

Provider Led Entity

CDI Quality Institute PLE Neck Pain AUC 2019 Update

Appropriateness of advanced imaging procedures* in patients with Neck Pain and the following clinical presentations

*Including MRI, CT, CT myelography, bone scan, PET and PET/CT

05/07/2019

Abbreviation list:

ACR	American College of Radiology	MRI	Magnetic resonance imaging
AUC	Appropriate Use Criteria	NASS	North American Spine Society
CES	Cauda equina syndrome	PET	Positron emission tomography
CRP	C-reactive protein	PHQ-2	Patient Health Questionnaire-2
CT	Computed tomography	PLE	Provider Led Entity
ESR	Erythrocyte sedimentation rate	RMDQ	Roland-Morris Disability Questionnaire
FDG	Fluorodeoxyglucose	SF-36	36-Item Short Form Survey
HNP	Herniated nucleus pulposus	STIR	Short tau inversion recovery sequence
ICSI	Institute for Clinical Systems Improvement		

Red flag: Neck pain and/or radiculopathy with clinical, radiologic and/or laboratory suspicion of cancer:

- **Green** – MRI without IV contrast or MRI with and without IV contrast*
- **Yellow** – CT or CT myelography in a patient unable to undergo MRI
- **Yellow** – CT to evaluate equivocal MRI findings (to evaluate for osteolysis) or for characterization of a lesion detected on MRI
- **Yellow** – CT as the initial study (particularly if conventional radiographs show an area of osteolysis or to evaluate an area of increase uptake on bone scan)
- **Yellow** – bone scan to evaluate for multiple bone lesions with metastatic disease
- **Yellow** – PET or PET/CT for indeterminate lesions on CT or MRI in patients with a known PET sensitive cancer
- **Orange** – bone scan without prior MRI or CT
- **Red** – bone scan as a primary diagnostic test to evaluate for lesions in patients with known or suspected multiple myeloma
- **Red** – MRI with IV contrast

*Indications for IV contrast on MRI examinations of the cervical spine include prior cervical spine surgery; suspected epidural, intradural or intramedullary disease; and/or known or suspected neurologic disease (such as multiple sclerosis or Lyme’s disease).

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus opinion summary:

Bussières et al (2008) recommend radiographs and MRI in the evaluation of patients with neck pain and suspected neoplasm.

MRI is indicated for the evaluation of patients with evidence of neoplasm on x-rays of the cervical spine with or without a history of cancer (PLE expert panel consensus opinion).

In patients with *known malignancy, new or increasing nontraumatic cervical or neck pain or radiculopathy, initial imaging*, the *American College of Radiology* recommends MRI cervical spine without and with IV contrast or MRI cervical spine without IV contrast (usually appropriate). Radiography cervical spine (to detect pathological changes in cortical bone or identification of osteolytic lesions), CT cervical spine with IV contrast, CT cervical spine without IV contrast, MRI cervical spine with IV contrast, or Tc-99m bone scan whole body with SPECT/CT neck (for detecting suspected osseous metastasis with increased diagnostic accuracy) *may be appropriate* (McDonald et al [ACR] 2018).

CT without contrast is indicated in patients who cannot undergo MRI who have new onset neck pain and a history of cancer, abnormalities on conventional radiographs or clinical suspicion of cancer (PLE expert panel consensus opinion).

CT myelography is indicated to evaluate for intradural neoplasm or spinal metastases in patients with new or progressive neurologic symptoms who cannot undergo MRI (PLE expert panel consensus opinion).

Clinical notes:

- There is no consensus on the most predictive clinical signs of vertebral malignancy in the cervical spine. Our recommendations are based the lumbar spine literature, however, the incidence of malignancy in the cervical spine may not be as high as it is in the lumbar spine (PLE expert panel consensus opinion).
- In the lumbar spine literature, a history of cancer was found to be the only factor with a significant likelihood ratio (15) for malignancy (Chou et al [ACP] 2011). Unexplained weight loss, lack of improvement after 1 month and age older than 50 years of age were weaker predictors (positive likelihood ratios 2.7-3.0) (Chou et al [ACP] 2011). Cervical lymphadenopathy and an elevated ESR (> 20mm) might also prompt additional evaluation (PLE expert panel consensus opinion).
- In patients with new onset neck pain and secondary flags for malignancy, imaging might reasonably be deferred unless symptoms do not improve over several weeks as is recommended in the lumbar spine (Chou et al [ACP] 2011). Another strategy would be to obtain radiographs and an erythrocyte sedimentation rate (ESR) in these patients and reserve immediate MRI or CT to patients with abnormalities on one of these tests (Chou et al [ACP & APS] 2007).

Technical Notes:

- STIR, T2 fat saturation and/or diffusion-weight images may increase the conspicuity and sensitivity for vertebral neoplasm (PLE expert panel consensus opinion).
- MRI with intravenous contrast can be useful in patients with a clinical suspicion for intradural metastases, primary intradural/perineural neoplasm and/or cord abnormalities noted on noncontrast MRI (PLE expert panel consensus opinion).

Evidence update (2010-present):

There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above.

Red flag: Neck pain and/or radiculopathy with clinical, radiologic and/or laboratory suspicion of infection:

- **Green** – MRI without IV contrast or MRI with and without IV contrast*
- **Yellow** – CT in patients unable to undergo MRI
- **Yellow** – CT in patients with equivocal findings on MRI to evaluate for endplate destruction or poorly demarcated endplate erosions
- **Yellow** – CT as the initial study (particularly with evidence of endplate erosions on conventional radiographs)
- **Red** – bone scan; PET; PET/CT; MRI with IV contrast

*Indications for IV contrast on MRI examinations of the cervical spine include prior cervical spine surgery, suspected epidural or paraspinal abscess, and/or known or suspected neurologic disease (such as multiple sclerosis or Lyme’s disease).

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: none.

Guideline and PLE expert panel consensus opinion summary:

Bussièrès et al (2008) recommend radiographs and MRI in the evaluation of patients with neck pain and suspected infection.

In patients with *suspicion for infection with new or increasing nontraumatic cervical or neck pain or radiculopathy, initial imaging*, the *American College of Radiology* recommends MRI cervical spine without and with IV contrast (usually appropriate). CT cervical spine with IV contrast (complementary to MRI), MRI cervical spine without IV contrast, CT cervical spine without IV contrast, MRI cervical spine with IV contrast, or radiography cervical spine *may be appropriate* (McDonald et al [ACR] 2018).

CT with or without myelography is indicated in patients with new onset neck pain and suspected cervical spine infection in patients who cannot undergo MRI (PLE expert panel consensus opinion).

Clinical notes:

- Immediate imaging is indicated in patients with new onset neck pain, a clinical suspicion of infection and findings on radiograph consistent with or indeterminate for infection and/or neurologic findings (PLE expert panel consensus opinion).
- Clinical flags for infection include new moderate to severe and/or progressive pain following an invasive spine procedure or injection, erosive or osteolytic changes on radiograph, new onset neck pain with fever, or new onset neck pain with elevated WBC or ESR, and disproportionate pain (PLE expert panel consensus opinion).
- Risk factors for infection include recent infection, IV drug abuse, diabetes, immunosuppression and liver or renal failure (McDonald et al [ACR] 2018).
- In patients with new onset neck pain and no fever, radiographs and a CRP or ESR can be obtained. Immediate imaging can be obtained if either of these tests are abnormal (McDonald et al [ACR] 2018). Imaging can be deferred until follow-up in patients with negative radiographs and a negative ESR.

Technical notes:

- STIR or T2 fat saturation images are useful to identify marrow edema and paraspinal/epidural edema, phlegmon or abscess (PLE expert panel consensus opinion).
- Diffusion-weight imaging (the “claw sign”) may help differentiate inflammatory disc degeneration from vertebral spondylodiscitis (Patel et al 2014).
- MRI with IV contrast is useful to differentiate between phlegmon and abscess (Patel et al 2014).

Evidence update (2010-present):

There were no new studies which significantly affected the conclusions and recommendations from the high quality guidelines noted above.

Red flag: Cervical myelopathy:

- **Green** – MRI without IV contrast or MRI with and without IV contrast*
- **Yellow** – CT/CT myelography in a patient unable to undergo MRI
- **Yellow** – CT/CT myelography in a patient with equivocal or nondiagnostic findings on MRI
- **Yellow** – CT/CT myelography in patients with prior cervical spine fusion or disc arthroplasty or for surgical planning with or without prior MRI
- **Yellow** – CT or CT myelography for stenosis associated with known or suspected OPLL, DISH or crystal deposition disease with or without prior MRI
- **Red** – bone scan; PET; PET/CT; MRI with IV contrast

*Indications for IV contrast on MRI examinations of the cervical spine include prior cervical spine surgery; suspected epidural, intradural or intramedullary disease; and/or known or suspected neurologic disease (such as multiple sclerosis or Lyme’s disease).

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus opinion summary:

Mummaneni et al (2009) and Bussières et al (2008) recommend imaging with MRI to evaluate for a compressive lesions in patients with myelopathy or radiculo-myelopathy.

Bussières et al (2008) and Guzman et al (2009) recommend imaging with MRI in neck pain patients with disabling pain, major neurologic deficits and progressive neurological deficits.

In patients with painful myelopathy, the *American College of Radiology* recommends MRI cervical spine without IV contrast (8), MRI without and with IV contrast (7), CT without IV contrast (7) and CT myelography cervical spine (5) (Roth et al [ACR] 2015).

In patients with myelopathy, sudden onset or slowly progressive, the *American College of Radiology* recommends MRI cervical spine without IV contrast (9), MRI without and with IV contrast (9), CT myelography (6) and CT without contrast cervical spine (5) (Roth et al [ACR] 2015). CTA and MRA might also be considered if vascular pathology is suspected.

In patients with *chronic cervical neck pain without or with radiculopathy, radiographs show ossification in the posterior longitudinal ligament (OPLL), next imaging study*, the *American College of Radiology* recommends CT cervical spine without IV contrast (usually appropriate). CT myelography cervical spine (to help identify regions of position-dependent cord compression related to cervical spinal stenosis from OPLL) or MRI cervical spine without IV contrast (to assess cord abutment/signal changes secondary to spinal canal narrowing or to evaluate exiting nerve roots in the setting of radiculopathy) *may be appropriate* (McDonald et al [ACR] 2018).

Bussières et al (2008) recommend radiographs and MRI or CT myelography in the evaluation of patients with disabling arm pain, progressive deficit, or for preoperative planning in patients with cervical compressive myelopathy and radiculomyelopathy.

Mummaneni et al (2009) recommend the use of preoperative MR imaging or CT myelography to confirm a compressive lesion in the setting of clinical cervical myelopathy prior to elective cervical spine surgery (level of evidence, Class II; strength of recommendation, C).

Thin section CT and CT myelography with multiplanar reformats are indicated to assess the integrity of a spine fusion in patients with neck pain and myelopathy at initial evaluation or following MRI for surgical planning (PLE expert panel consensus opinion).

Thin section CT and CT myelography with multiplanar reformats are recommended to evaluate the integrity of disc replacement devices in symptomatic patients (PLE expert panel consensus opinion).

Clinical notes:

- Symptoms of myelopathy include loss of coordination, sensory disturbance at multiple levels, stiffness of the upper and lower extremities, an acute change in bowel or bladder, and frequent falling.
- Signs of myelopathy include hyperreflexia, weakness, Lhermitte sign, clonus, Hoffmann sign, and a positive Babinski sign.
- Preoperative MR findings imaging T1 hypointensity combined with T2 hyperintensity at the same level in the cervical cord may predict a poor surgical outcome (Mummaneni et al 2009, quality of evidence, Class III; strength of recommendation, D).
- There is conflicting Class III evidence of whether T2 hyperintensity alone at a single level predicts poor outcome.
- Because of the risks of cervical myelography, consider MRI, plain CT and/or neurological/spine subspecialist evaluation prior to myelography (PLE expert panel consensus opinion).
- Consider thoracic spine MRI and/or neurologic subspecialist evaluation in patients with myelopathic or lower extremity symptoms or signs and a negative MRI of the cervical spine (PLE expert panel consensus opinion).

Technical notes:

- MRI examinations should include the cervico-occipital junction and the upper thoracic spine (PLE expert panel consensus opinion).
- MRI with IV contrast may be useful to characterize intradural and intramedullary abnormalities, and/or to evaluate patient with known neurologic disorders such as multiple sclerosis or Lyme's disease (PLE expert panel consensus opinion).
- CT examinations obtained to evaluate the integrity of spine fusions should utilize thin sections with reformatted sections in the sagittal and coronal or coronal oblique planes (PLE expert panel consensus opinion).
- CT and MRI spine examinations obtained in patients with instrumentation, interbody implants with metallic beads, metallic interbody implants or total disc replacement devices should utilize metal artifact reduction techniques (PLE expert panel consensus opinion).

Evidence update (2010-present):

Chen et al (2016) conducted a meta-analysis to compare postoperative functional outcomes in cervical spondylosis myelopathy (CSM) patients according to T2-weighted and T1-weighted MRI images. A total of 10 studies met inclusion criteria (n = 650 CSM patients). Weighted mean differences and 95% confidence intervals were used to summarize the data. The surgical outcomes were poorer in the patients with T2 intramedullary signal changes, especially when the signal changes were

multisegmental, had a well-defined border and were associated with T1 intramedullary signal changes. The authors conclude that preoperative MRI including T1 and T2 imaging can thus be used to predict postoperative recovery in CSM patients (moderate level of evidence).

Sun et al (2011) conducted a prospective randomized controlled study to investigate whether intramedullary spinal cord changes in signal intensity on MRI affect surgical opportunity and approach for cervical myelopathy due to ossification of the posterior longitudinal ligament (OPLL). A total of 56 patients (mean age 57.5) were assigned to either anterior decompression/fusion (n = 27) or posterior laminectomy (n = 29). Patients were followed up for an average 20.3 months (range 12-34 months). Clinical outcomes were assessed by the average operative time, blood loss, Japanese Orthopedic Association (JOA) score, improvement rate (IR) and complication. The study found that, regardless of hyperintensity on T2-weighted imaging or hypointensity on T1-weighted imaging in patients with OPLL, severe damage to the spinal cord is indicated. Surgical treatment should be provided before the advent of intramedullary spinal cord changes in signal intensity on MRI. The anterior approach is more effective than posterior approach for treating cervical myelopathy due to OPLL characterized by intramedullary spinal cord changes in signal intensity on MRI (high level of evidence).

Tetreault et al (2013) conducted a systematic review to determine whether there are MRI characteristics in patients with cervical spondylotic myelopathy that affect treatment decisions or predict postsurgical outcomes or adverse events. Twenty publications were included (3 assessing MRI predictors of clinical deterioration in conservative treatment; 17 evaluated MRI anatomic or cord characteristics that could predict surgical outcome or adverse events). Results of analysis found low evidence suggesting that high signal intensity (SI) grade on T2WI is not associated with patient deterioration during conservative treatment. There is low evidence identifying number of high SI segments on T2WI, low signal segments on T1WI combined T1/T2 SI, and SI ratio as important negative predictors of surgical outcome. The authors make the following recommendations: 1) We suggest that when clinically feasible, surgeons rely on MRI to confirm the diagnosis of CSM and rely on clinical history and examination to determine progression and severity of disease; 2) T2 signal may be a useful prognostic indicator when used in combination with low SI change on T1WI, or as a ratio comparing compressed with noncompressed segments, or as a ratio of T2 compared with T1WI (moderate level of evidence).

Vendantam et al (2013) conducted a systematic review on different classifications of T2-weighted (T2W) increased signal intensity (ISI) on preoperative MR images of patients with cervical spondylotic myelopathy (CSM). A total of 22 studies were included, including 11 prospective studies (n = 1,508 patients). Methodological variations in previous studies made it difficult to compare studies and results. The authors conclude that: both multisegmental T2W ISI, and sharp intense T2W ISI are associated with poorer surgical outcome (Class II evidence); and the regression of T2W ISI postoperatively correlates with better functional outcomes (Class II) (moderate level of evidence).

Rhee et al (2015) conducted a systematic review to determine best criteria for radiological determination of postoperative subaxial cervical fusion to be applied to current clinical practice. A total of 12 publications were included, and assessed C2 to C7 via anterior or posterior approach, at > 12 weeks postoperative, with any graft or implant. Results found that of advanced imaging modalities, there is moderate evidence that CT is more accurate and reliable than MRI in assessing anterior cervical fusion. The authors recommend that radiographs be the initial method for determining posterior cervical fusion but suggest a lower threshold for obtaining CT scans because dynamic radiographs may not be as useful if spinous processes have been removed by laminectomy (moderate level of evidence).

Neck pain with or without uncomplicated radiculopathy*, no red flags and no prior management:

- **Green** –
- **Yellow** –
- **Orange** – MRI without IV contrast; MRI with and without IV contrast; CT; CT myelography; bone scan
- **Red** – PET; PET/CT; MRI with IV contrast

*Uncomplicated radiculopathy refers to patients without major trauma, no red flags and no major or progressive neurological deficits. These patient may have sensor or minor/single group motor symptoms.

Level of Evidence: Low

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus opinion summary:

Bussières et al (2008) do not recommend routine imaging in patient with acute, subacute or persistent neck pain with or without uncomplicated radiculopathy at initial presentation.

The *Bone and Joint Task Force on Neck Pain* (Guzman et al 2009) recommends that diagnostic testing is not indicated in the initial assessment of grade I or grade II neck pain.

In patients with *new or increasing nontraumatic cervical or neck pain, no “red flags”, initial imaging*, the *American College of Radiology* recommends radiography cervical spine (usually appropriate). MRI cervical spine without IV contrast (to detect soft abnormalities in symptomatic individuals) or CT cervical spine without IV contrast (to depict cortical bone or assess facet degenerative disease, osteophyte formation, vacuum phenomenon, or joint capsular calcification) *may be appropriate* (McDonald et al [ACR] 2018).

In patients with *chronic cervical or neck pain, initial imaging*, the *American College of Radiology* recommends radiography cervical spine (usually appropriate). MRI cervical spine without IV contrast (to detect soft abnormalities in symptomatic individuals) or CT cervical spine without IV contrast (when neurological symptoms are present) *may be appropriate* (McDonald et al [ACR] 2018).

Clinical notes:

- Most patients with cervical radiculopathy will improve regardless of nonoperative treatment modality, with approximately 88% improving within four weeks of nonoperative management (Childress & Becker, 2016).
- Red flags include marked or progressive neurological signs, myelopathy, or red flags including a suspicion of cancer, fracture or infection (PLE expert panel consensus opinion).

Evidence update (2010-present):

There were no new studies which significantly affected the conclusions and recommendations from the guidelines noted above.

Neck pain with moderate to severe radiculopathy and one of the following:

- **Failure of conservative therapy (including uncontrolled pain and/or marked disability, pain increasing during conservative therapy and moderate to severe pain and/or dysfunction persisting after an appropriate trial of conservative therapy);**
- **Persistent or recurrent symptoms following surgery;**
- **Major or progressive neurologic deficits, or**
- **Evaluation for injection therapy or surgery:**
 - **Green** - MRI without IV contrast or MRI with and without IV contrast*
 - **Yellow** – CT or CT myelography in a patient unable to undergo MRI
 - **Yellow** – CT or CT myelography in a patient with discordant MRI findings and symptoms
 - **Yellow** – CT or CT myelography in a patient with evidence of OPLL on prior radiographs or MRI
 - **Yellow** – CT or CT myelography in a patient with a history of previous cervical fusion or disc arthroplasty or in patients undergoing surgical planning following MRI
 - **Yellow** – CT as the initial study without prior MRI and without contraindications to MRI
 - **Orange** – CT myelography as the initial study without prior MRI and without contraindications to MRI
 - **Red** – bone scan; PET; PET/CT; MRI with IV contrast

*Indications for IV contrast on MRI examinations of the cervical spine include prior cervical spine surgery; suspected epidural, intradural or intramedullary disease; and/or known or suspected neurologic disease (such as multiple sclerosis or Lyme’s disease).

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus opinion summary:

NASS (2010) recommends MRI for the confirmation of correlative compressive lesions in cervical radiculopathy patients who have failed a course of conservative therapy and who may be a candidate for interventional or surgical treatment (moderate level of evidence).

NASS (2010) recommends CT as the initial study to confirm correlative compressive lesions in cervical radiculopathy patients who have failed a course of conservative therapy and who may be a candidate for interventional or surgical treatment who have a contraindication to MRI (consensus opinion).

NASS (2010) recommends CT myelography to evaluate cervical radiculopathy patients with discordant signs and symptoms on MRI, and to confirm correlative compressive in patients who have failed a course of conservative therapy, who may be a candidate for interventional or surgical treatment and who cannot undergo MRI (moderate level of evidence).

Mummaneni et al (2009) recommend the use of preoperative MR imaging or CT myelography to confirm a compressive lesion in the setting of clinical cervical radiculopathy prior to elective cervical spine surgery (level of evidence, Class II; strength of recommendation, C).

The *Bone and Joint Task Force on Neck Pain* (Guzman et al 2009) recommends MRI or CT in patients with incapacitating radicular pain, major neurologic deficits at onset or progression of deficits.

In patients with *new or increasing nontraumatic cervical radiculopathy, "no red flags", initial imaging*, the *American College of Radiology* recommends MRI cervical spine without IV contrast (usually appropriate). CT cervical spine without IV contrast (to define bony elements or to assess neuroforaminal stenosis secondary to uncovertebral or facet hypertrophy) or radiography cervical spine *may be appropriate* (McDonald et al [ACR] 2018).

In patients with *chronic cervical neck pain without or with radiculopathy, radiographs show ossification in the posterior longitudinal ligament (OPLL), next imaging study*, the *American College of Radiology* recommends CT cervical spine without IV contrast (usually appropriate). CT myelography cervical spine (to help identify regions of position-dependent cord compression related to cervical spinal stenosis from OPLL) or MRI cervical spine without IV contrast (to assess cord abutment/signal changes secondary to spinal canal narrowing or to evaluate exiting nerve roots in the setting of radiculopathy) *may be appropriate* (McDonald et al [ACR] 2018).

CT and CT myelography are indicated in patients with neck pain and radiculopathy who cannot undergo MRI (PLE expert panel consensus opinion).

Thin section CT and CT myelography with multiplanar reformats are indicated in patients with neck pain and radiculopathy in order to assess the integrity of interbody and posterior spinal fusions at initial evaluation and for surgical planning with or without prior MRI (PLE expert panel consensus opinion).

Thin section CT and CT myelography with multiplanar reconstructions are recommended to evaluate the integrity of disc replacement devices in symptomatic patients (PLE expert panel consensus opinion).

Clinical notes:

- The natural history of cervical disc herniation with radiculopathy is for improvement in the first 4 weeks for most patients with noninvasive therapy (PLE expert panel consensus opinion).
- Early treatment of radiculopathy is noninvasive and may consist of manipulation, exercise therapy, physical therapy or pharmacologic therapy (PLE expert panel consensus opinion).
- Failure of conservative care can be defined as moderate to severe persistent symptoms following an appropriate period of conservative care (typically 4-6 weeks), uncontrolled pain marked limitation of function, increasing pain during conservative care or inability to participate in noninvasive care for an appropriate period of time (PLE expert panel consensus opinion).
- Immediate imaging is indicated in patients presenting with major or progressive neurologic deficits (PLE expert panel consensus opinion).

Technical notes:

- Findings on MRI and CT are nonspecific and require strict correlation of symptoms and findings on physical exam to determine the significance (PLE expert panel consensus opinion).

- CT examinations obtained to evaluate the integrity of spine fusions should utilize thin sections with reformatted sections in the sagittal and coronal or coronal oblique planes (PLE expert panel consensus opinion).
- CT and MRI spine examinations obtained in patients with instrumentation, interbody implants with metallic beads, metallic interbody implants or total disc replacement devices should utilize metal artifact reduction techniques (PLE expert panel consensus opinion).

Evidence update (2010-present):

Kuijper et al (2011) reported on the interobserver reliability of MRI evaluation in patients with cervical radiculopathy. They found substantial interobserver agreement between neuroradiologists for the detection of root compression on MRI in a series of patients with well-defined, recent onset cervical radiculopathy. Agreement on the cause of root compression, i.e., disc herniation and spondylotic foraminal stenosis is less robust. The kappa score for evaluation of herniated discs and of spondylotic foramen stenosis was 0.59 and 0.63, respectively. A kappa score of 0.67 was found for the presence of root compression (moderate level of evidence).

Rhee et al (2015) conducted a systematic review to determine best criteria for radiological determination of postoperative subaxial cervical fusion to be applied to current clinical practice. A total of 12 publications were included, and assessed C2 to C7 via anterior or posterior approach, at > 12 weeks postoperative, with any graft or implant. Results found that of advanced imaging modalities, there is moderate evidence that CT is more accurate and reliable than MRI in assessing anterior cervical fusion. The authors recommend that radiographs be the initial method for determining posterior cervical fusion but suggest a lower threshold for obtaining CT scans because dynamic radiographs may not be as useful if spinous processes have been removed by laminectomy (moderate level of evidence).

Nonspecific neck pain (moderate or severe) without significant radiculopathy, myelopathy or red flags, and with:

- **Failure of conservative therapy (including uncontrolled pain and/or marked disability, pain increasing during conservative therapy, and moderate to severe pain and/or dysfunction persisting after an appropriate trial of conservative therapy); or**
- **Evaluation for injection therapy or surgery:**
 - **Green** – MRI without IV contrast or MRI with and without IV contrast*
 - **Yellow** – CT in a patient unable to undergo MRI
 - **Yellow** – CT as the initial study without contraindications to MRI
 - **Yellow** – CT in a patient with a history of a cervical spine fusion or disc arthroplasty
 - **Yellow** – CT in a patient undergoing surgical planning with or without previous MRI
 - **Orange** – bone scan, except in patients with indeterminate or inconclusive bone lesions on MRI or CT
 - **Orange** – PET or PET/CT except in patients with indeterminate or inconclusive MRI or CT scans and a known PET sensitive cancer
 - **Red** - CT myelography in patients without radiculopathy or myelopathy
 - **Red** – MRI with IV contrast

*Indications for IV contrast on MRI examinations of the cervical spine include prior cervical spine surgery; suspected epidural, intradural or intramedullary disease; and/or known or suspected neurologic disease (such as multiple sclerosis or Lyme’s disease).

Level of Evidence: Moderate

Notes concerning applicability and/or patient preferences: none

Guideline and PLE expert panel consensus opinion summary:

Bussières et al (2008) recommend radiographs and MRI in the evaluation of patients with neck pain not responding to or progressing after a 4 week course of conservative therapy.

NASS (2010) states that MRI is suggested for the confirmation of correlative compressive lesions in cervical spine patients who have failed a course of conservative therapy and who may be candidates for interventional or surgical treatment (Grade of Recommendation: B).

CT and CT myelography are indicated in patients with moderate to severe neck pain who cannot undergo MRI (PLE expert panel consensus opinion).

CT is indicated in patients with neck pain in order to assess the integrity of interbody and posterior spinal fusions at initial evaluation and or for surgery planning with or without previous MRI (PLE expert panel consensus opinion).

Thin section CT and CT myelography with multiplanar reconstructions are recommended to evaluate the integrity of disc replacement devices in symptomatic patients (PLE expert panel consensus opinion).

Clinical notes:

- Practitioners should emphasize that acute neck pain is nearly always benign and generally resolves within 1 to 6 weeks, and that the first line of treatment for neck pain is conservative care (PLE expert panel consensus opinion).
- Conservative care may consist of manipulation, exercise therapy, physical therapy, cognitive behavioral therapy, multidisciplinary rehabilitation, pharmacologic therapy or time (for patients unable or unwilling to undergo available noninvasive treatments) (PLE expert panel consensus opinion).
- Clinicians should consider alternative or second levels of conservative care if the patient is not improving at the time of re-evaluation at 2-6 weeks (PLE expert panel consensus opinion). Clinicians should consider the use of radiograph, depression screening (PHG-2) and a fear avoidance survey at the time of re-evaluation at 2-6 weeks (PLE expert panel consensus opinion).
- In referring patients with nonspecific neck pain who have failed noninvasive therapies, other published guidelines suggest referring patients to a spine specialist after a period of 8-12 weeks (PLE expert panel consensus opinion).

Technical notes:

- Findings on MRI and CT are nonspecific and require strict correlation of symptoms and findings on physical exam to determine the significance (PLE expert panel consensus opinion).
- CT examinations obtained to evaluate the integrity of spine fusions should utilize thin sections with reformatted sections in the sagittal and coronal or coronal oblique planes (PLE expert panel consensus opinion).
- CT and MRI spine examinations obtained in patients with instrumentation, interbody implants with metallic beads, metallic interbody implants or total disc replacement devices should utilize metal artifact reduction techniques (PLE expert panel consensus opinion).

Evidence update (2010-present):

Rhee et al (2015) conducted a systematic review to determine best criteria for radiological determination of postoperative subaxial cervical fusion to be applied to current clinical practice. A total of 12 publications were included, and assessed C2 to C7 via anterior or posterior approach, at > 12 weeks postoperative, with any graft or implant. Results found that of advanced imaging modalities, there is moderate evidence that CT is more accurate and reliable than MRI in assessing anterior cervical fusion. The authors recommend that radiographs be the initial method for determining posterior cervical fusion but suggest a lower threshold for obtaining CT scans because dynamic radiographs may not be as useful if spinous processes have been removed by laminectomy (moderate level of evidence).

Guideline exclusions:

- WBC scan/Ga scan
- Major trauma
- Immediate post-op imaging in patients with fusion surgery
- The use of IV contrast in imaging patients with previous spine surgery
- Inflammatory spondyloarthropathy
- Pregnant patients and
- Pediatric patients.

AUC Revision History:

<u>Revision Date:</u>	<u>New AUC Clinical Scenario(s):</u>	<u>Posting Date:</u>	<u>Approved By:</u>
05/07/2019	n/a	05/17/2019	CDI Quality Institute's Multidisciplinary Committee

Information on our evidence development process, including our conflicts of interest policy is available on our website at [https://www.mycdi.com/about us/cdi quality institute/provider led entity/](https://www.mycdi.com/about-us/cdi-quality-institute/provider-led-entity/)