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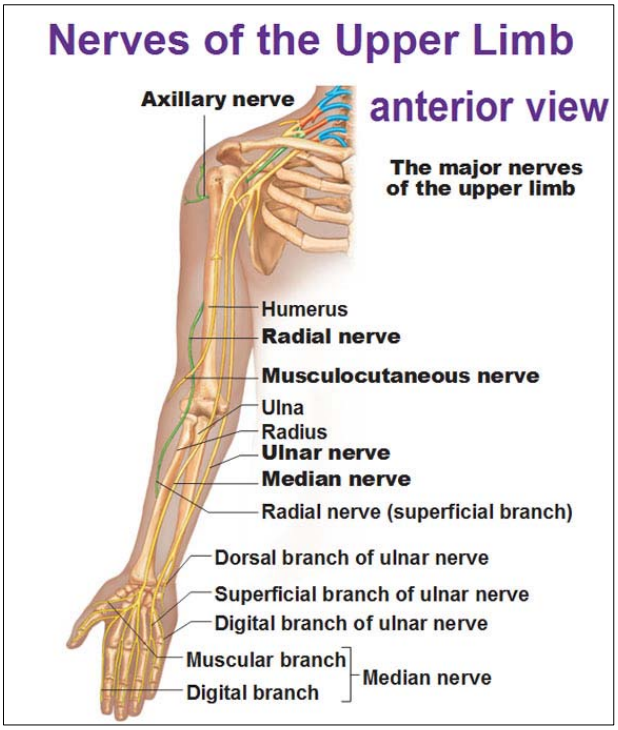
AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

To Rate Impairment Neuropathy Examination Findings Must be Present at MMI

- Entrapment/compression neuropathies are rated when an objective verifiable diagnosis is present, supported by positive clinical findings and loss of function. The diagnosis should be documented by electromyography as well as sensory and nerve conduction studies. AMA Guides 5th (pg.493)

- **AMA Guides Section 16.5 & 16.5a, pg. 480:**



"Accurate diagnosis of peripheral nerve disorders is based on a detailed history, a thorough physical examination with special emphasis on the nervous and vascular system, and appropriate diagnostic tests including a variety of electrical and imaging studies.

The evaluation of permanent impairment resulting from peripheral nerve disorders is based on the anatomic distribution and severity of loss of function resulting from (1) sensory deficits or pain and (2) motor deficits or loss of power. "

- **AMA Guides requires that physicians, before estimating the extent of any impairment, establish an accurate diagnosis.** The primary requirement is the confirmation of the presence or absence of specific pathology or loss of organ function. **Neurodiagnostic studies are an integral part of this process.**

- **Neurodiagnostic testing is essential as an adjunct to the clinical examination in order to determine the diagnosis on which the impairment is based.** Electrodiagnostic tests can be necessary to localize neurologic lesions affecting the peripheral nerves. The simple determination of a diagnosis is not sufficient to assess the level of impairment or disability. **Electrodiagnostic Testing is necessary in order to document the degree of neurologic deficit.** AMA Disability Evaluation- 2nd Edition, pgs .442 - 445. AMA Guides 5th, (pg.480)

- **Nerve conduction and needle electromyography (EMG) studies help to determine which nerves are involved and their anatomic location**. Skillful differentiation of peripheral neuropathy and neuromuscular disorders may also be possible.

- **Expert neuromuscular knowledge and understanding of pathologic manifestations of disease processes are necessary for the appropriate application and performance of these tests, particularly the EMG.** These tests are objective and require minimal cooperation from the individual being tested. They reflect pathology in the largest, fastest-conducting nerve fibers. The interpretation of these tests must be correlated with a detailed neurologic evaluation. AMA Guides 5th (pg. 307)

AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

Diagnosis - The diagnosis of focal nerve compromise is based on (I) the history and symptoms, (2) objective clinical signs and findings on neurologic examination, and (3) documentation by electrodiagnostic studies. Standard roentgenograms (X-rays) and more involved imaging studies may also be useful to exclude other diagnoses. **Normal electrodiagnostic tests fail to meet the definitions necessary to permit a diagnosis of focal nerve compromise for the purpose of impairment rating**.

History - The history should include a listing of occupations; avocations; ADLs; factors that alleviate or aggravate the symptoms; comorbid medical injuries, diagnoses, and conditions; and past surgical procedures or trauma. **The compromise of a major peripheral nerve or one of its branches is manifested by a disturbance of a specific motor, sensory, or autonomic function. The symptoms may vary from slight, intermittent paresthesias (numbness and/or tingling), to constant paresthesias.** Pain with activity may or may not be present. Motor weakness and muscle atrophy are uncommon. **The severity of the nerve damage and symptoms depends on the duration, magnitude, and type of compromise, as well as on the microanatomy of the nerve involved.**

Physical & Neurological Examination- The vast majority of focal neuropathy syndromes come to medical attention long before they develop the severe neuropathy that manifests as objective findings of sensory loss (decreased 2-point discrimination or sharp vs. dull perception) or motor weakness on examination. **The vast majority of nerve entrapment syndromes are diagnosed based on believable symptoms and an abnormal nerve conduction study, but a normal neurologic exam (strength and sensibility).**

The physical examination evaluates sensibility alterations, muscle strength, range of motion, and muscle reflexes in all major muscle groups of the bilateral upper extremities. AMA 5th (pg. 435)

A detailed neurologic examination enables the physician to identify the location of nervous system impairment. The purpose of ancillary (provocative) testing is to assess the severity and location of the lesion and confirm the underlying pathology. It is important to remember that an abnormality found on ancillary testing (anatomic or physiologic) is an impairment but is not necessarily assigned an impairment rating if functions needed for activities of daily living are not affected. The nervous system is able to compensate for a variety of lesions due to its plasticity and redundancy, sometimes resulting in limited representation on the neurologic examination.

Reliable objective exam findings are muscle atrophy and neurologic weakness (not weakness due to pain produced by strength testing, which may be seen with use of the dynamometer grip strength testing). Somewhat reliable subjective findings include decreased sensibility as measured by 2-point discrimination, absent sharp vs. dull stimulus perception, or abnormal monofilament testing. Sensory change in which the individual comments that a stimulus feels subjectively different in one nerve distribution compared with others and changes in vibratory perception are not sensitive or specific enough for use in the diagnosis of local nerve compromise for impairment rating purposes.

Quantitative sensory tests are portable tests, easily conducted in the clinician's office, which provide a quantitative assessment of sensation. These tests can provide information about nerve fibers not examined by nerve conduction studies. **For Entrapment Neuropathies, 'slowing of conduction' is the chief finding of The Nerve Conduction Studies**. - AMA Disability Evaluation, (pg. 466)

AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

Except in the most obvious cases, where motor, sensory and reflex changes are unequivocal, definable and consistent, the task of delineating the presence and extent of a suspected abnormality is heavily dependent on electrodiagnostic procedures.

All clinical tests used to examine the degree of functional loss of sensibility are related to cutaneous touch-pressure sensation. **At present, the two-point test for fine discrimination sensibility is most widely used, followed by the monofilament touch-pressure threshold test**. The pinprick test can be useful to determine whether pain protective sensation is intact and to identify discrepancies between dermatomal findings and reported symptoms. More accurate assessment is obtained by using the sharp and dull sides of the pin at random. Vibration testing has yet to be associated with functional levels of sensibility.

Semmes-Weinstein Test (More Sensitive in Neuropathy & Nerve Compression)

The **Semmes-Weinstein** monofilament pressure aesthesiometer measures light-touch and deep-pressure thresholds with sufficient accuracy to quantify returning sensibility levels long before two-point discrimination is measurable. The moving two-point discrimination test may be useful in evaluating recovering nerve function because response to this stimulus returns before response to a static two-point stimulus. Functional isolation of the finger, as noted in the blindfolded picking-up test, can help determine the presence or absence of any useful sensibility in the digit.

The patterns of nerve loss and recovery seen in neuropathy or neuritis from disease or nerve compression are different from those following nerve lacerations. Within the limits of current instruments, two-point discrimination tests have been normal, whereas both the Semmes-Weinstein pressure aesthesiometer and nerve conduction studies have been abnormal in both clinical and induced neuropathies.

Two-Point Discrimination Test (Most Specific for Nerve Lacerations)

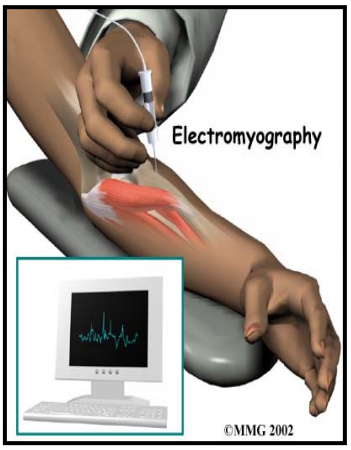
Two-point discrimination has its widest application for individuals, who have sustained nerve lacerations, in whom presence of two-point discrimination usually indicates significant return of function. Testing is started distally and proceeds proximally. The distance between the tips of the instrument is set first at 5 mm. As the individual being tested closes his or her eyes, the tips of the testing device are applied lightly to the sides of the pulp of the distal segment of the digit in a random sequence, in a longitudinal orientation. Because it is light-touch discrimination that is being tested, the pressure applied should be very light and must not produce a point of blanching or skin indentation.

The interval between applications should be no less than 3 to 5 seconds. A series of touches with one or two points is made, and the individual immediately indicates whether one or two points are felt. Two out of three responses must be accurate for scoring. The distance between the ends is progressively increased until the required accurate responses are elicited, at which time the distance is recorded.

Sensibility assessment is one of the most challenging tasks in impairment evaluation. The subjective nature of sensibility testing can relate to a number of variables involving the testing environment, the individual being tested, the test instruments and methods of administration, and the examiner.

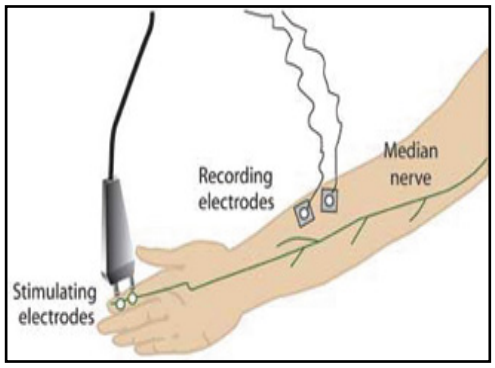
AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

Electrodiagnostic Evaluation



The electrodiagnostic examination includes nerve conduction studies (NCS), with or without EMG (needle) studies or examination. The EMG (needle) examination evaluates muscle cell membrane activity, confirming that a neurologic cause of muscle dysfunction is present. Nerve conduction studies assess only the largest, most heavily myelinated axons.

Electromyogram (EMG or electromyography). This test measures how quickly nerves are carrying electrical signals to the muscles. A thin-needled electrode is inserted into the muscles that appear to be affected by a nerve injury. An instrument records the electrical activity in the muscle at rest and as the muscle moves (contracts).



For impairment rating purposes, upper limb nerve conduction studies must be done with a limb temperature maintained at or above 32°C. The limb temperature must be stated in the report.

Focal demyelination is characteristic of isolated compression neuropathy. Longitudinal demyelination is typical of a generalized peripheral neuropathy. In moderate (conduction block) or severe (axon loss) focal nerve compromise, the amplitude (voltage) of the motor (compound motor action potential or CMAP) and sensory (sensory nerve action potential or SNAP) responses will be significantly decreased with stimulation proximal to the site of compression and recording distal to the site of compromise.

If either motor weakness or sensory loss is present on examination, substantial amounts of at least conduction block (moderate neuropathy), and usually actual axon loss (severe neuropathy), or a combination of both must be present on nerve conduction testing.

In severe focal nerve compromise (axon loss), the nerve conduction studies will show loss of amplitude with stimulation both proximal to and distal to the site of compression. Stimulation distal to the compromise gives the best indication of live axons. In severe focal neuropathy with axon loss the needle EMG exam will show denervation changes of fibrillation potentials and positive waves subacutely, and re-innervation changes of large amplitude polyphasic and decreased recruitment chronically.

In a case in which an examiner finds either sensory loss or neurologic strength loss on physical exam and yet the nerve conduction studies are either normal or show only conduction delays, logically, either the physical examination or the nerve conduction testing is incorrect. It may be appropriate to repeat the physical examination by the same or a different examiner and/or to repeat the nerve conduction testing by an appropriately trained physician, which could include consideration of a certified physician by the **(www.aanem.org).**

- **Electromyographers** use different, nonstandardized definitions of normal. A physician may for treatment purposes, choose to accept an Electromyographers' report interpreting a study as abnormal and consistent with focal neuropathy.

AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

Postoperative Electrodiagnostics when pre-surgical studies more than 1 year old

Postoperative nerve conduction studies are not required to rate impairment for focal nerve compromise syndromes. Significant improvement in nerve conduction studies usually occurs. Some of the improvement is almost immediate, and some occurs over months. Many individuals recover and are asymptomatic, but nerve conduction testing still detects minor slowing (prolonged latencies). Whether or not the nerve conduction tests recover to normal after surgical or nonsurgical treatment does not influence the impairment rating. **The preoperative electrodiagnostic test should be used in the impairment rating unless postoperative studies were done for a clinical indication of failure to improve with surgery and the postoperative study is clearly worse than the preoperative electrodiagnostic study. In this rare case the postoperative study is used.**

Multiple Simultaneous Neuropathies

Multiple, concurrent focal nerve compromise syndromes in the same upper limb are being diagnosed more frequently. Individual risk factors such as preexisting diabetic peripheral neuropathy and hereditary generalized peripheral neuropathy likely play a role in persons who present with simultaneous carpal tunnel syndrome and ulnar neuropathy at the elbow. Both impairments may be rated.

Nerve conduction testing of the upper limbs can clarify the role of generalized peripheral nerve disease and is especially helpful when apportionment between systemic disease and work causation is necessary.

If more than 3 diagnosable focal neuropathies are identified Chapter 16 should not be used. The peripheral neuropathy section of Chapter 13, Section 13.9 should be used, as in these cases almost always the principal problem is a generalized peripheral neuropathy (medical disease) not usually related to occupational or avocational activities.

For an individual with 3 or more simultaneous focal nerve neuropathies causation apportionment must be considered, to the medical disease and not the occupation, when the condition is found not to have industrial causation, e.g. polyneuropathy due diabetes.

Calculating an Impairment Rating for Permanent PND Abnormalities

The upper extremity impairment is calculated by multiplying the grade of severity of the sensory deficit (Table 16-10a – pg. 482) and/or of the motor deficit (Table 16-11a- pg.484) by the respective maximum upper extremity impairment value resulting from sensory and/or motor deficits of each nerve structure involved, as listed in *[text omitted]* ***Table 16-15 – pg. 492, the major peripheral nerves. –*** AMA Guides 5th, pg. 481

In order to receive a permanent impairment, the complaints of pain and loss of sensation have to be consistent, reproducible, and in the defined anatomic pathway of the spinal nerve, brachial plexus or major peripheral nerve that is diseased. AMA Guides 5th-Section 16.5b (pg. 481)

"The pathology that affects the peripheral nerve system (PNS) produces signs and symptoms in the extremities that are specific to the level of area of injury." Only unequivocal and permanent sensory deficits are given permanent impairment ratings. Lesions of an individual nerve produce symptoms and signs in the distribution of the involved nerve." AMA 5th Section 16.3 pgs. 445, 446; Section 16.5, pg. 480 & AMA Disability Evaluation 2nd Edition, pg. 481

The origins and functions of the peripheral nerves that serve the upper extremities are summarized on Table 16-12, pg.484. The motor innervation of the upper extremity is shown in Figure 16-47, pg. 487. The cutaneous innervation and related nerves are shown in Figure 16-48, pg. 488 the dermatomes of the upper extremities in Figure 16-49, pg. 490.

Refer to AMA Guides 5th Table 16-12a&B, (pgs. 485 &486)
FUNCTIONS OF THE UPPER EXTREMITIES PERIPHERAL NERVE * †

Nerve Root	Sensory	Pain	Reflex	Motor
Musculocutaneous Nerve (very rarely damaged)	Lateral Forearm to Wrist	Lateral Forearm	Biceps Jerk	Elbow Flexion with elbow fully supinated (biceps & brachialis)
Suprascapular Nerve (Direct blow to neck base)	Posterolateral Shoulder	Posterolateral Shoulder & Periscapular Region		Supraspinatus (Initiates Abduction) & Infraspinatus Muscle (externally rotates arm)
Axillary Nerve (dislocated shoulder, deep IM injection)	Over Deltoid (Small area)	Across Shoulder Tip	None	Second 90^0 of shoulder abduction (deltoid) (teres minor cannot be evaluated)
Radial Nerve (Crutch Palsy)	Lateral dorsal forearm Back of 1st & 2nd digits	Dorsum(back) of thumb & index finger	Triceps & Supinator jerk	Elbow Extension (Triceps) Wrist Extension / Finger Extension Elbow Flexion, half supinated (brachioradialis)
Median Nerve (Carpal Tunnel or Wrist Trauma)	Lateral Palm & lateral fingers	1st, 2nd 3rd digits Spreads up forearm	Finger Jerks	Wrist Flexors / Pronators of Forearm Long Finger Flexors (1st, 2nd & 3rd) Abductor Pollicis Brevis
Ulnar Nerve (elbow: trauma, bed rest, olecranon) (wrist: local trauma, ganglion of wrist joint)	Medial Palm 5th digit and medial half of 4th	Ulnar supplied fingers and palm distal to the wrist	None	All small hand muscles except APB. However injury at elbow seems to preferentially affect first dorsal interosseous muscle flexor carpi ulnaris (clinical evidence of involvement unusual) Finger flexors (medial 2 fingers). Again clinical involvement unusual

***See Table 16-10a to grade sensory deficit or pain. / † See Table 16 11a to grade motor deficit.**

Grading Sensory Deficits or Pain – AMA Guides 5th, - Section 16.5b pgs. 481-

A wide range of abnormal sensations may be associated with peripheral nerve lesions, including diminished sensation (anesthesia or hypesthesia), abnormal sensation (dysesthesia or paresthesia), and increased sensation (hyperesthesia). Another possible manifestation is pain of various types, including pain resulting from nonnoxious stimulus (allodynia), overreactive pain (hyperpathia), a state of dysesthetic pain (deafferentation), and, most significantly, the sustained, burning pain present in CRPS I (RSD) and CRPS II, (causalgia). Cold intolerance may also be present.

Table 16-10 is used for pain that is due to *nerve injury* or disease that has been documented with objective physical findings or electrodiagnostic abnormalities. *It is not to be used for pain in the distribution of a nerve that has not been injured* except in diagnosed cases of complex regional pain syndromes. The examiner must use clinical judgment to estimate the appropriate percentage of sensory deficits or pain within the range of values shown for each severity grade. **The maximum value for each grade is not applied automatically. –** AMA pg. 482

AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

AMA Guides 5th Table 16-10 (pg. 482) - Peripheral Nerves Disorders: Determining Impairment of the UE Due to Sensory Deficits of Pain

a. Classification

Grade	Description of % Sensory Grade Sensory Deficit or Pain	% Of Sensory Deficit
5	No loss of sensibility, abnormal sensation, or pain	0
4	Distorted superficial tactile sensibility (diminished light touch), with or without minimal abnormal sensations or pain that is forgotten during activity	1-25
3	Distorted superficial tactile sensibility (diminished light touch and two-point discrimination), with some abnormal sensations or slight pain, that interferes with some activities	26-60
2	Decreased superficial cutaneous pain and tactile sensibility (decreased protective sensibility), with abnormal sensations or moderate pain that may prevent some activities.	61-80
1	Deep cutaneous pain sensibility present; absent superficial pain and tactile sensibility (absent protective sensibility), with abnormal sensations or severe pain that prevents most activity	81-99
0	Absent sensibility, abnormal sensations, 100 or severe pain that prevents all activity	100

b. Procedure

1. Identify the area of involvement using the cutaneous Innervation chart (Figure 16-48) or the dermatome chart (Figure 16-49).
2. Identify the nerve structure(s) that innervate the area(s) (Table 16-12 and Figures 16-48, 16-49, and 16-50).
3. Grade the severity of the sensory deficit or pain according to the classification given above (a). Use clinical judgment to select the appropriate percentage from the range of values shown for each severity grade.
4. Find the maximum upper extremity impairment value due to sensory deficit or pain for each nerve structure involved: spinal nerves (Table 16-13), brachial plexus (Table 16-14), and major peripheral nerves (Table 16-15).
5. Multiply the severity of the sensory deficit by the Maximum upper extremity impairment value to obtain the upper extremity impairment for each nerve structure involved.

Grading Motor Deficits and Loss of Power – AMA Guides 5th, pg. 483

Involvement of the peripheral nerve system structures may lead to paralysis or weakness of the muscles they supply and/or to characteristic sensory changes. Clinical examination of the upper extremity demands precise anatomic knowledge to properly select the muscle tests that correlate to the specific nerve structure(s) involved (Table 16-12). Some muscles display a dual or variable pattern of nerve supply and require special consideration.

Upper extremity impairments due to motor deficits and loss of power resulting from peripheral nerve disorders are determined according to the grade of severity of loss of function and the relative maximum upper extremity impairment value of the nerve structure involved, as shown in the classification (a) and procedural (b) steps described in Table 16-11, pg. 484 and the impairment determination method detailed in Section 16.5b, pg. 481.

AMA Guides 5th, Section 16.5: Peripheral Nerve Disorders (PND) / Neuropathies Neurological Examination & Testing

AMA 5th Edition, Table 16-11 (pg. 484): Peripheral Nerve Disorders UE Impairment Due to Motor and Loss of Power Deficits,

a. Classification

Grade	Description of Muscle Function	% Of Sensory Deficit
5	Complete active range of motion against gravity with full resistance	0
4	Complete active range of motion against gravity with some resistance	1-25
3	Complete active range of motion against gravity only, without resistance	26-60
2	Complete active range of motion against gravity with gravity eliminated	61-80
1	Evidence of slight contractility; no joint movement	81-99
0	No evidence of slight contractility.	100

b. Procedure

1. Identify the motion involved, such as flexion, extension, etc.
2. Identify the muscle(s) performing the motion and the motor nerve(s) involved.
3. Grade the severity of motor deficit of individual muscles according to the classification given above.
4. Find the maximum impairment of the upper extremity due to motor deficit for each nerve structure involved: spinal nerves (Table 16-13), brachial plexus (Table 16-14), and major peripheral nerves (Table 16-1 5).
5 *Multiply* the severity of the motor deficit by the maximum impairment value to obtain the upper extremity impairment for each structure involved.

Table 16-11 is not to be used for rating weakness that is not due to a diagnosed injury of a specific nerve or nerves since weakness may be due to many causes including pain. A diagnosis of nerve injury can usually be made by a careful physical examination done by an examiner who has sufficient knowledge of the anatomy and function of the part. If there is doubt about the presence of a nerve injury, electromyographic studies may be necessary to confirm the diagnosis.

AMA Guides Substantial Medical Evidence Standards for Permanent Impairment

- **AMA Guides Section 2.6b, pg. 22: Calculating the Impairment Ratings**
  Evaluating physician:
  1. **Compares the medical findings with the impairment criteria listed within the *Guides* and calculate the appropriate impairment rating.**
  2. **Discusses how specific findings relate to and compare with the criteria described in the applicable *Guides* chapter.**
  3. **Refers to and explain the absence of any pertinent data and how the physician determined the impairment rating with limited data.**

- **AMA Guides Section 2.6c: Discussion of How Each Impairment Rating Was Calculated**
- **Evaluating physician:**
  - **2.6c.1** Includes an explanation of each impairment value with reference to the applicable criteria of the *Guides.* Combine multiple impairments for a whole person impairment.
  - **2.6c.2** Includes a summary list of impairments and impairment ratings by percentage, including calculation of the whole person impairment.

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MMI Medical Report Clinical Substantial Medical Evidence Checklist
Upper Extremities Peripheral Nerve Disorders Impairments (PND)

"The pathology that affects the PNS produces signs and symptoms in the extremities that are specific to the level of area of injury." Only unequivocal and permanent sensory deficits are given permanent impairment ratings. Lesions of an individual nerve produce symptoms and signs in the distribution of the involved nerve." AMA 5th Section 16.3 pgs. 445, 446; Section 16.5, pg. 480 & AMA Disability Evaluation 2nd Edition, pg. 481

AMA Guides 5th - Figure 16-48 (pg. 488),
AMA Disability Evaluation (2nd Edition), Figure 35-2: