



# CLINICAL GUIDELINES

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## PND Imaging Policy

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eviCore healthcare Clinical Decision Support Tool Diagnostic Strategies: This tool addresses common symptoms and symptom complexes. Imaging requests for individuals with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician, specialist and/or individual's Primary Care Physician (PCP) may provide additional insight.

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## **PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES**

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**ABBREVIATIONS for PERIPHERAL NERVE DISORDERS IMAGING**  
**GUIDELINES**

<b>AIDS</b>	Acquired Immunodeficiency Syndrome
<b>ALS</b>	Amyotrophic Lateral Sclerosis
<b>CIDP</b>	Chronic Inflammatory Demyelinating Polyneuropathy
<b>CNS</b>	central nervous system
<b>CPK</b>	creatinine phosphokinase
<b>CT</b>	computed tomography
<b>EMG</b>	electromyogram
<b>LEMS</b>	Lambert-Eaton Myasthenic Syndrome
<b>MG</b>	myasthenia gravis
<b>MRI</b>	magnetic resonance imaging
<b>MRN</b>	magnetic resonance neurography
<b>MRS</b>	magnetic resonance spectroscopy
<b>NCV</b>	nerve conduction velocity
<b>PET</b>	positron emission tomography
<b>PNS</b>	peripheral nervous system
<b>PNST</b>	Peripheral Nerve Sheath Tumor
<b>POEMS</b>	Polyneuropathy, Organomegaly, Endocrinopathy, M-protein, Skin changes
<b>TOS</b>	Thoracic Outlet Syndrome

## PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES

### PN-1~GENERAL GUIDELINES

A current clinical evaluation (within 60 days) is required before advanced imaging can be considered. The clinical evaluation may include a relevant history and physical examination, including a neurological examination, appropriate laboratory studies, non-advanced imaging modalities, electromyography and nerve conduction (EMG/NCV) studies. Other meaningful contact (telephone call, electronic mail or messaging) by an established patient can substitute for a face-to-face clinical evaluation.

✓ MRI is, most often, preferable to CT.

#### **Reference**

1. Bowen BC et al. *Magnetic Resonance Imaging of the Peripheral Nervous System*. In Latchaw RE, Kucharczyk J, Moseley ME. *Imaging of the Nervous System*. Philadelphia, Elsevier, 2005, pp.1479-1497.

## PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES

### PN-2~FOCAL NEUROPATHY

Focal Disorder	EMG/NCV Initially?	Advanced Imaging
<b>Carpal Tunnel Syndrome</b>	YES	<ul style="list-style-type: none"> <li>• No established role for advanced imaging</li> <li>• Ultrasound of the wrist to estimate size of the carpal tunnel may be helpful in the evaluation and confirmation of carpal tunnel syndrome pre-operatively when EMG findings are equivocal and clinical findings are uncertain</li> <li>• See also: <b><u>MS-21~Wrist</u></b> and</li> <li>• <b><u>SP-3~Cervical Radiculopathy</u></b></li> </ul>
<b>Ulnar Neuropathy</b>	YES	<b>For pre-op only:</b> MRI of the elbow without contrast (CPT <sup>®</sup> 73221) or MRI of the upper arm forearm without contrast (CPT <sup>®</sup> 73218)
<b>Radial Neuropathy</b>	YES	<ul style="list-style-type: none"> <li>• MRI of the upper arm or forearm without contrast (CPT<sup>®</sup> 73218) in severe cases when surgery is being considered.</li> <li>• MRI of the upper arm or forearm without and with contrast (CPT<sup>®</sup> 73220) if there is a suspicion of a nerve tumor such as a neuroma</li> </ul>
<b>Radial Neuropathy Notes:</b> Leads to wrist drop with common sites of entrapment the inferior aspect of the humerus (Saturday night palsy) or the forearm (Posterior Interosseus Syndrome). Trauma or fractures of the humerus, radius, or ulna can damage the radial nerve		
<b>Sciatic Neuropathy</b>	YES	CT pelvis with contrast (CPT <sup>®</sup> 72193) or MRI pelvis without contrast (CPT <sup>®</sup> 72195) should be performed in the evaluation of these entities. CT pelvis without contrast is not indicated due to lack of soft tissue contrast. It should only be performed in the rare circumstance of contrast allergy and contraindication to MRI such as pacemaking device.
<b>Sciatic Neuropathy Notes:</b> 98% from lumbar radiculopathy, also trauma to the gluteal area with hematoma, injection palsy, hip or pelvic fractures, or hip replacement (arthroplasty) and rarely Piriformis Syndrome involves entrapment of the sciatic nerve at the sciatic notch in the pelvis by a tight piriformis muscle band		
<b>Femoral Neuropathy</b>	NO	CT pelvis with contrast (CPT <sup>®</sup> 72193) or MRI pelvis without contrast (CPT <sup>®</sup> 72195) should be performed in the evaluation of these entities.

<b>Femoral Neuropathy Notes:</b> as a complication of pelvic surgery in women or those on anticoagulants with retroperitoneal bleeding		
<b>Meralgia Paresthetica</b>	NO	CT pelvis with contrast (CPT <sup>®</sup> 72193) or MRI pelvis without contrast (CPT <sup>®</sup> 72195) should be performed in the evaluation of these entities. CT pelvis without contrast is not indicated due to lack of soft tissue contrast. It should only be performed in the rare circumstance of contrast allergy and contraindication to MRI such as pacemaking device.
<b>Meralgia Paresthetica Notes:</b> sensory loss in the lateral femoral cutaneous nerve as it exits the pelvis under the inguinal ligament (lateral thigh without extension into lower leg)		
<b>Peroneal Neuropathy</b>	YES	Knee MRI without contrast (CPT <sup>®</sup> 73721) or MRI lower extremity other than joint without contrast (CPT <sup>®</sup> 73718) in severe cases when surgery is considered
<b>Peroneal Neuropathy Notes:</b> foot drop which usually resolves unless L5 radiculopathy		
<b>Tarsal Tunnel Syndrome</b>	N/A	See: <b><u>MS-27 Tarsal Tunnel</u></b>
<b>Other Peripheral Mononeuropathies</b>	N/A	MRI without or without and with contrast if preoperative

## References

1. Andreisek G, Crook DW, Burg D, Marincek B, Weishaupt D. Peripheral neuropathies of the median, radial, and ulnar nerves: MR imaging features. *Radiographics*.2006;26:1267-1287.
2. Iverson DJ. MRI detection of cysts of the knee causing common peroneal neuropathy. *Neurology*. 2005;65:1829-1831.
3. Cartwright MS, Walker FO. Neuromuscular ultrasound in common entrapment neuropathies. *Muscle & Nerve*.2013;48:696-704.
4. Linda DD, Harish S, Stewart BG, Finlay K, et al. Multimodality imaging of peripheral neuropathies of the upper limb and brachial plexus. *Radiographics*.2010;30:1373-1400.

## PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES

### PN-3~POLY NEUROPATHY

Poly-Disorder	EMG/NCV Initially?	Advanced Imaging	Comments
<b>PNS/CNS Crossover Syndromes</b>	YES	MRI without and with contrast of brain and/or spinal cord if clinical findings point to abnormalities in those areas.	Guillain-Barré syndrome
<b>AIDS Related Cytomegaloviral Neuropathy/ Radiculopathy</b>	YES	Lumbar spine MRI without and with contrast (CPT <sup>®</sup> 72158) if suspected	Urinary retention and a clinically confusing picture in the legs
<b>Chronic Inflammatory Demyelinating Polyneuropathy (CIDP)</b>	YES	Lumbar spine MRI without and with contrast (CPT <sup>®</sup> 72158) if uncertain following EMG	
<b>Multifocal Motor Neuropathy</b>	YES	MRI of the brachial plexus without and with contrast (CPT <sup>®</sup> 71552 or CPT <sup>®</sup> 73220) if uncertain following EMG	
<b>POEMS (Polyneuropathy, Organomegaly, Endocrinopathy, M-protein, Skin changes)</b>	YES	Advanced imaging is for the non-neurological entities of this rare osteosclerotic plasmacytoma syndrome	See: <b><u>ONC-25~Multiple Myeloma</u></b>
<b>Subacute Sensory Neuronopathy &amp; Other Paraneoplastic Demyelinating Neuropathies</b>	YES	Advanced imaging guided by <b><u>HD-22</u></b> for collagen <u>vascular</u> disorders	See: <b><u>HD-22~Cerebral Vasculitis</u></b> (systemic lupus, Sjogren's syndrome, Beçet's disease, polyarteritis nodosa, Churg-Strauss syndrome, and Wegener's granulomatosis)

### References

1. Anders HJ, Goebel FD. Cytomegalovirus polyradiculopathy in patients with AIDS. *Clin Infect Dis.* 1998;27:345-352.
2. Duggins AJ, McLoed JG, Pollard JD, et al. Spinal root and plexus hypertrophy in chronic inflammatory demyelinating polyneuropathy. *Brain.* 1999;122:1383-1390.
3. Amato AA, Barohn RJ, Katz JS, Saperstein DS. Clinical spectrum of chronic acquired demyelinating polyneuropathies. *Muscle & Nerve.* 2001;24:311-324.
4. Darnell RB, Posner JB. Paraneoplastic Syndromes Involving the Nervous System. *N Engl J Med.* 2003;349:1543-1554.

5. Antoine JC, Bouhour F, Camdessanche JP. [18F]fluorodeoxyglucose positron emission tomography in the diagnosis of cancer in patients with paraneoplastic neurological syndrome and anti-Hu antibodies. *Ann Neurol.* 2000;48:105-108.



## PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES

### PN-4~BRACHIAL PLEXUS

- ✓ Brachial plexus studies can be coded either as upper extremity other than joint MRI without or without and with contrast (CPT<sup>®</sup> 73218 or CPT<sup>®</sup> 73220), chest MRI without or without and with contrast (CPT<sup>®</sup> 71550 or CPT<sup>®</sup> 71552) or neck MRI without (CPT<sup>®</sup> 70540) or without and with contrast (CPT<sup>®</sup> 70543) (if upper trunk) after EMG/NCV examination for:
  - Malignant infiltration (EMG not required)
  - Radiation plexitis to r/o malignant infiltration
  - Brachial plexitis (Parsonage-Turner Syndrome or painful brachial amyotrophy).
    - Self-limited syndrome characterized by initial shoulder region pain followed by weakness of specific muscles in a pattern which does not conform to involvement of a single root or distal peripheral nerve
    - Consider MRI of the cervical spine if radiculopathy.
    - See: **SP-3 Cervical Radiculopathy**
  - Traumatic injury
  - Neurogenic Thoracic Outlet Syndrome (TOS) failed a 2 to 3 month trial of conservative management and are being considered for surgical treatment.
  - See: **CH-32~Thoracic Outlet Syndrome**
  - Preoperative study which requires evaluation of the brachial plexus

### **References**

1. Adkins MC, Wittenberg KH. MR imaging of nontraumatic brachial plexopathies: frequency and spectrum of findings. *Radiographics*.2000; 20:1023-1032.
2. Aiken AH, Angevine PD, Angtuaco EJ, Brown DC, et al. *ACR Appropriateness Criteria®*, *Plexopathy*. 2012.
3. Van Es HW. MRI of the brachial plexus. *Eur Radiol*. 2001; 11:325-336.
4. Foley KM, Kori SH, Posner JB. Brachial plexus lesions in patients with cancer: 100 cases. *Neurology*.1981;31:45-50.
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6. Husband JE, MacVicar AD, Padhani AR, Qayyum A, Revell P. Symptomatic brachial plexopathy following treatment for breast cancer: utility of MR imaging with surface-coil techniques. *Radiology*. 2000;214:837-842.
7. McDonald TJ, Miller JD, Pruitt S. Acute brachial plexus neuritis: an uncommon cause of shoulder pain. *Am Fam Physician*. 2000;62:2067-2072.

## PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES

### **PN-5~LUMBAR and LUMBOSACRAL PLEXUS**

- ✓ The following studies can be considered: MRI Pelvis without and with contrast with fat suppression imaging (CPT<sup>®</sup> 72197) **OR** MRI Abdomen *and* Pelvis without and with contrast with fat suppression imaging (CPT<sup>®</sup> 74183 and CPT<sup>®</sup> 72197) **OR** if MRI is not available, CT Pelvis with contrast (CPT<sup>®</sup> 72193) **OR** CT Abdomen *and* Pelvis with contrast (CPT<sup>®</sup> 74177) can be considered after EMG/NCV based on whether the upper lumbar plexus (abdominal retroperitoneal space) or the lumbosacral plexus (pelvis), respectively, is involved based on:
- Malignant infiltration (EMG not required)
  - Radiation plexopathy to r/o malignant infiltration
  - Traumatic injury

#### **References**

1. Brejt N, Berry J, Nisbet A, et al. Pelvic radiculopathies, lumbarsacral plexopathie, and neuropathies in oncologic disease: a multidisciplinary approach to a diagnostic challenge. *Cancer Imaging*, 2013; 13:591-601.
2. McDonald JW, Sadwosky C. Spinal-cord injury. *The Lancet*, 2002;359:417-425.

## **PN-6~MUSCLE DISORDERS**

### **PN-6.1 Neuromuscular Disease**

- ✓ Myasthenia Gravis (MG) is associated with thymic disease and can undergo:
  - Chest CT with contrast (CPT<sup>®</sup> 71260) after an established diagnosis of MG
    - Can be repeated if initial CT previously negative and now symptoms of chest mass, rising anti-striated muscle antibody titers, or need for preoperative evaluation (clinical presentation, electro-diagnostic studies, and antibody titers).

### **Lambert–Eaton myasthenic syndrome (LEMS) is associated with small cell lung cancer and can undergo:**

- ✓ Chest CT with contrast (CPT<sup>®</sup> 71260) with a suspected diagnosis (CXR, symptoms of lung mass, clinical presentation, electro-diagnostic studies, and antibody titers).
  - Can be repeated if initial CT previously negative after 3 months with persistent suspicion.
- ✓ Stiff man syndrome is associated with small cell lung cancer and breast cancer
  - Chest CT with contrast (CPT<sup>®</sup> 71260) if Stiff Man Syndrome is suspected based on clinical findings.

### **PN-6.2 Inflammatory Muscle Diseases**

MRI and ultrasound are increasingly being used in the evaluation of muscle disease. MRI may be helpful in demonstrating abnormalities in muscles that are difficult to examine or not clinically weak, and MRI can also help distinguish between different types of muscle disease. MRI is also useful in determining sites for muscle biopsy.

MRI without contrast (CPT 73218/73718) or MRI without and with contrast (CPT 73220/73720) for:

- 1) additional evaluation of myopathy or myositis (based on clinical exam and adjunct testing with EMG/NCV and labs)
- 2) to plan muscle biopsy
- 3) treatment monitoring

See also Pediatric Inflammatory Muscle Diseases: **PEDMS 3**

- ✓ All cases with dermatomyositis and polymyositis can undergo search for occult neoplasm (see **ONC – 30.3 Paraneoplastic Syndromes**):
  - Initially with Chest CT with contrast (CPT<sup>®</sup> 71260) for lung cancer and pelvic ultrasound (in women) (CPT<sup>®</sup> 76856 or CPT<sup>®</sup> 76857 and/or CPT<sup>®</sup> 76830 [transvaginal]) for ovarian cancer should be done initially.
  - Abdomen and pelvis CT with contrast (CPT<sup>®</sup> 74177) if the above fail to make a diagnosis.

### **PN-6.3 Gaucher Disease (Storage Disorders)**

See **AB-11~Gaucher Disease** in the Abdomen Imaging Guidelines.

See **PEDPN-4~Gaucher Disease** in the pediatric PND Imaging Guidelines

### **References**

1. Darnell R, Posner J. Paraneoplastic syndromes involving the nervous system.. *N Engl J Med.* 2003; 349:1543-1554.
2. Schweitzer M, Fort J. Cost-effectiveness of MR imaging in evaluating polymyositis. *Am J Roentgenol.* 1995; 165:1469-1471?
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5. Sekul E, Chow C, Dalakas M. Magnetic resonance imaging of the forearm as a diagnostic aid in patients with sporadic inclusion body myositis. *Neurology.* 1997;48:863-866.
6. Lundberg I, Chung Y. Treatment and investigation of idiopathic inflammatory myopathies. *Rheumatology.* 2000;39:7-17.
7. Park J, Olsen N. Utility of magnetic resonance imaging in the evaluation of patients with inflammatory myopathies. *Curr Rheumatol Reports.* 2001; 3:334-345.
8. Hill C, Zhang Y, Sigurgeirsson B, et al. Frequency of specific cancer types in dermatomyositis and polymyositis: a population-based study. *Lancet.* 2001; 357:96-100.
9. Maas M, Poll L, Terk M. Imaging and quantifying skeletal involvement in Gaucher disease. *B J Radiol.* 2002; 75 suppl 1:A13-A24.
10. Giraldo P, Pocovi M, Perez-Calvo J, Rubio-Felix, Giralt M. Report of the Spanish Gaucher's disease registry: clinical and genetic characteristics. *Haematologica.* 2000; 85:792-799. 2016.
11. Rosow et al. The Role of Electrodiagnostic Testing, Imaging, and Muscle Biopsy in the Investigation of Muscle Disease. *Continuum* 2016, vol. 22(6) 1787-1802.

**PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES**

**PN-7~NEWER IMAGING TECHNIQUES**

See: **HD-24.5 Magnetic Resonance Neurography (MRN)**

**PN-8~AMYOTROPHIC LATERAL SCLEROSIS (ALS)**

- ✓ MRI of the brain, cervical, thoracic, and lumbar spine most often without contrast, but may be without and with contrast with menigeal symptoms.
  - Can be considered when ALS is suspected (combination of upper and lower motor neuron findings) to establish a diagnosis.
  - Repeat imaging can be evaluated based on the appropriate Spine Imaging Guidelines.

**References**

1. Agosta F, Chio A, Cosottini M, De Stefano N, et al. The present and the future of neuroimaging in amyotrophic lateral sclerosis. *American Journal of Neuroradiology*. 2010; 31: 1769-1777.
2. Kollwe K, Korner S, Dengler R, Petri S, Mohammadi B. Magnetic resonance imaging in amyotrophic lateral sclerosis. *Neurology Research International*. 2012; v2012.
3. Filippi M, Agosta F, Abrahams S, Fazekas F, et al. EFNS guidelines on the use of neuroimaging in the management of motor neuron diseases. *Eur J Neurol*. 2010; 17:526-e20.
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## PERIPHERAL NERVE DISORDERS (PND) IMAGING GUIDELINES

### **PN-9~PERIPHERAL NERVE SHEATH TUMORS (PNST)**

- ✓ Tumors (Schwannomas or Neurofibromas) that arise from Schwann cells or other connective tissue of the nerve are located anywhere in the body and can undergo advanced imaging when suspected, which may include:
  - MRI brain without and with contrast (CPT<sup>®</sup> 70553)
  - Cervical, thoracic, and lumbar spine MRI without and with contrast (CPT<sup>®</sup> 72156, CPT<sup>®</sup> 72157, and CPT<sup>®</sup> 72158) if paraspinous neurofibroma is found any spine level or multiple simplex perineural neurofibromas.
  - Follow-up imaging is not needed unless:
    - New symptoms or neurological findings
    - Malignant transformation (5%) is known or suspected; includes a metastatic work-up CT chest and abdomen with contrast (CPT<sup>®</sup> 71260 and CPT<sup>®</sup> 74160).
- ✓ See: **PACONC-2.3 Neurofibromatosis**, Type 1

#### **References**

1. Riccardi V. The genetic predisposition to and histogenesis of neurofibromas and neurofibrosarcoma in neurofibromatosis type 1. *Neurosurg Focus*. 2007; 22(6):E3.
2. Li C, Huang G, Wu H, et al. Differentiation of soft tissue benign and malignant peripheral nerve sheath tumors with magnetic resonance imaging. *Clin Imaging*. 2008; 32(2): 121-127.
3. Murovic J, Kim D, Kline D. Neurofibromatosis-associated nerve sheath tumors. Case report and review of the literature. *Neurosurg Focus*. 2006; 20(1):E1.

**PN-10~NUCLEAR IMAGING**

- ✓ Nuclear Medicine
  - Nuclear medicine studies are not generally indicated in the evaluation of peripheral nerve disorders. See **PEDPN-2~Neurofibromatosis** for specific imaging guidelines regarding PET/CT in evaluation of peripheral nerve tumors.