



CLINICAL GUIDELINES

Pediatric Peripheral Nerve Disorders (PND) Imaging Guidelines

Version 1.0.2024

Effective February 1, 2024



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.

eviCore's Clinical Review Criteria ("CRC") and related content is made available for the limited uses of: reference; and individual use, only limited to facilitating the determination of medically necessary and appropriate clinical treatment by clinicians for specific delegated patients under their care. The CRC and related content is proprietary information of eviCore, and copyrighted to the full extent of the law. Except as expressly permitted, you may not modify, copy, reproduce, republish, upload, post, transmit, hyperlink to or from, or distribute in any way the CRC, nor may you sell, transfer, distribute, assign, lease, reproduce, or otherwise use the CRC in commerce, in a manner that competes with us or infringes upon our rights, or for any public or commercial endeavor without our prior and express written consent.

CPT® (Current Procedural Terminology) is a registered trademark of the American Medical Association (AMA). CPT® five digit codes, nomenclature and other data are copyright 2023 American Medical Association. All Rights Reserved. No fee schedules, basic units, relative values or related listings are included in the CPT® book. AMA does not directly or indirectly practice medicine or dispense medical services. AMA assumes no liability for the data contained herein or not contained herein.

©2023 eviCore healthcare. All rights reserved.

Table of Contents

Guideline	Page
General Guidelines (PEDPN-1).....	3
Neurofibromatosis (PEDPN-2).....	12
Brachial Plexus (PEDPN-3).....	16
Gaucher Disease (PEDPN-4).....	19
Spinal Muscular Atrophy (PEDPN -5).....	21

General Guidelines (PEDPN-1)

Guideline	Page
Procedure Codes Associated with Peripheral Nerve Disorders (PND)	
Imaging.....	4
General Guidelines (PEDPN-1.0).....	7
Age Considerations (PEDPN-1.1).....	8
Modality General Considerations (PEDPN-1.3).....	9
References (PEDPND-1).....	11

Procedure Codes Associated with Peripheral Nerve Disorders (PND) Imaging

PNP.GG.ProcedureCodes.A
v1.0.2024

MRI	CPT®
MRI Neck without contrast	70540
MRI Neck without and with contrast	70543
MRI Cervical without contrast	72141
MRI Cervical without and with contrast	72156
MRI Brachial Plexus without contrast (unilateral)	73218
MRI Brachial Plexus without and with contrast (unilateral)	73220
MRI Brachial Plexus without contrast (bilateral)	71550
MRI Brachial Plexus without and with contrast (bilateral)	71552
MRI Chest without contrast	71550
MRI Chest without and with contrast	71552
MRI Thoracic without contrast	72146
MRI Thoracic without and with contrast	72157
MRI Lumbar without contrast	72148
MRI Lumbar without and with contrast	72158
MRI Abdomen without contrast	74181
MRI Abdomen without and with contrast	74183
MRI Pelvis without contrast	72195
MRI Pelvis without and with contrast	72197
MRI Upper Extremity Other Than Joint without contrast	73218
MRI Upper Extremity Other Than Joint with contrast (rarely used)	73219
MRI Upper Extremity Other Than Joint without and with contrast	73220
MRI Upper Extremity Joint without contrast	73221
MRI Upper Extremity Joint with contrast (rarely used)	73222
MRI Upper Extremity Joint without and with contrast	73223
MRI Lower Extremity Other Than Joint without contrast	73718
MRI Lower Extremity Other Than Joint with contrast (rarely used)	73719

MRI	CPT[®]
MRI Lower Extremity Other Than Joint without and with contrast	73720
MRI Lower Extremity Joint without contrast	73721
MRI Lower Extremity Joint with contrast (rarely used)	73722
MRI Lower Extremity Joint without and with contrast	73723
Unlisted MRI procedure (for radiation planning or surgical software)	76498

MRA	CPT[®]
MRA Upper Extremity	73225
MRA Lower Extremity	73725

Nuclear Medicine	
PET Imaging; limited area (this code not used in pediatrics)	78811
PET Imaging: skull base to mid-thigh (this code not used in pediatrics)	78812
PET Imaging: whole body (this code not used in pediatrics)	78813
PET with concurrently acquired CT; limited area (this code rarely used in pediatrics)	78814
PET with concurrently acquired CT; skull base to mid-thigh	78815
PET with concurrently acquired CT; whole body	78816
Bone Marrow Imaging Limited Areas	78102
Bone Marrow Imaging Multiple Areas	78103
Bone Marrow Imaging Whole Body	78104
Nuclear Bone Scan Limited	78300
Nuclear Bone Scan Multiple Areas	78305
Nuclear Bone Scan Whole Body	78306
Bone Scan Three Phase	78315
Radiopharmaceutical Localization Imaging Limited Area	78800
Radiopharmaceutical Localization Imaging Whole Body	78802

Nuclear Medicine	
Radiopharmaceutical Localization Imaging SPECT	78803

General Guidelines (PEDPN-1.0)

PNP.GG.0001.0.A

v1.0.2024

- A pertinent clinical evaluation including a detailed history, physical examination since the onset or change in symptoms with a thorough neurologic examination, appropriate laboratory studies, and basic imaging such as plain radiography or ultrasound should be performed prior to considering advanced imaging (CT, MRI, Nuclear Medicine), unless the individual is undergoing guideline-supported scheduled imaging evaluation. A meaningful technological contact (telehealth visit, telephone call, electronic mail or messaging) since the onset or change in symptoms can serve as a pertinent clinical evaluation.
 - EMG may not be of clinical utility or obtainable in infants or individuals with severe developmental delay
 - EMG/NCS results may not be abnormal until 10 days after injury.
- Unless otherwise stated in a specific guideline section, the use of advanced imaging to screen asymptomatic individuals for disorders involving the peripheral nervous system is not supported. Advanced imaging of the peripheral nervous system is only appropriate in individuals who have documented active clinical signs or symptoms of disease involving the peripheral nervous system.
- Unless otherwise stated in a specific guideline section, repeat imaging studies of the peripheral nervous system are not necessary unless there is evidence for progression of disease, new onset of disease, and/or documentation of how repeat imaging will affect individual management or treatment decisions.

Age Considerations (PEDPN-1.1)

PNP.GG.0001.1.A

v1.0.2024

- Many conditions affecting the peripheral nervous system in the pediatric population are different diagnoses than those occurring in the adult population. For those diseases that occur in both pediatric and adult populations, minor differences may exist in management due to individual age, comorbidities, and differences in disease natural history between children and adults.
- Individuals who are 18 years old or younger¹¹ should be imaged according to the Pediatric Peripheral Nerve Disorders Imaging Guidelines if discussed. Any conditions not specifically discussed in the Pediatric Peripheral Nerve Disorder Imaging Guidelines should be imaged according to the General Peripheral Nerve Disorder Imaging Guidelines. Individuals who are >18 years old should be imaged according to the General Peripheral Nerve Disorders Imaging Guidelines, except where directed otherwise by a specific guideline section.

Modality General Considerations (PEDPN-1.3)

PNP.GG.0001.3.A

v1.0.2024

- MRI
 - MRI without and with contrast is the preferred modality for pediatric peripheral nerve imaging unless otherwise stated in a specific guideline section.
 - Due to the length of time required for MRI acquisition and the need to minimize individual movement, anesthesia is usually required for almost all infants (except neonates) and young children (age <7 years) as well as older children with delays in development or maturity. This anesthesia may be administered via oral or intravenous routes. In this individual population, MRI sessions should be planned with a goal of minimizing anesthesia exposure by adhering to the following considerations:
 - MRI procedures can be performed without and/or with contrast as supported by these condition-based guidelines. If intravenous access will already be present for anesthesia administration and there is no contraindication for using contrast, imaging without and with contrast may be appropriate if requested. By doing so, the requesting provider may avoid repetitive anesthesia administration to perform an MRI with contrast if the initial study without contrast is inconclusive.
 - Recent evidence based literature demonstrates the potential for gadolinium deposition in various organs including the brain after the use of MRI contrast.
 - The U.S. Food and Drug Administration (FDA) has noted that there is currently no evidence to suggest that gadolinium retention in the brain is harmful and restricting gadolinium-based contrast agents (GBCAs) use is not warranted at this time. It has been recommended that GBCA use should be limited to circumstances in which additional information provided by the contrast agent is necessary and the necessity of repetitive MRIs with GBCAs should be assessed.
 - If multiple body areas are supported by the guidelines for the clinical condition being evaluated, MRI of all necessary body areas should be obtained concurrently in the same anesthesia session.
- CT
 - CT is rarely used in the evaluation of pediatric peripheral nerve disorders. See specific guideline sections for indications.
- Ultrasound
 - Ultrasound is rarely used in the evaluation of pediatric peripheral nerve disorders. See specific guideline sections for indications.

- Nuclear Medicine
 - Nuclear medicine studies are generally not indicated in the evaluation of peripheral nerve disorders. See **Neurofibromatosis (PEDPN-2)** for specific imaging guidelines regarding PET/CT in evaluation of peripheral nerve tumors.
- 3D Rendering
 - 3D Rendering indications in pediatric PND imaging are identical to those in the general imaging guidelines. See **3D Rendering (Preface-4.1)** in the Preface Imaging Guidelines.
- The guidelines listed in this section for certain specific indications are not intended to be all-inclusive; clinical judgment remains paramount and variance from these guidelines may be appropriate and warranted for specific clinical situations

References (PEDPND-1)

v1.0.2024

1. Bowen BC. Magnetic resonance imaging of the peripheral nervous system. In: Latchaw RE, Kucharczyk J, Moseley ME, et al., eds. *Imaging of the Nervous System*. Philadelphia, PA. Elsevier. 2005:1479-1497.
2. Reighard C, Junaid S, Jackson WM, et al. Anesthetic Exposure During Childhood and Neurodevelopmental Outcomes. *JAMA Netw Open*. 2022;5(6):e2217427. doi:10.1001/jamanetworkopen.2022.17427.
3. Fraum TJ, Ludwig DR, Bashir MR, Fowler KJ. Gadolinium-based contrast agents: A comprehensive risk assessment. *J Magn Reson Imaging*. 2017;46(2):338-353. doi: 10.1002/jmri.25625.
4. Update on FDA approach to safety issue of gadolinium retention after administration of gadolinium-based contrast agents. Available at: <https://www.fda.gov/media/116492/download>. September 20, 2018.
5. Blumfield E, Swenson DW, Iyer RS, Stanescu AL. Gadolinium-based contrast agents — review of recent literature on magnetic resonance imaging signal intensity changes and tissue deposits, with emphasis on pediatric patients. *Pediatr Radiol*. 2019;49(4):448-457. doi: 10.1007/s00247-018-4304-8.
6. Raybaud C and Barkovich AJ. Chapter 6: The Phakomatoses. In: *Pediatric Neuroimaging*. 5th ed. Philadelphia. Wolters Kluwer. 2012:569-636.
7. Soderlund KA, Smith AB, Rushing EJ, Smirniotopolous JG. Radiologic-Pathologic Correlation of Pediatric and Adolescent Spinal Neoplasms: Part 2, Intradural Extramedullary Spinal Neoplasms. *AJR Am J Roentgenol*. 2012;198(1):44-51. doi: 10.2214/ajr.11.7121.
8. Kang PB, McMillan HJ, Kuntz NL, et al. Utility and practice of electrodiagnostic testing in the pediatric population: An AANEM consensus statement. *Muscle Nerve*. 2020;61(2):143-155. doi: 10.1002/mus.26752.
9. Orozco V, et al. A Systematic Review of the Electrodiagnostic Assessment of Neonatal Brachial Plexus. *Neurol Neurobiol (Tallinn)*. 2020;3(2). doi: 10.31487/j.nnb.2020.02.12.
10. Artunduaga M, Liou CA, Morin CE, et al. Safety challenges related to the use of sedation and general anesthesia in pediatric patients undergoing magnetic resonance imaging examinations. *Pediatr Radiol*. 2021;51(5):724-735. doi: 10.1007/s00247-021-05044-5
11. Implementation Guide: Medicaid State Plan Eligibility Eligibility Groups Mandatory Coverage Infants and Children under Age 19. Available at: <https://www.hhs.gov/guidance/document/implementation-guide-medicaid-state-plan-eligibility-eligibility-groups-aeu-mandatory-2>. Issue date July 14, 2017.

Neurofibromatosis (PEDPN-2)

Guideline	Page
Neurofibromatosis – General Information (PEDPN-2.0).....	13
Neurofibromatosis 1 (PEDPN-2.1).....	14
Neurofibromatosis 2 (PEDPN-2.2).....	15

Neurofibromatosis – General Information (PEDPN-2.0)

PNP.NF.0002.0.A

v1.0.2024

- This guideline section includes imaging indications for individuals with neurofibromatosis and known benign lesions.
- For cancer screening guidelines, see **Neurofibromatosis 1 and 2 (NF1 and NF2) (PEDONC-2.3)** in the Pediatric Oncology Imaging Guidelines.
- For Peripheral Nerve Sheath Tumors, see **Peripheral Nerve Sheath Tumors (PNST) (PND-9.1)** in the Peripheral Nerve Disorders (PND) Imaging Guidelines.
- For guidelines related to known malignancies in individuals with NF1, see the appropriate imaging guideline for the specific cancer type.

Neurofibromatosis 1 (PEDPN-2.1)

PNP.NF.0002.1.A

v1.0.2024

- See **Neurofibromatosis 1 and 2 (NF1 and NF2) (PEDONC-2.3)** in the Pediatric Oncology Imaging Guidelines.
- For Peripheral Nerve Sheath Tumors, see **Peripheral Nerve Sheath Tumors (PNST) (PND-9.1)** in the Peripheral Nerve Disorders (PND) Imaging Guidelines.
- For guidelines related to known malignancies in individuals with NF1, see the appropriate imaging guideline for the specific cancer type.

Neurofibromatosis 2 (PEDPN-2.2)

PNP.NF.0002.2.A

v1.0.2024

- See **Neurofibromatosis 1 and 2 (NF1 and NF2) (PEDONC-2.3)** in the Pediatric Oncology Imaging Guidelines.
- Individuals with NF2 and known meningioma should be imaged according to guidelines in **Meningiomas (Intracranial and Intraspinal) (ONC-2.8)** in the Oncology Imaging Guidelines.
- Individuals with NF2 and known ependymoma should be imaged according to guidelines in **Ependymoma (PEDONC-4.8)** in the Pediatric Oncology Imaging Guidelines.

Brachial Plexus (PEDPN-3)

Guideline	Page
Brachial Plexus (PEDPN-3.1).....	17
References (PEDPND-3).....	18

Brachial Plexus (PEDPN-3.1)

PNP.BP.0003.1.A

v1.0.2024

Disorders of the brachial plexus can generally be identified and distinguished from lesions in other locations by clinical and electromyography/nerve conduction (EMG/NCV) examination. If the diagnosis remains unclear, advanced imaging can be helpful as a pre-operative study to evaluate the anatomy of brachial plexus lesions that should have already been defined by clinical examination.

- MRI is the preferred modality for imaging the brachial plexus. The goal of imaging is to visualize the entire course of the neural network from the preganglionic to the postganglionic segments.
 - CT is not often useful and should not be used as a substitute for MRI.
 - MRI Upper Extremity Other Than Joint without contrast (CPT® 73218) or without and with contrast (CPT® 73220) is indicated for unilateral brachial plexus.
 - MRI Chest without contrast (CPT® 71550) or without and with contrast (CPT® 71552) is indicated for bilateral brachial plexus studies. MRI Neck without contrast (CPT® 70540) is indicated for upper trunk lesions.
 - It is rare for more than one CPT® code to be necessary to adequately image the brachial plexus area of interest.
 - MRI Shoulder without contrast (CPT® 73221) or without and with contrast (CPT® 73223) is indicated in infants with brachial plexopathy due to birth trauma if requested for preoperative planning. These individuals often have glenohumeral dysplasia and require shoulder surgery.
 - Ultrasound also may be indicated in infants with brachial plexus injury to show the glenoid dysplasia and associated shoulder subluxation
 - MRI Cervical Spine without contrast (CPT® 72141) is indicated if there is clinical suspicion for cervical nerve root avulsion.
 - PET/CT skull base to mid-thigh (CPT® 78815) is appropriate if there is a contraindication to MRI in individuals with a known malignancy or post-treatment syndrome.

References (PEDPND-3)

v1.0.2024

1. Expert Panel on Neurological and Musculoskeletal Imaging, Boulter DJ, Job J, et al. ACR Appropriateness Criteria® Plexopathy: 2021 Update. *J Am Coll Radiol*. 2021;18(11S):S423-S441. doi: 10.1016/j.jacr.2021.08.014.
2. Gunes A, Bulut E, Uzumcugil A, Oguz KK. Brachial Plexus Ultrasound and MRI in Children with Brachial Plexus Birth Injury. *AJNR Am J Neuroradiol*. 2018;39(9):1745-1750. doi: 10.3174/ajnr.A5749.
3. Menashe SJ, Tse R, Nixon JN, et al. Brachial Plexus Birth Palsy: Multimodality Imaging of Spine and Shoulder Abnormalities in Children. *AJR Am J Roentgenol*. 2015;204(2):W199-W206. doi: 10.2214/ajr.14.12862.
4. Somashekar DK, Di Pietro MA, Joseph JR, Yang LJS, Parmar HA. Utility of ultrasound in noninvasive preoperative workup of neonatal brachial plexus palsy. *Pediatr Radiol*. 2015;46(5):695-703. doi: 10.1007/s00247-015-3524-4.
5. Volpe JJ. Injuries of extracranial, cranial, intracranial, spinal cord and peripheral nervous system structures. In: *Volpe's Neurology of the Newborn*, 6th ed. Elsevier. Philadelphia 2018:1093-1123.

Gaucher Disease (PEDPN-4)

Guideline	Page
Gaucher Disease (PEDPN-4.1).....	20

Gaucher Disease (PEDPN-4.1)

PNP.GD.0004.1.A

v1.0.2024

- Gaucher Disease imaging indications in pediatric individuals are very similar to those for adult individuals. See **Gaucher Disease (Storage Disorders) (PN-6.3)** in the Peripheral Nerve Disorders (PND) Imaging Guidelines.

Spinal Muscular Atrophy (PEDPN -5)

Guideline	Page
Spinal Muscular Atrophy (PEDPN-5.1).....	22
References (PEDPND-5).....	23

Spinal Muscular Atrophy (PEDPN-5.1)

PNP.SA.0005.1.A

v1.0.2024

- Spinal Muscular Atrophy
 - Molecular genetic testing is the standard tool for diagnosis for the early consideration in any infant with weakness or hypotonia
 - MRI is usually not indicated
 - See **Developmental Motor Delay (PEDHD-19.3)** in the Pediatric Head Imaging Guidelines for presentation of weakness or a loss of skills.

References (PEDPND-5)

v1.0.2024

1. Nance JR. Spinal Muscular Atrophy. *Continuum (Minneapolis, Minn)*. 2020;26(5, Peripheral Nerve And Motor Neuron Disorders):1348–1368.
2. Glascock J, et al. Treatment Algorithm for Infants Diagnosed with Spinal Muscular Atrophy through Newborn Screening. Research Report 8. *J Neuromuscul Dis*. 2018;5(2):145–158. doi: 10.3233/JND-180304.
3. Prior TW, Leach ME and Finanger E. Spinal Muscular Atrophy. *GeneReviews*®. Created: February 24, 2000; Updated: 2020 Dec 3. Copyright © 1993-2020, University of Washington, Seattle. GeneReviews is a registered trademark of the University of Washington, Seattle. All rights reserved.