sides. Sensory conduction of both ulnar nerves were of low amplitude with normal peak latency on the right and prolonged peak latency on the left. Right sural sensory conduction was normal.

DISCUSSION:

There is electrical evidence to suggest the presence of bilateral ulnar neuropathies that localize to the region of the retroepicondylar groove. The segmental slowing in conduction velocities suggests a focus of demyelination, which usually corresponds to a good prognosis for recovery. There is however additional electrical evidence for some degree of axonal loss in the territory of the left ulnar nerve based on the low distal compound muscle action potential amplitude.
Case Study 3:

54 year-old man with left arm pain and numbness in the 4th and 5th digits for several months.

This is a normal Ulnar motor study to the ADM

Same patient, but slowing to the FDI is apparent. The fascicles going to the FDI are involved, but the fascicles going to the ADM are spared.
NCS summary:
SNC – Orthodromic stimulation of the median nerve is normal. Orthodromic stimulation of the ulnar nerve reveals reduced amplitude and normal peak latency.
MNC – The median nerve recording is normal. The ulnar nerve recording from the ADM is normal. Ulnar nerve recording from the FDI reveals slowing across the elbow.
Bibliography


