National Imaging Associates, Inc.*	
Clinical guideline **CERVICAL SPINE CT**	**Original Date: September 1997**
CPT Codes: 72125, 72126, 72127	**Last Revised Date: ~~May~~ April 202~~1~~0**
Guideline Number: NIA_CG_041	**Implementation Date: January 2022~~1~~**

INDICATIONS FOR CERVICAL SPINE CT ~~:~~
(Combination requests at end of the document)

For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate
(Acharya, 2019; ACR, 2013; NASS, 2010; ~~Acharya, 2019~~ Teoli, 2021)

- **With any of the following new neurological deficits documented on physical exam**
  - **Extremity muscular weakness**
  - **Pathologic (e.g., Babinski, Lhermitte's sign, Chaddock Sign, Hoffman's) or abnormal reflexes**
  - **Absent/decreased sensory changes along a particular cervical dermatome (nerve distribution): pin prick, touch, vibration, proprioception, or temperature**
  - **Upper or lower extremity increase muscle tone/spasticity**
  - **New onset bowel or bladder dysfunction (e.g., retention or incontinence)**
  - **Gait abnormalities (see ~~table~~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 contraindicated
(Allegri, 2016)

- With new or worsening objective **neurologic deficits*** on exam**, as above**
- Failure of conservative treatment* for at least six (6) weeks within the last six (6) months (ACR, 2013; Eubanks, 2010)
- 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 (NASS, 2013))~~.~~
- **Isolated neck pain in pediatric population (ACR, 2016) – conservative care not required if red flags present (see combination request below thoracic and lumbar spine may also be indicated)**

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- Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006).
- Neck pain associated with suspected inflammation, infection, or malignancy

As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion" (ACR, 2015; Rao, 2018) 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~~A~~ contraindication to MRI is not required.

- For preoperative evaluation/planning~~,~~
- CT discogram
- 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) (Starling, 2013)
- 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)
- Changing neurologic status post-operatively~~.~~
- Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings~~.~~
- Residual or new neurological deficits or symptoms (Rao, 2018)- see neurological deficit section above*.
- When combo requests 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 (~~i.~~e.g., the need for both soft tissue and bony anatomy is required) (Fisher, 2013)~~.~~
    - 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) (Choi, 2011)
        - 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 contraindicated (ACR, 2015; Behrbalk, 2013; Davies, 2018; Vilaca, 2016; Waly, 2017)

- **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 injury
(ACR, 2018)

- Presents with any of the following **neurological deficits**~~: muscle weakness, abnormal reflexes, and/or sensory changes along a particular dermatome (nerve distribution). *~~ **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**~~.~~ **(ACR, 2021; Koivikko, 2008)**~~, ACR)~~
- When the patient is clinically unevaluable or there are preliminary imaging findings (x~~X~~-ray or CT) needing further evaluation~~.~~
- ~~History of underlying spinal abnormalities (i.e., ankylosing spondylitis) (Koivikko, 2008)~~
- When office notes specify the patient meets NEXUS (National Emergency X-Radiography Utilization Study) or CCR (Canadian Cervical Rules) criteria for imaging (ACR, 2018):
    - 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 i~~I~~t is appropriate to perform both examinations" (ACR, 2018))~~.~~

~~**For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate**~~
~~(ACR, 2013; NASS, 2010)~~

- ~~With any of the following new neurological deficits: extremity muscular weakness; pathologic (e.g. Babinski, Hoffman's) or abnormal reflexes; or abnormal sensory changes along a particular dermatome (nerve distribution) as documented on physical exam; bowel or bladder dysfunction; spasticity, sensory, or motor level.~~

For evaluation of known fracture or known/new compression fractures
(ACR, ~~2012~~**2018**)

- 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 above (Alexandru, 2012)**
- **Prior to a planned surgery/intervention or if the results of the CT will change management**~~.~~

CT myelogram is indicated when signs and symptoms are incongruent with MRI findings or MRI cannot be performed/contraindicated/surgeon preference ~~when MRI is contraindicated~~ (Grams, 2010; Morita, 2011; Naganawa, 2011; NASS, 2012; Ozdoba; 2011; Starling, 2013)~~(ACR, 2019; NASS, 2010)~~

- 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

~~**Ossification Posterior Longitudinal Ligament (OPPL)** (Choi, 2011)~~

- ~~CT to evaluate the calcification and MR for evaluation of cord~~
  - ~~Both CT and MRI would be approvable if surgery is planned as signal changes in the cord would suggest a poorer prognosis after surgery.~~

~~**For evaluation of suspected myelopathy when Cervical Spine MRI is contraindicated**~~
~~(ACR, 2015; Behrbalk, 2013; Davies, 2018; Vilaca, 2016; Waly, 2017)~~

- ~~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 (Signs: unsteadiness, broad-based gait, increased muscle tone, weakness and wasting of the upper and lower limbs; diminished sensation to light touch, temperature, proprioception, vibration; limb hyperreflexia and pathologic reflexes; bowel and bladder dysfunction in more severe cases).~~

~~**For evaluation of known or new compression fractures with worsening neck pain** (ACR, 2018)~~

- ~~With history of malignancy (if MRI is contraindicated)~~
- ~~With an associated new focal neurologic deficit~~
- ~~Prior to a planned surgery/intervention or if the results of the CT will change management.~~

For evaluation 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)
(ACR, 2108; Kim, 2012; Roberts, 2010)
Primary tumor

- **Initial staging or re-staging of a known primary spinal tumor~~.~~**
- **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 above (Alexandru, 2012)**

Metastatic tumor~~:~~

- **With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam**

- Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine
- With an associated new focal neurologic deficit (Alexandru, 2012)
- Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck ~~that~~ pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine (ACR, 2018; Ziu, 2019)~~.~~

~~**For evaluation of known tumor, cancer, or evidence of metastasis with any of the following** (MRI is usually the preferred study, but CT may help characterize solitary indeterminate lesions (Kim, 2012))~~

- ~~For staging of known tumor~~
- ~~For follow-up evaluation of patient undergoing active cancer treatment.~~
- ~~Presents with new signs or symptoms (e.g. physical, laboratory, and/or imaging findings) of new tumor or change in tumor.~~
- ~~With evidence of metastasis on bone scan or previous imaging study.~~
- ~~Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck that pain occurs at night, and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine when MRI cannot be done (ACR, 2018; Ziu, 2019).~~

For evaluation of inconclusive/indeterminate finding on prior imaging that requires further clarification~~:~~

- One follow-up exam to ensure no suspicious change has occurred in prior imaging finding. No further surveillance unless specified as highly suspicious or change was found on last follow-up exam. When MRI cannot be performed, ~~or~~ is contraindicated, or CT is preferred to characterize the finding ~~For evaluation of suspected tumor when Cervical Spine MRI is contraindicated or inappropriate~~

(ACR, 2018)

- ~~Prior abnormal or indeterminate imaging that requires further clarification.~~

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 /~~,~~ abscess when ~~, or inflammatory disease when~~ Cervical Spine MRI is contraindicated
(ACR, 2018)

- ~~**Infection:**~~
- As evidenced by signs and/or symptoms, laboratory (i.e., abnormal white blood cell count, ESR and/or CRP) or prior imaging findings (Bond, 2016)

- Follow-up imaging of infection
  - With worsening symptoms/laboratory values (i.e., white blood cell count, ESR/CRP) or radiographic findings (Berbari, 2015)

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) (Colebatch, 2013; Tehranzadeh, 2017)
  - 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 spine (Henderson, 2017)
- **Spondyloarthropathies, known or suspected**
  - **Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and appropriate rheumatology workup**

~~In rheumatoid arthritis with neurologic signs or symptoms, evidence of subluxation or positive radiograph (lateral radiograph in flexion and neutral should be the initial study) when MRI is contraindicated or for surgical treatment planning (Colebatch, 2013)~~

For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma when Cervical Spine MRI is contraindicated
(ACR, 2015; Nagashima, 2010)

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

~~**As part of initial post-operative/procedural evaluation ("CT best examination to assess for hardware complication, extent of fusion"** (ACR, 2015; Rao, 2018) **and MRI for cord, nerve root compression, disc pathology, or post-op infection):**~~

- ~~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.~~
- ~~Changing neurologic status post-operatively.~~
- ~~Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings.~~
- ~~Residual or recurrent symptoms with any of the following neurological deficits: Upper extremity weakness, objective sensory loss, or abnormal reflexes (Rao, 2018).~~

~~**Other Indications for a Cervical Spine CT:**~~

- ~~For preoperative evaluation and Cervical Spine MRI is contraindicated~~
~~CT discogram~~
- **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 stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009)~~.~~
- Known Arnold-Chiari syndrome- (For initial imaging 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 pathology (Hitson, 2015)
    - ~~Known~~ Known Chiari II (Arnold-Chiari syndrome), III, or IV malformation ~~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) (Legare, 2020; White, 2016)
- Syrinx or syringomyelia (known or suspected)~~:~~
    - With neurologic findings and/or predisposing conditions (e.g., Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015)),
    - To further characterize a suspicious abnormality seen on prior imaging~~.~~
    - Known syrinx with new/worsening symptoms~~.~~
- Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))
- ~~Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS; Duz, 2008; Milhorat, 2009; NIH), and MRI is contraindicated.~~
- ~~Known Arnold-Chiari syndrome and Cervical Spine MRI is contraindicated.~~
- ~~Congenital abnormalities in the presence of neurologic deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016) when MRI is contraindicated or for characterization of bony detail.~~
- ~~Syrinx or syringomyelia (known or suspected) and Cervical Spine MRI is contraindicated:~~
    - ~~With neurologic findings and/or predisposing conditions (e.g. Chiari malformation, prior trauma, neoplasm, arachnoiditis, severe spondylosis (Timpone, 2015)),~~
    - ~~To further characterize a suspicious abnormality seen on prior imaging.~~
    - ~~Known syrinx with worsening symptoms.~~
    - ~~CSF leak highly suspected and supported by patient history and/or physical exam findings (CT myelogram).~~
- ~~For pediatric population and MRI is contraindicated (ACR, 2016)~~
    - ~~Red flags that prompt imaging should include the presence of constant pain, night pain, and radicular pain lasting for 4 weeks or more.~~
    - ~~Back pain associated with suspected inflammation, infection, or malignancy~~

- ~~In rheumatoid arthritis with neurologic signs or symptoms, evidence of subluxation or positive radiograph (lateral radiograph in flexion and neutral should be the initial study) when MRI is contraindicated or for surgical treatment planning (Colebatch, 2013)~~

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

Indications for combination studies: (ACR, 2017, 2019) - For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure

Brain CT/Cervical CT

- **For evaluation of known Arnold-Chiari Malformation**

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

- **Any combination of these studies for:**
  - **Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10 (ACR, 2018; SRS, 2019; Strahle, 2015).**
  - **In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning (Trenga, 2016)**
  - **Neck pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging.**
  - **Scoliosis with any of the following (Ozturk, 2010):**
    - **Progressive spinal deformity;**
    - **Neurologic deficit;**
    - **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 I (Radic, 2018; Strahle, 2011)**
  - **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 (Milhorat, 2009; Strahle, 2015)**~~.~~
- **Arnold Chiari II-IV**
  - **For initial evaluation and follow-~~-~~up as appropriate**
- **Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia required for imaging (Hertzler, 2010)**~~.~~

- Toe walking in a child when associated with upper motor neuron signs including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))
- Neck pain in a child with any of the following red flags (conservative care not required when red flags present):
    - Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed (Bernstein, 2007; Feldman, 2006)
    - Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram).
    - Suspected ~~L~~leptomeningeal carcinomatosis (LC) (Shah, 2011)
    - Any combination of these for spinal survey in patient with metastases.
    - Tumor evaluation and monitoring in neurocutaneous syndromes - See Background
    - 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) (Starling, 2013)
    - CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning
    - Post-procedure (discogram) CT

~~**Cervical/Thoracic/Lumbar CTs:**~~

- ~~CT myelogram when MRI is contraindicated~~
- ~~Post-procedure (discogram) CT.~~
- ~~Any combination of these for scoliosis survey in infant/child with congenital scoliosis or under the age of 10 (ACR, 2018; Strahle, 2015).~~
- ~~Any combination of these for spinal survey in patient with metastases.~~
- ~~For evaluation of spinal abnormalities associated with Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia) (Milhorat, 2009; Strahle, 2015).~~
- ~~Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high risk cutaneous stigmata (Duz, 2008; Milhorat, 2009), when anesthesia required for imaging and **MRI is contraindicated.**~~
- ~~Drop metastasis from brain or spine **when MRI contraindicated** (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram).~~

~~**Cervical MRI/CT**~~

- ~~For unstable craniocervical junction.~~

~~**Brain CT/Cervical CT**~~

- ~~For evaluation of Arnold-Chiari Malformation and Cervical Spine MRI is contraindicated.~~

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 Therapy:** (S~~s~~pine) should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a ~~physician~~ **physician** supervised home exercise program**, and/or osteopathic manipulative medicine (OMT) or chiropractic care **when considered safe and appropriate**. ~~.~~

****Home Exercise Program - (HEP)/ Therapy** – the following elements are required to meet guidelines for completion of conservative therapy (ACR, 2015; Last, 2009):

- Information provided on exercise prescription/plan AND
- ~~Follow~~ **Follow**-up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6-week period), or inability to complete HEP due to physical reason- i.e., increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute "inability to complete" HEP).
- Dates and duration of failed PT, ~~physician~~ **physician**-supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

Infection, Abscess, or Inflammatory disease

- Most common site is the lumbar spine (58%), followed by the thoracic spine (30%) and the cervical spine (11%) (Graeber, 2019)
- High risk populations (indwelling hardware, history of endocarditis, IVDA, recent procedures) with appropriate signs/symptoms

Table 1: Gait and spine imaging‡

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
Ataxic	Broad based, clumsy, staggering, lack of coordination, usually also with limb ataxia	Brain imaging
Apraxic	Magnetic, shuffling, difficulty initiating	Brain imaging
Parkinsonian	Stooped, small steps, rigid, turning en bloc, decreased arm swing	Brain Imaging
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	EMG→ foot drop Lumbar spine MRI Pelvis MR appropriate evidence of plexopathy
Vestibular	Insecure, veer to one side, worse when eyes closed, vertigo	Consider Brain/IAC MRI as per GL

(‡References: Chhetri, 2014; Clinch, 2021; Gait, 2021; Haynes, 2018; Marshall, 2012; Pirker, 2017)

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%) (Vilaca, 2016).

~~**Gait and spine imaging:**~~

~~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~~
~~Ataxic~~	~~Broad based, clumsy, staggering, lack of~~	~~Brain imaging~~

	coordination, usually also with limb ataxia	
Apraxie	Magnetic, shuffling, difficulty initiating	Brain imaging
Parkinsonian	Stooped, small steps, rigid, turning en bloc, decreased arm swing	Brain Imaging
Choreiform	Irregular, jerky, involuntary movements	Medication review, consider brain imaging as per movement disorder Brain MR guidelines
Sensory ataxie	Cautious, stomping, worsening without visual input (ie + Romberg)	EMG, blood work, consider spinal (cervical or thoracic cord imagng) imaging based on EMG
Neurogenic	Steppage, dragging of toes	EMG→ foot drop Lumbar spine MRI Pelvis MR appropriate evidence of plexopathy
Vestibular	Insecure, veer to one side, worse when eyes closed, vertigo	Consider Brain/IAC MRI as per GL

CT and Infection of the spine - Infection of the spine is not easy to differentiate from other spinal disorders, e.g., degenerative disease, spinal neoplasms, and non-infective inflammatory lesions. Infections may affect different parts of the spine, e.g., vertebrae, intervertebral discs, and paraspinal tissues. Imaging is important to obtain early diagnosis and treatment to avoid permanent neurologic deficits. When MRI is contraindicated, CT may be used to evaluate infections of the spine.

CT and Degenerative Disc Disease – Degenerative disc disease is very common, and CT may be indicated when MRI is contraindicated, when chronic degenerative changes are accompanied by conditions, e.g., new neurological deficits; onset of joint tenderness of a localized area of the spine; new abnormal nerve conductions studies; exacerbation of chronic neck or back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

Ossification Posterior Longitudinal Ligament (OPLL) (Choi, 2011) - Most common in cervical spine (rare but more severe in thoracic spine).

Table 2: MRI and Cutaneous Stigmata (Dias, 2015)

Risk Stratification for Various Cutaneous Markers		
High Risk	**Intermediate Risk**	**Low Risk**
• Hypertrichosis • Infantile hemangioma • Artretic meningocele • DST • Subcutaneous lipoma • Caudal appendage • Segmental hemangiomas in association with LUMBAR‡ syndrome	• Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined or PWS when darker red and well-defined)	• Coccygeal dimple • Light hair • Isolated café au lait spots • Mongolian spots • Hypo- and hypermelanotic macules or papules • Deviated or forked gluteal cleft • Nonmidline lesions
‡LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.		

~~**MRI and Cutaneous Stigmata** (Dias, 2015)~~

TABLE 1 Risk Stratification for Various Cutaneous Markers

High Risk	Intermediate Risk	Low Risk
Hypertrichosis	Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined, or PWS when darker red and well defined)	Coccygeal dimple
Infantile hemangioma		Light hair
Atretic meningocele		Isolated café au lait spots
DST		Mongolian spots
Subcutaneous lipoma		Hypo- and hypermelanotic macules or papules
Caudal appendage		Deviated or forked gluteal cleft
Segmental hemangiomas in association with LUMBAR syndrome		Nonmidline lesions

LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.

Back Pain with Cancer History - 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~~:~~ primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget's disease (osteitis deformans); infiltrative neoplasms, including and not limited to, multiple myeloma and lymphoma, and metastatic neoplasms (ACR, 2018).

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 (Ziu, 2019).

Cervical Spine Trauma Imaging (ACR, 2018): The National Emergency X-Radiography Utilization Study (NEXUS) and the Canadian Cervical Rules (CCR) represent clinical criteria used to help determine the presence of significant cervical spine injury. Although the criteria are highly sensitive (99.6% for NEXUS), specificity is low (12.9% for Nexus).

A patient not meeting any of the NEXUS criteria of focal neurologic deficit, midline spinal tenderness, altered consciousness, intoxication or distracting injury is unlikely to have a significant cervical spine injury. Imaging evaluation of the cervical spine in these patients is not necessary. In the CCR criteria, a patient without any high risk factors (Age >65 years~~;~~, paresthesias in extremities~~;~~ dangerous mechanism~~;~~ falls from ≥3 feet/5 stairs~~;~~ axial load to

head~~;~~ motor vehicle crash with high speed, rollover, or ejection~~;~~ bicycle collision~~;~~ motorized recreational vehicle accident) is next evaluated for low risk factors (s~~S~~imple rear-end motor vehicle crash, patient in sitting position in emergency center, patient ambulatory at any time after trauma, delayed onset of neck pain, absence of midline cervical spine tenderness). If the patient meets a low risk criteria, they are asked to move their head 45 degrees from midline in both directions. If the patient can accomplish this, the spine is cleared and imaging is not necessary.

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, brachial plexus injury in neonates, radiation therapy treatment planning, and cerebrospinal fluid (CSF) leak (ACR, 2019; Pomerantz, 2016)~~-~~.

POLICY HISTORY~~:~~

Date	Summary
April 2021	• Added/modified ○ Modified section on neurological deficits ○ Back pain in a child added/modified red flags ○ Gait table in background ○ Post-surgical modified/clarified surgical criteria for combination exams and surgeon preference for exam type ○ Removed myelopathy combination studies ○ Updated/added MS Criteria ▪ Combination section for initial imaging and follow up ▪ Added pediatric MS ○ Modified known tumor imaging into primary and metastatic disease ○ Added toe walking for pediatric patients ○ Modified Combination exam wording ○ Added Achondroplasia to criteria
May 2020	• Added ○ For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate, added “new” deficits ○ Expanded CT myelogram indications ○ Added Imaging of Ossification of the Posterior Longitudinal Ligament (OPPL)

	○ Added imaging in high risk patients predisposed to spinal injury ○ Added imaging in high risk patients for atlantoaxial injury ○ Added to background of imaging of infection ○ Modified Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or to include pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine ○ Added Osteopathic Manipulative medicine to conservative care therapy
June 2019	• Added: ○ new or worsening objective neuro deficits for chronic and acute back pain; CSF leak ○ last 6 months for allowable post op f/u period and removed EMG comment ○ red flags specifically for peds back pain and pain related to malignancy, infection, inflammation ○ new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain; ○ For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism ○ CT myelogram ○ Rheumatoid arthritis ○ Specifics on neuro deficits including pathologic reflexes and spasticity, sensory, or motor level ○ Spinal trauma ○ New or increasing back pain in cancer patients with high suspicion of mets

~~**Review Date:** June 2019~~
~~**Review Summary:**~~
~~• Added:~~
~~○ new or worsening objective neuro deficits for chronic and acute back pain; CSF leak~~
~~○ last 6 months for allowable post op f/u period and removed EMG comment~~
~~○ red flags specifically for peds back pain and pain related to malignancy, infection, inflammation~~

- new sections: pars defect; compression fractures; congenital abnormalities including section on scoliosis and vertebral anomalies in children w/back pain;
- For combination studies cervical/thoracic/lumbar added drop metastasis, tumor evaluation for neurocutaneous syndromes, and abnormalities associated w/Arnold Chiari, as well as separate indication for tethered cord or spinal dysraphism
- CT myelogram
- Rheumatoid arthritis
- Specifics on neuro deficits including pathologic reflexes and spasticity, sensory, or motor level
- Spinal trauma
- New or increasing back pain in cancer patients with high suspicion of mets

Review Date: May 2020
Review Summary:

- Added
  - For evaluation of neurologic deficits when Cervical Spine MRI is contraindicated or inappropriate, added "new" deficits
  - Expanded CT myelogram indications
  - Added Imaging of Ossification of the Posterior Longitudinal Ligament (OPPL)
  - Added imaging in high risk patients predisposed to spinal injury
  - Added imaging in high risk patients for atlantoaxial injury
  - Added to background of imaging of infection
  - Modified Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or to include pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine
  - Added Osteopathic Manipulative medicine to conservative care therapy

April 2021

- Added/modified
  - Modified section on neurological deficits
  - Back pain in a child added/modified red flags
  - Gait table in background
  - Post-surgical modified/clarified surgical criteria for combination exams and surgeon preference for exam type
  - Removed myelopathy combination studies
  - Updated/added MS Criteria
    - Combination section for initial imaging and follow up
    - Added pediatric MS
  - Modified known tumor imaging into primary and metastatic disease
  - Added toe walking for pediatric patients
  - Modified Combination exam wording
  - Added Achondroplasia to criteria

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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.

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