



*National Imaging Associates, Inc.	
Clinical guideline CERVICAL SPINE CT	Original Date: September 1997
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GENERAL INFORMATION

- *It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.*
- *Where a specific clinical indication is not directly addressed in this guideline, medical necessity determination will be made based on widely accepted standard of care criteria. These criteria are supported by evidence-based or peer-reviewed sources such as medical literature, societal guidelines and state/national recommendations.*

INDICATIONS FOR CERVICAL SPINE CT

†If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months), the results of the prior study should be:

- **Inconclusive or show a need for additional or follow-up imaging evaluation OR**
- **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.**

(*Unless approvable in the [combination section](#) as noted in the guidelines)

For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate¹⁻⁴

- With any of the following new neurological deficits documented on physical exam
 - Extremity muscular weakness (and not likely caused by plexopathy or peripheral neuropathy)
 - Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's and other upper motor neuron signs); OR abnormal deep tendon reflexes (and not likely caused by plexopathy, or peripheral neuropathy)

- Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature (and not likely caused by plexopathy or peripheral neuropathy)
- Upper or lower extremity increase muscle tone/spasticity
- New onset bowel or bladder dysfunction (e.g., retention or incontinence)—not related to an inherent bowel or bladder process
- Gait abnormalities (see [Table 1](#) below for more details)
- Suspected cord compression with any neurological deficits as listed above

For evaluation of neck pain with any of the following when Cervical Spine MRI is contraindicated⁵

- With new or worsening objective [neurologic deficits](#) on exam, as above
- Failure of conservative treatment* for a minimum of six (6) weeks within the last six (6) months;⁶

NOTE - Failure of conservative treatment is defined as one of the following:

- Lack of meaningful improvement after a full course of treatment; **OR**
- Progression or worsening of symptoms during treatment; **OR**
- Documentation of a medical reason the member is unable to participate in treatment

Closure of medical or therapy offices, patient inconvenience, or noncompliance without explanation does not constitute “inability to complete” treatment.

- With progression or worsening of symptoms during the course of conservative treatment*
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a cervical radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain)⁷
- Isolated back pain in pediatric population^{8, 9} – conservative care not required if red flags present. Red flags that prompt imaging include any of the following:
 - Age 5 or younger, **OR**
 - Constant pain, **OR**
 - Pain lasting > 4 weeks, **OR**
 - Abnormal neurologic examination, **OR**
 - Early morning stiffness and/or gelling, **OR**
 - Night pain that prevents or disrupts sleep, **OR**
 - Radicular pain, **OR**
 - Fever or weight loss or malaise, **OR**^{10, 11}
 - Postural changes (e.g., kyphosis or scoliosis), **OR**
 - Limp (or refusal to walk in a younger child)

As part of initial pre-operative/post-operative/procedural evaluation (“CT best examination to assess for hardware complication, extent of fusion and pseudarthrosis”^{12, 13} and MRI for cord, nerve root compression, disc pathology, or post-op infection)

Note: If ordered by Neurosurgeon or orthopedic surgeon for purposes of surgical planning, a contraindication to MRI is not required.

- For preoperative evaluation/planning
- CT discogram
- Evaluation of post operative pseudoarthrosis after initial x-rays (CT should not be done before 6 months after surgery)
- CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))¹⁴
- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms)
- Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings
- New or changing neurological deficits or symptoms post-operatively^{12, 15} - see [neurological deficit](#) section above.
- When combo requests (see [above statement](#)⁺) are submitted (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously (e.g., the need for both soft tissue and bony anatomy is required)¹⁶
 - Combination requests where both cervical spine CT and MRI cervical spine are both approvable (not an all-inclusive list):
 - OPLL (Ossification of posterior longitudinal ligament)¹⁷
 - Pathologic or complex fractures
 - Malignant process of spine with both bony and soft tissue involvement
 - Unstable craniocervical junction
 - Clearly documented indication for bony and soft tissue abnormality where assessment will change management for the patient

For evaluation of suspected myelopathy when Cervical Spine MRI is contraindicated¹⁸⁻²²

- Does **NOT** require conservative care
- Progressive symptoms including hand clumsiness, worsening handwriting, difficulty with grasping and holding objects, diffuse numbness in the hands, pins and needles sensation, increasing difficulty with balance and ambulation
- Any of the [neurological deficits](#) as noted above

For evaluation of trauma or acute injury²³

- Presents with any of the following [neurological deficits](#) as above
- With progression or worsening of symptoms during the course of [conservative treatment](#)*
- History of underlying spinal abnormalities (i.e., ankylosing spondylitis) (Both MRI and CT are approvable)^{24, 25}

- When the patient is clinically unevaluable or there are preliminary imaging findings (x-ray or CT) needing further evaluation
- When office notes specify the patient meets NEXUS (National Emergency X-Radiography Utilization Study) or CCR (Canadian Cervical Rules) criteria for imaging²³:
 - CT for initial imaging
 - MRI when suspect spinal cord or nerve root injury or when patient is obtunded, and CT is negative
 - CT or MRI for treatment planning of unstable spine

("MRI and CT provide complementary information. When indicated it is appropriate to perform both examinations"²³)

For evaluation of known fracture or new compression fractures with worsening neck pain^{23, 26}

- To assess union of a fracture when physical examination, plain radiographs, or prior imaging suggest delayed or non-healing
- To determine the position of fracture fragments
- With history of malignancy (if MRI is contraindicated or cannot be performed)
- With an associated new focal [neurologic deficit](#) as above²⁷
- Prior to a planned surgery/intervention or if the results of the CT will change management

CT myelogram: When MRI cannot be performed/contraindicated/surgeon preference^{14, 28-32}

- When signs and symptoms inconsistent or not explained by the MRI findings
- Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula)
- Surgical planning, especially regarding to the nerve roots or evaluation of dural sac
- Evaluation of suspected brachial plexus or nerve root injury in the neonate

For evaluation of tumor, cancer, or metastasis with any of the following:

(MRI is usually the preferred study- CT may be needed to further characterize solitary indeterminate lesions seen on MRI)^{9, 33, 34}

- **Primary tumor**
 - Initial staging primary spinal tumor³⁵
 - Follow-up of known primary cancer of patient undergoing active treatment within the past year or as per surveillance imaging guidance for that cancer
 - Known spinal tumor with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings)
 - With an associated new focal [neurologic deficit](#) as above²⁷
- **Metastatic tumor**
 - With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam

- With an associated new focal neurologic deficit²⁷
- Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine^{9,36}

Other Indications

Further evaluation of indeterminate findings on prior imaging (unless follow up is otherwise specified within the guideline):

- For initial evaluation of an inconclusive finding on a prior imaging report that requires further clarification. When MRI cannot be performed, is contraindicated, or CT is preferred to characterize the finding⁹
- One follow-up exam of a prior indeterminate MR/CT finding to ensure no suspicious interval change has occurred. (No further surveillance unless specified as highly suspicious or change was found on last follow-up exam). When MRI cannot be performed, is contraindicated, or CT is preferred to characterize the finding.⁹ When MRI cannot be performed, is contraindicated, or CT is preferred to characterize the finding⁹

Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine, or Lumbar Spine

For evaluation of known or suspected infection (osteomyelitis)/abscess when Cervical Spine MRI is contraindicated³⁷

- As evidenced by signs and/or symptoms, laboratory (i.e., abnormal white blood cell count, ESR and/or CRP) or prior imaging findings³⁸
- Follow-up imaging of infection
 - With worsening symptoms/laboratory values (i.e., white blood cell count, ESR/CRP) or radiographic findings³⁹

For evaluation of known or suspected inflammatory disease or atlantoaxial instability when MRI is contraindicated or for surgical treatment planning:

- In rheumatoid arthritis with neurologic signs/symptoms, or evidence of subluxation on radiographs (lateral radiograph in flexion and neutral should be the initial study)^{40, 41}
 - Patients with negative radiographs but symptoms suggestive of cervical instability or in patients with neurologic deficits
- High-risk disorders affecting the atlantoaxial articulation, such as Down syndrome, Marfan syndrome with neurological signs/symptoms, abnormal neurological exam, or evidence of abnormal or inconclusive radiographs of the cervical spine⁴²
- Spondyloarthropathies, known or suspected

- Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and appropriate rheumatology workup

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma when Cervical Spine MRI is contraindicated^{37, 43}

- As evidenced by signs/symptoms, laboratory, or prior imaging findings

Other Indications for a Cervical Spine CT when MRI is contraindicated or cannot be performed

(Note- See [combination requests](#), below, for initial advanced imaging assessment and pre-operatively)

- Tethered cord or spinal dysraphism (known or suspected), based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata⁴⁴⁻⁴⁶
 - Known Arnold-Chiari syndrome (For [initial imaging](#) (one-time initial modality assessment) see combination below)
 - Known Chiari I malformation without syrinx or hydrocephalus, follow-up imaging after initial diagnosis with new or changing signs/symptoms or exam findings consistent with spinal cord pathology⁴⁷
 - Known Chiari II (Arnold-Chiari syndrome), III, or IV malformation
 - Achondroplasia (one Cervical Spine MRI to assess the craniocervical junction, as early as possible (even in asymptomatic cases)^{48, 49}
- Syrinx or syringomyelia (known or suspected)
 - With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis)⁵⁰
 - To further characterize a suspicious abnormality seen on prior imaging
 - Known syrinx with new/worsening symptoms
- Toe walking in a child with signs/symptoms of myelopathy localized to the Cervical Spine
- Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's)
 - After detailed neurological exam and appropriate initial work up

Initial evaluation of trigeminal neuralgia not explained on recent Brain imaging

COMBINATION STUDIES WITH CERVICAL SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE

Brain CT/Cervical CT

- For evaluation of known Arnold-Chiari Malformation

Cervical and Thoracic CT

- Initial evaluation of known or suspected syrinx or syringomyelia
 - With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis)⁵⁰
 - To further characterize a suspicious abnormality seen on prior imaging
 - Known syrinx with new/worsening symptom

Any combination of Cervical and/or Thoracic and/or Lumbar CTs:

Note: These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging.

Exception- Indications for combination studies^{51, 52}: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure

- Any combination of these studies for:
 - Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10⁵³⁻⁵⁵ (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies)
 - In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning⁵⁶
 - Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging
 - Scoliosis with any of the following⁵⁷:
 - Progressive spinal deformity;
 - Neurologic deficit (new or unexplained);
 - Early onset;
 - Atypical curve (e.g., short segment, >30' kyphosis, left thoracic curve, associated organ anomalies);
 - Pre-operative planning; OR
 - When office notes clearly document how imaging will change management
- Arnold-Chiari malformations^{58, 59}
 - Arnold-Chiari I
 - For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed^{44, 53}
 - Arnold-Chiari II-IV - For initial evaluation and follow-up as appropriate
 - Usually associated with open and closed spinal dysraphism, particularly meningocele)
- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata,⁴⁴⁻⁴⁶ when anesthesia required for imaging⁶⁰ (e.g., meningocele, lipomeningocele, diastematomyelia, fatty/thickened filum terminale, and other spinal cord malformations)
- Oncological Applications (e.g., primary nervous system, metastatic)
 - Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram)- See [Overview](#)
 - Suspected leptomeningeal carcinomatosis (LC)⁶¹- See [Overview](#)

- Any combination of these for spinal survey in patient with metastases
- Tumor evaluation and monitoring in neurocutaneous syndromes
- CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))¹⁴
- CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning
- Post-procedure (discogram) CT

BACKGROUND

Computed tomography (CT) is performed for the evaluation of the cervical spine. CT may be used as the primary imaging modality, or it may complement other modalities. Primary indications for CT include conditions, e.g., traumatic, neoplastic, and infectious. CT is often used to study the cervical spine for conditions such as degenerative disc disease when MRI is contraindicated. CT provides excellent depiction of bone detail and is used in the evaluation of known fractures of the cervical spine and for evaluation of postoperative patients.

OVERVIEW

*Conservative Treatment

Non-operative conservative treatment should include a multimodality approach consisting of at least one (1) active and one (1) inactive component targeting the affected region.

Active Modalities

- Physical therapy
- Physician-supervised home exercise program**
- Chiropractic care

Inactive Modalities

- Medications (e.g., NSAIDs, steroids, analgesics)
- Injections (e.g., epidural injection, selective nerve root block)
- Medical Devices (e.g., TENS unit, bracing)

**Home Exercise Program (HEP)

The following two elements are required to meet conservative therapy guidelines for HEP:^{13, 62}

- Documentation of an exercise prescription/plan provided by a physician, physical therapist, or chiropractor; **AND**
- Follow-up documentation regarding completion of HEP after the required 6-week timeframe or inability to complete HEP due to a documented medical reason (e.g., increased pain or inability to physically perform exercises).

Cervical myelopathy – Symptom severity varies, and a high index of suspicion is essential for making the proper diagnosis in early cases. Symptoms of pain and radiculopathy may not be present. The natural history of myelopathy is characterized by neurological deterioration. The most frequently encountered symptom is gait abnormality (86%) followed by increased muscular reflexes (79.1%), pathological reflexes (65.1%), paresthesia of upper limb (69.8%) and pain (67.4%).¹⁹

Table 1: Gait and spine imaging⁶³⁻⁶⁸

Gait	Characteristic	Work up/Imaging
Hemiparetic	Spastic unilateral, circumduction	Brain and/or, Cervical spine imaging based on associated symptoms
Diplegic	Spastic bilateral, circumduction	Brain, Cervical and Thoracic Spine imaging
Myelopathic	Wide based, stiff, unsteady	Cervical and/or Thoracic spine MRI based on associated symptoms
Cerebellar Ataxic	Broad based, clumsy, staggering, lack of coordination, usually also with limb ataxia	Brain imaging see Brain MRI Guideline
Apraxic	Magnetic, shuffling, difficulty initiating	Brain imaging see Brain MRI Guideline
Parkinsonian	Stooped, small steps, rigid, turning en bloc, decreased arm swing	Brain Imaging see Brain MRI Guideline
Choreiform	Irregular, jerky, involuntary movements	Medication review, consider brain imaging as per movement disorder Brain MR guidelines
Sensory ataxic	Cautious, stomping, worsening without visual input (ie + Romberg)	EMG, blood work, consider spinal (cervical or thoracic cord imaging) imaging based on EMG
Neurogenic	Steppage, dragging of toes	<ul style="list-style-type: none"> • EMG initial testing; • BUT if there is a foot drop, lumbar spine MRI is appropriate without EMG • Pelvis MR if there is evidence of plexopathy
Vestibular	Insecure, veer to one side, worse when eyes closed, vertigo	Consider Brain/IAC MRI see Brain MRI Guideline

Ossification Posterior Longitudinal Ligament (OPLL)¹⁷ – Most common in cervical spine (rare but more severe in thoracic spine).

Table 2: CT and Cutaneous Stigmata⁶⁹

Risk Stratification for Various Cutaneous Markers		
<u>High Risk</u>	<u>Intermediate Risk</u>	<u>Low Risk</u>
<ul style="list-style-type: none"> • Hypertrichosis • Infantile hemangioma • Atretic meningocele • DST • Subcutaneous lipoma • Caudal appendage • Segmental hemangiomas in association with LUMBAR[‡] syndrome 	<ul style="list-style-type: none"> • Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined or PWS when darker red and well-defined) 	<ul style="list-style-type: none"> • Coccygeal dimple • Light hair • Isolated café au lait spots • Mongolian spots • Hypo- and hypermelanotic macules or papules • Deviated or forked gluteal cleft • Nonmidline lesions
<p>[‡]LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.</p>		

Neck and Back Pain with Cancer History – Bone is the third most common site of metastases after the liver and the lungs, and approximately two-thirds of all osseous metastases occur in the spine. Approximately 60–70% of patients with systemic cancer will have spinal metastasis. Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history, but without known active cancer or a tumor that tends to metastasize to the spine. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

“Neoplasms causing VCF (vertebral compression fractures) include 1) primary bone neoplasms, such as hemangioma (aggressive type) or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget’s disease (osteitis deformans); 2) primary malignant neoplasms including but not limited to multiple myeloma and lymphoma; and 3) metastatic neoplasms.”²⁶

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumors can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process.³⁶

CT Myelogram – Myelography is the instillation of intrathecal contrast media under fluoroscopy. Patients are then imaged with CT to evaluate for spinal canal pathology. Although this technique has diminished greatly due to the advent of MRI due to its non-invasiveness and

superior soft-tissue contrast, myelography is still a useful technique for conventional indications, such as spinal stenosis, when MRI is contraindicated or nondiagnostic or surgeon preference (see guidelines above), brachial plexus injury in neonates, radiation therapy treatment planning, and cerebrospinal fluid (CSF) leak.^{70, 71}

Drop Metastases⁷² – Drop metastases are intradural extramedullary spinal metastases that arise from intracranial lesions. Common examples of intracranial neoplasms that result in drop metastases include pineal tumors, ependymomas, medulloblastomas, germinomas, primitive neuroectodermal tumors (PNET), glioblastomas multiform, anaplastic astrocytomas, oligodendrogliomas and less commonly choroid plexus neoplasms and teratomas.

Leptomeningeal Carcinomatosis⁷³ – Leptomeningeal carcinomatosis is a complication of cancer in which cancerous cells spread to the membranes (meninges) that covers the brain and spinal cord. The most common solid tumors that involve the leptomeninges are breast, lung, melanoma, gastrointestinal, and primary central nervous system tumors.

POLICY HISTORY

Date	Summary
Dec 2023	Conservative treatment language updated in body and background
May 2023	<ul style="list-style-type: none"> • Updated references • Updated background section • Clarified pathological reflexes • Added pseudoarthrosis to surgery section • Added “Further evaluation of indeterminate or questionable findings on prior imaging”: • Clarified cerebellar ataxia in gait table • Added: “Initial evaluation of trigeminal neuralgia not explained on recent Brain imaging” • General Information moved to beginning of guideline with added statement on clinical indications not addressed in this guideline • Added statement regarding further evaluation of indeterminate findings on prior imaging • Removed Additional Resources
March 2022	<ul style="list-style-type: none"> • Added <ul style="list-style-type: none"> ○ Combination request for overlapping body part statement ○ Clarified muscle weakness no related to plexopathy or peripheral neuropathy ○ Clarified bowel and bladder dysfunction – not related to an inherent bowel or bladder problem ○ Clarified isolated neck pain in pediatric patient ○ Clarified CT myelogram section ○ Added subsection for cervical and thoracic spine section for syrinx and syringomyelia ○ Descriptions for tethered cord ○ Background section of Drop Metastases ○ Background section of Leptomeningeal Carcinomatosis ○ Clarified toe walking in pediatric patient with myelopathy for cervical spine • Removed <ul style="list-style-type: none"> ○ Removed from combination section syrinx and syringomyelia and added subsection for cervical and thoracic spine section ○ Removed pediatric back pain from the total spine combination section

REFERENCES

1. Acharya AB, Fowler JB. Chaddock Reflex. StatPearls Publishing. Updated June 27, 2022. Accessed December 1, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK519555/>
2. Teoli D, Rocha Cabrero F, Ghassemzadeh S. Lhermitte Sign. StatPearls Publishing. Updated September 21, 2022. Accessed December 1, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK493237/>
3. Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders. North American Spine Society (NASS). Updated 2010. Accessed December 1, 2022. <https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/CervicalRadiculopathy.pdf>
4. Albert TJ, Murrell SE. Surgical management of cervical radiculopathy. *J Am Acad Orthop Surg*. Nov-Dec 1999;7(6):368-76. doi:10.5435/00124635-199911000-00003
5. Allegri M, Montella S, Salici F, et al. Mechanisms of low back pain: a guide for diagnosis and therapy. *F1000Res*. 2016;5doi:10.12688/f1000research.8105.2
6. Eubanks JD. Cervical radiculopathy: nonoperative management of neck pain and radicular symptoms. *Am Fam Physician*. Jan 1 2010;81(1):33-40.
7. North American Spine Society. Five things physicians and patients should question: Don't use electromyography (EMG) and nerve conduction studies (NCS) to determine the cause of axial lumbar, thoracic or cervical spine pain. Choosing Wisely Initiative ABIM Foundation. Updated 2019. Accessed December 1, 2022. <https://www.choosingwisely.org/clinician-lists/nass-emg-nerve-conduction-studies-to-determine-cause-of-spine-pain/>
8. American College of Radiology. ACR Appropriateness Criteria® Back Pain—Child. American College of Radiology (ACR). Updated 2016. Accessed December 1, 2022. <https://acsearch.acr.org/docs/3099011/Narrative/>
9. American College of Radiology. ACR Appropriateness Criteria® Cervical Neck Pain or Cervical Radiculopathy. American College of Radiology. Updated 2018. Accessed December 1, 2022. <https://acsearch.acr.org/docs/69426/Narrative/>
10. Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. Dec 1 2007;76(11):1669-76.
11. Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. May-Jun 2006;26(3):353-7. doi:10.1097/01.bpo.0000214928.25809.f9
12. Rao D, Scuderi G, Scuderi C, Grewal R, Sandhu SJ. The Use of Imaging in Management of Patients with Low Back Pain. *J Clin Imaging Sci*. 2018;8:30. doi:10.4103/jcis.JCIS_16_18
13. American College of Radiology. ACR Appropriateness Criteria® Low Back Pain. American College of Radiology (ACR). Updated 2021. Accessed January 29, 2023. <https://acsearch.acr.org/docs/69483/Narrative/>
14. Starling A, Hernandez F, Hoxworth JM, et al. Sensitivity of MRI of the spine compared with CT myelography in orthostatic headache with CSF leak. *Neurology*. Nov 12 2013;81(20):1789-92. doi:10.1212/01.wnl.0000435555.13695.22
15. Corona-Cedillo R, Saavedra-Navarrete MT, Espinoza-Garcia JJ, Mendoza-Aguilar AN, Ternovoy SK, Roldan-Valadez E. Imaging Assessment of the Postoperative Spine: An Updated

Pictorial Review of Selected Complications. *Biomed Res Int*. 2021;2021:9940001.

doi:10.1155/2021/9940001

16. Fisher BM, Cowles S, Matulich JR, Evanson BG, Vega D, Dissanaik S. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. Dec 2013;206(6):987-93; discussion 993-4. doi:10.1016/j.amjsurg.2013.08.021
17. Choi BW, Song KJ, Chang H. Ossification of the posterior longitudinal ligament: a review of literature. *Asian Spine J*. Dec 2011;5(4):267-76. doi:10.4184/asj.2011.5.4.267
18. Waly FJ, Abduljabbar FH, Fortin M, Nooh A, Weber M. Preoperative Computed Tomography Myelography Parameters as Predictors of Outcome in Patients With Degenerative Cervical Myelopathy: Results of a Systematic Review. *Global Spine J*. Sep 2017;7(6):521-528. doi:10.1177/2192568217701101
19. de Oliveira Vilaça C, Orsini M, Leite MA, et al. Cervical Spondylotic Myelopathy: What the Neurologist Should Know. *Neurol Int*. Nov 2 2016;8(4):6330. doi:10.4081/ni.2016.6330
20. Davies BM, Mowforth OD, Smith EK, Kotter MR. Degenerative cervical myelopathy. *Bmj*. Feb 22 2018;360:k186. doi:10.1136/bmj.k186
21. Behrbalk E, Salame K, Regev GJ, Keynan O, Boszczyk B, Lidar Z. Delayed diagnosis of cervical spondylotic myelopathy by primary care physicians. *Neurosurg Focus*. Jul 2013;35(1):E1. doi:10.3171/2013.3.Focus1374
22. American College of Radiology. ACR Appropriateness Criteria® Myelopathy. American College of Radiology (ACR). Updated 2020. Accessed January 29, 2023. <https://acsearch.acr.org/docs/69484/Narrative/>
23. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Trauma American College of Radiology. Updated 2018. Accessed December 1, 2022. <https://acsearch.acr.org/docs/69359/Narrative/>
24. American College of Radiology. ACR Appropriateness Criteria® Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. American College of Radiology (ACR). Updated 2021. Accessed December 1, 2022. <https://acsearch.acr.org/docs/3094107/Narrative/>
25. Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. *Skeletal Radiol*. Sep 2008;37(9):813-9. doi:10.1007/s00256-008-0484-x
26. American College of Radiology. ACR Appropriateness Criteria® Management of Vertebral Compression Fractures. American College of Radiology. Updated 2022. Accessed December 1, 2022. <https://acsearch.acr.org/docs/70545/Narrative/>
27. Alexandru D, So W. Evaluation and management of vertebral compression fractures. *Perm J*. Fall 2012;16(4):46-51. doi:10.7812/tpp/12-037
28. Grams AE, Gempt J, Förschler A. Comparison of spinal anatomy between 3-Tesla MRI and CT-myelography under healthy and pathological conditions. *Surg Radiol Anat*. Jul 2010;32(6):581-5. doi:10.1007/s00276-009-0601-0
29. Morita M, Miyauchi A, Okuda S, Oda T, Iwasaki M. Comparison between MRI and myelography in lumbar spinal canal stenosis for the decision of levels of decompression surgery. *J Spinal Disord Tech*. Feb 2011;24(1):31-6. doi:10.1097/BSD.0b013e3181d4c993
30. Naganawa T, Miyamoto K, Ogura H, Suzuki N, Shimizu K. Comparison of magnetic resonance imaging and computed tomogram-myelography for evaluation of cross sections of cervical spinal morphology. *Spine (Phila Pa 1976)*. Jan 1 2011;36(1):50-6. doi:10.1097/BRS.0b013e3181cb469c

31. Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Lumbar Disc Herniation with Radiculopathy. North American Spine Society (NASS). Updated 2012. Accessed December 1, 2022. <https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/LumbarDiscHerniation.pdf>
32. Ozdoba C, Gralla J, Rieke A, Binggeli R, Schroth G. Myelography in the Age of MRI: Why We Do It, and How We Do It. *Radiol Res Pract*. 2011;2011:329017. doi:10.1155/2011/329017
33. Kim YS, Han IH, Lee IS, Lee JS, Choi BK. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc*. 2012;52(2):126-132. doi:10.3340/jkns.2012.52.2.126
34. Roberts CC, Daffner RH, Weissman BN, et al. ACR appropriateness criteria on metastatic bone disease. *J Am Coll Radiol*. Jun 2010;7(6):400-9. doi:10.1016/j.jacr.2010.02.015
35. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): Central Nervous System Cancers Version 2.2022. National Comprehensive Cancer Network (NCCN). Updated September 29, 2022. Accessed January 23, 2023. https://www.nccn.org/professionals/physician_gls/pdf/cns.pdf
36. Ziu E, Viswanathan VK, Mesfin FB. Spinal Metastasis. StatPearls Publishing. Updated August 22, 2022. Accessed December 1, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK441950/>
37. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Infection. American College of Radiology (ACR). Updated 2021. Accessed December 1, 2022. <https://acsearch.acr.org/docs/3148734/Narrative/>
38. Bond A, Manian FA. Spinal Epidural Abscess: A Review with Special Emphasis on Earlier Diagnosis. *Biomed Res Int*. 2016;2016:1614328. doi:10.1155/2016/1614328
39. Berbari EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis*. Sep 15 2015;61(6):e26-46. doi:10.1093/cid/civ482
40. Colebatch AN, Edwards CJ, Østergaard M, et al. EULAR recommendations for the use of imaging of the joints in the clinical management of rheumatoid arthritis. *Ann Rheum Dis*. Jun 2013;72(6):804-14. doi:10.1136/annrheumdis-2012-203158
41. Mańczak M, Gasik R. Cervical spine instability in the course of rheumatoid arthritis - imaging methods. *Reumatologia*. 2017;55(4):201-207. doi:10.5114/reum.2017.69782
42. Henderson FC, Sr., Austin C, Benzel E, et al. Neurological and spinal manifestations of the Ehlers-Danlos syndromes. *Am J Med Genet C Semin Med Genet*. Mar 2017;175(1):195-211. doi:10.1002/ajmg.c.31549
43. Nagashima H, Yamane K, Nishi T, Nanjo Y, Teshima R. Recent trends in spinal infections: retrospective analysis of patients treated during the past 50 years. *Int Orthop*. Mar 2010;34(3):395-9. doi:10.1007/s00264-009-0741-1
44. Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: preliminary results of sectioning filum terminale. *Surg Neurol*. Jul 2009;72(1):20-35. doi:10.1016/j.surneu.2009.03.008
45. Düz B, Gocmen S, Secer HI, Basal S, Gönül E. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008;31(3):272-8. doi:10.1080/10790268.2008.11760722
46. Zalatimo O. Tethered Spinal Cord Syndrome. American Association of Neurological Surgeons (AANS). Accessed December 1, 2022. <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Tethered-Spinal-Cord-Syndrome>

47. Whitson WJ, Lane JR, Bauer DF, Durham SR. A prospective natural history study of nonoperatively managed Chiari I malformation: does follow-up MRI surveillance alter surgical decision making? *J Neurosurg Pediatr.* Aug 2015;16(2):159-66. doi:10.3171/2014.12.Peds14301
48. Legare JM. Achondroplasia. University of Washington, Seattle. Updated January 6, 2022. Accessed December 1, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK1152/>
49. White KK, Bompadre V, Goldberg MJ, et al. Best practices in the evaluation and treatment of foramen magnum stenosis in achondroplasia during infancy. *Am J Med Genet A.* Jan 2016;170a(1):42-51. doi:10.1002/ajmg.a.37394
50. Timpone VM, Patel SH. MRI of a syrinx: is contrast material always necessary? *AJR Am J Roentgenol.* May 2015;204(5):1082-5. doi:10.2214/ajr.14.13310
51. American College of Radiology. ACR Appropriateness Criteria® Headache. American College of Radiology. Updated 2022. Accessed January 23, 2023. <https://acsearch.acr.org/docs/69482/Narrative/>
52. American College of Radiology. ACR Appropriateness Criteria® Headache-Child. American College of Radiology. Updated 2017. Accessed December 1, 2022. <https://acsearch.acr.org/docs/69439/Narrative/>
53. Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg Pediatr.* Jun 2015;15(6):607-11. doi:10.3171/2014.11.Peds14135
54. Juvenile Scoliosis. Scoliosis Research Society (SRS). Accessed December 1, 2022. <https://www.srs.org/professionals/online-education-and-resources/conditions-and-treatments/juvenile-scoliosis>
55. American College of Radiology. ACR Appropriateness Criteria® Scoliosis-Child. American College of Radiology. Updated 2018. Accessed December 1, 2022. <https://acsearch.acr.org/docs/3101564/Narrative/>
56. Trenga AP, Singla A, Feger MA, Abel MF. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop.* Aug 2016;10(4):343-52. doi:10.1007/s11832-016-0752-6
57. Ozturk C, Karadereler S, Ornek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop.* Apr 2010;34(4):543-6. doi:10.1007/s00264-009-0817-y
58. Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJ, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg Pediatr.* Aug 2011;8(2):205-13. doi:10.3171/2011.5.Peds1121
59. Radic JAE, Cochrane DD. Choosing Wisely Canada: Pediatric Neurosurgery Recommendations. *Paediatr Child Health.* Sep 2018;23(6):383-387. doi:10.1093/pch/pxy012
60. Hertzler DA, 2nd, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: a review of the literature from embryology to adult presentation. *Neurosurg Focus.* Jul 2010;29(1):E1. doi:10.3171/2010.3.Focus1079
61. Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol.* 2011;2011:769753. doi:10.1155/2011/769753
62. Last AR, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician.* Jun 15 2009;79(12):1067-74.
63. Stanford Medicine. Gait Abnormalities. Stanford University. Accessed January 23, 2023. <https://stanfordmedicine25.stanford.edu/the25/gait.html>

64. Haynes KB, Wimberly RL, VanPelt JM, Jo CH, Riccio AI, Delgado MR. Toe Walking: A Neurological Perspective After Referral From Pediatric Orthopaedic Surgeons. *J Pediatr Orthop*. Mar 2018;38(3):152-156. doi:10.1097/bpo.0000000000001115
65. Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. Aug 2014;14(4):242-51. doi:10.1136/practneurol-2013-000764
66. Foster H, Drummond P, Jandial S, Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. *BMJ Best Practice*. Updated February 23, 2021. Accessed January 23, 2023. <https://bestpractice.bmj.com/topics/en-us/709>
67. Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurol Clin Pract*. Jun 2012;2(2):103-111. doi:10.1212/CPJ.0b013e31825a7823
68. Pirker W, Katzenschlager R. Gait disorders in adults and the elderly : A clinical guide. *Wien Klin Wochenschr*. Feb 2017;129(3-4):81-95. doi:10.1007/s00508-016-1096-4
69. Dias M, Partington M. Congenital Brain and Spinal Cord Malformations and Their Associated Cutaneous Markers. *Pediatrics*. Oct 2015;136(4):e1105-19. doi:10.1542/peds.2015-2854
70. Pomerantz SR. Myelography: modern technique and indications. *Handb Clin Neurol*. 2016;135:193-208. doi:10.1016/b978-0-444-53485-9.00010-6
71. American College of Radiology (ACR), American Society of Neuroradiology (ASNR), Society for Pediatric Radiology (SPR). ACR-ASNR-SPR Practice Parameter for the Performance of Myelography and Cisternography. American College of Radiology. Updated 2019. Accessed December 1, 2022. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/myelog-cisternog.pdf>
72. Ahmed A. MRI features of disseminated 'drop metastases'. *S Afr Med J*. Jul 2008;98(7):522-3.
73. Batool A, Kasi A. Leptomeningeal Carcinomatosis. StatPearls Publishing Copyright © 2022, StatPearls Publishing LLC. Updated April 5, 2022. Accessed December 1, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK499862/>

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