

**American College of Radiology  
ACR Appropriateness Criteria®  
Cervical Neck Pain or Cervical Radiculopathy**

**Variant 1:**                      **New or increasing nontraumatic cervical or neck pain. No “red flags.” Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography cervical spine	Usually Appropriate	☢☢
MRI cervical spine without IV contrast	May Be Appropriate (Disagreement)	○
CT cervical spine without IV contrast	May Be Appropriate	☢☢☢
CT cervical spine with IV contrast	Usually Not Appropriate	☢☢☢
MRI cervical spine without and with IV contrast	Usually Not Appropriate	○
CT cervical spine without and with IV contrast	Usually Not Appropriate	☢☢☢
CT myelography cervical spine	Usually Not Appropriate	☢☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢
Discography cervical spine	Usually Not Appropriate	☢☢
Facet injection/medial branch block cervical spine	Usually Not Appropriate	☢☢
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
MRI cervical spine with IV contrast	Usually Not Appropriate	○
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	☢☢☢
Radiographic myelography cervical spine	Usually Not Appropriate	☢☢☢

**Variant 2:****New or increasing nontraumatic cervical radiculopathy. No “red flags.” Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI cervical spine without IV contrast	Usually Appropriate	○
CT cervical spine without IV contrast	May Be Appropriate	☢☢☢
Radiography cervical spine	May Be Appropriate (Disagreement)	☢☢
MRI cervical spine without and with IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	☢☢☢
CT myelography cervical spine	Usually Not Appropriate	☢☢☢☢
CT cervical spine with IV contrast	Usually Not Appropriate	☢☢☢
CT cervical spine without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢
Discography cervical spine	Usually Not Appropriate	☢☢
Facet injection/medial branch block cervical spine	Usually Not Appropriate	☢☢
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
MRI cervical spine with IV contrast	Usually Not Appropriate	○
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	☢☢☢

**Variant 3:** Prior cervical spine surgery. New or increasing nontraumatic cervical or neck pain or radiculopathy. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography cervical spine	Usually Appropriate	☼☼
CT cervical spine without IV contrast	Usually Appropriate	☼☼☼
MRI cervical spine without and with IV contrast	May Be Appropriate (Disagreement)	○
MRI cervical spine without IV contrast	May Be Appropriate (Disagreement)	○
CT myelography cervical spine	May Be Appropriate	☼☼☼☼
Radiographic myelography cervical spine	Usually Not Appropriate	☼☼☼
CT cervical spine with IV contrast	Usually Not Appropriate	☼☼☼
MRI cervical spine with IV contrast	Usually Not Appropriate	○
CT cervical spine without and with IV contrast	Usually Not Appropriate	☼☼☼
CTA neck with IV contrast	Usually Not Appropriate	☼☼☼
Discography cervical spine	Usually Not Appropriate	☼☼
Facet injection/medial branch block cervical spine	Usually Not Appropriate	☼☼
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	☼☼☼

**Variant 4:**

**Suspicion for infection with new or increasing nontraumatic cervical or neck pain or radiculopathy. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI cervical spine without and with IV contrast	Usually Appropriate	○
CT cervical spine with IV contrast	May Be Appropriate	⦿⦿⦿
MRI cervical spine without IV contrast	May Be Appropriate	○
CT cervical spine without IV contrast	May Be Appropriate (Disagreement)	⦿⦿⦿
MRI cervical spine with IV contrast	May Be Appropriate (Disagreement)	○
Radiography cervical spine	May Be Appropriate (Disagreement)	⦿⦿
CT cervical spine without and with IV contrast	Usually Not Appropriate	⦿⦿⦿
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	⦿⦿⦿⦿
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	⦿⦿⦿
CT myelography cervical spine	Usually Not Appropriate	⦿⦿⦿⦿
Gallium scan whole body	Usually Not Appropriate	⦿⦿⦿⦿
WBC scan whole body	Usually Not Appropriate	⦿⦿⦿⦿
CTA neck with IV contrast	Usually Not Appropriate	⦿⦿⦿
Discography cervical spine	Usually Not Appropriate	⦿⦿
Facet injection/medial branch block cervical spine	Usually Not Appropriate	⦿⦿
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	⦿⦿⦿

**Variant 5:** Known malignancy. New or increasing nontraumatic cervical or neck pain or radiculopathy. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI cervical spine without and with IV contrast	Usually Appropriate	○
MRI cervical spine without IV contrast	Usually Appropriate	○
Radiography cervical spine	May Be Appropriate	☢☢
CT cervical spine with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
CT cervical spine without IV contrast	May Be Appropriate (Disagreement)	☢☢☢
MRI cervical spine with IV contrast	May Be Appropriate (Disagreement)	○
Bone scan whole body with SPECT or SPECT/CT neck	May Be Appropriate	☢☢☢
FDG PET/CT whole body	Usually Not Appropriate	☢☢☢☢
CT cervical spine without and with IV contrast	Usually Not Appropriate	☢☢☢
CT myelography cervical spine	Usually Not Appropriate	☢☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢
Discography cervical spine	Usually Not Appropriate	☢☢
Fluoride PET/CT whole body	Usually Not Appropriate	☢☢☢☢
Facet injection/medial branch block cervical spine	Usually Not Appropriate	☢☢
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	☢☢☢

**Variant 6:**

**Cervicogenic headache and new or increasing nontraumatic cervical or neck pain. No neurologic deficit. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI cervical spine without IV contrast	May Be Appropriate (Disagreement)	○
Radiography cervical spine	May Be Appropriate	☼☼
CT cervical spine without IV contrast	May Be Appropriate	☼☼☼
Facet injection/medial branch block cervical spine	May Be Appropriate	☼☼
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	☼☼☼
MRI cervical spine without and with IV contrast	Usually Not Appropriate	○
CT cervical spine with IV contrast	Usually Not Appropriate	☼☼☼
CT cervical spine without and with IV contrast	Usually Not Appropriate	☼☼☼
CT myelography cervical spine	Usually Not Appropriate	☼☼☼☼
CTA neck with IV contrast	Usually Not Appropriate	☼☼☼
Discography cervical spine	Usually Not Appropriate	☼☼
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
MRI cervical spine with IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	☼☼☼

**Variant 7: Chronic cervical or neck pain. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography cervical spine	Usually Appropriate	☢☢
MRI cervical spine without IV contrast	May Be Appropriate (Disagreement)	○
CT cervical spine without IV contrast	Usually Not Appropriate	☢☢☢
MRI cervical spine without and with IV contrast	Usually Not Appropriate	○
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	☢☢☢
CT cervical spine with IV contrast	Usually Not Appropriate	☢☢☢
CT cervical spine without and with IV contrast	Usually Not Appropriate	☢☢☢
CT myelography cervical spine	Usually Not Appropriate	☢☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢
Discography cervical spine	Usually Not Appropriate	☢☢
Facet injection/medial branch block cervical spine	Usually Not Appropriate	☢☢
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
MRI cervical spine with IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	☢☢☢

**Variant 8:**

**Chronic cervical or neck pain. No neurologic findings. Radiographs show degenerative changes. Next imaging study.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI cervical spine without IV contrast	Usually Appropriate	○
CT cervical spine without IV contrast	May Be Appropriate	☢☢☢
CT myelography cervical spine	May Be Appropriate	☢☢☢☢
MRI cervical spine without and with IV contrast	Usually Not Appropriate	○
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	☢☢☢
MRI cervical spine with IV contrast	Usually Not Appropriate	○
CT cervical spine with IV contrast	Usually Not Appropriate	☢☢☢
CT cervical spine without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢
Discography cervical spine	Usually Not Appropriate	☢☢
Facet injection/medial branch block cervical spine	Usually Not Appropriate	☢☢
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	☢☢☢



**Variant 9:**

**Chronic cervical or neck pain without or with radiculopathy. Radiographs show ossification in the posterior longitudinal ligament (OPLL). Next imaging study.**

Procedure	Appropriateness Category	Relative Radiation Level
CT cervical spine without IV contrast	Usually Appropriate	⦿⦿⦿
CT myelography cervical spine	May Be Appropriate (Disagreement)	⦿⦿⦿⦿
MRI cervical spine without IV contrast	May Be Appropriate (Disagreement)	○
MRI cervical spine without and with IV contrast	Usually Not Appropriate	○
Radiographic myelography cervical spine	Usually Not Appropriate	⦿⦿⦿
CT cervical spine with IV contrast	Usually Not Appropriate	⦿⦿⦿
CT cervical spine without and with IV contrast	Usually Not Appropriate	⦿⦿⦿
CTA neck with IV contrast	Usually Not Appropriate	⦿⦿⦿
Discography cervical spine	Usually Not Appropriate	⦿⦿
Facet injection/medial branch block cervical spine	Usually Not Appropriate	⦿⦿
MRA neck with IV contrast	Usually Not Appropriate	○
MRA neck without IV contrast	Usually Not Appropriate	○
MRI cervical spine with IV contrast	Usually Not Appropriate	○
Bone scan whole body with SPECT or SPECT/CT neck	Usually Not Appropriate	⦿⦿⦿

## CERVICAL NECK PAIN OR CERVICAL RADICULOPATHY

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### Summary of Literature Review

#### **Introduction/Background**

The physical, psychological, and socioeconomic impact of cervical or neck pain is extensive. In 2010, 16.3 million health care visits to hospitals and physician offices were related primarily to neck pain [1]. The Global Burden of Disease 2010 Study identified neck pain as the fourth leading cause of years lost to disability [2], with most epidemiological studies reporting an annual prevalence ranging between 15% and 50% [3-8]. Although most episodes resolve, nearly 50% of individuals continue to experience ongoing or recurrent pain [9].

The differential diagnosis of cervical or neck pain includes consideration of acute versus chronic, neuropathic versus nonneuropathic [10], and musculoskeletal versus nonmusculoskeletal processes. It is important to acknowledge overlap of symptoms of cervical or neck pain, and cervical radiculopathy with additional conditions and symptoms beyond the scope of this document. Imaging in the setting of spine trauma should be guided by the ACR Appropriateness Criteria<sup>®</sup> topic on “[Suspected Spine Trauma](#)” [11]. The presence of a neck mass or lymphadenopathy should be guided by the ACR Appropriateness Criteria<sup>®</sup> topic on “[Neck Mass/Adenopathy](#)” [12]. Neuropathic symptoms should be clarified by examination to exclude myelopathy or plexopathy, guided by the ACR Appropriateness Criteria<sup>®</sup> topic on “[Myelopathy](#)” [13] and ACR Appropriateness Criteria<sup>®</sup> topic on “[Plexopathy](#)” [14], respectively. Evaluation of cervicogenic headache may overlap with symptoms addressed in the ACR Appropriateness Criteria<sup>®</sup> topic on “[Headache](#)” [15]. The presence of clinical signs or symptoms suggesting meningitis, neck soft-tissue infection, or upper respiratory infection should be managed on clinical guidelines separate from this review of cervical neck pain.

Mechanical pain associated with facet joints, intervertebral discs, muscles, or fascia represents the majority of nontraumatic cervical or neck pain, with the acknowledgement that these may result from or accelerate in the setting of prior traumatic injury. Cervical neuropathic pain most commonly includes radicular symptoms from a herniated disc or osteophyte. Additional etiologies include tumor, infection, inflammation, and vascular causes; therefore, consideration of the patient’s medical history is critical to accurately guide imaging.

In low back pain, a system of “red flags” was adopted to aid clinicians in triaging patients seeking nonemergent care (see the ACR Appropriateness Criteria<sup>®</sup> topic on “[Low Back Pain](#)” [16]). Although the diagnostic accuracy of red flag symptoms is not validated for the cervical spine, the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders [1] recommended the adoption of a similar system for cervical and neck pain, with red flags of that include trauma, malignancy, prior neck surgery, spinal cord injury, systemic diseases including ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, inflammatory arthritis, and/or suspected infection, history of intravenous drug use, intractable pain despite therapy, or tenderness to palpation over a

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vertebral body. Additional proposed red flags include congenital findings, concomitant vascular disease in patients >50 years of age, abnormal labs (erythrocyte sedimentation rate, C-reactive protein level, white blood cell), and neurological deficits [10].

### **Special Imaging Considerations**

CT myelography has supplanted fluoroscopic myelography in most circumstances; however, there may be times when fluoroscopic myelography is also performed prior to CT imaging. For this document, the procedure term “CT myelography” is used to guide referral to the radiologist. The ultimate judgment regarding the appropriateness of any specific procedure—lumbar versus cervical puncture route, amount of contrast, and the extent and modality of imaging coverage—must be made by the radiologist, with appropriate documentation and coding [17].

### **Discussion of Procedures by Variant**

#### **Variant 1: New or increasing nontraumatic cervical or neck pain. No “red flags.” Initial imaging.**

Similar to low back pain, many cases of acute (<6 weeks’ duration) cervical or neck pain resolve, although nearly 50% of patients may continue to have residual or recurrent episodes of pain up to 1 year after initial presentation [18,19]. Factors associated with poor prognosis include female gender, older age, coexisting psychosocial pathology, and radicular symptoms [1], although the causation versus association of these relationships is not defined.

In absence of red flag symptoms, imaging may not be required at the time of initial presentation [1] as spondylotic changes are commonly identified on radiographs and MRI in patients >30 years of age and correlate poorly with the presence of neck pain [20-23]. Although the diagnostic accuracy of red flag symptoms is not validated for the cervical spine, the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders [1] recommended the adoption of a similar system for cervical and neck pain, with red flags including trauma, malignancy, prior neck surgery, spinal cord injury, systemic diseases—including ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, inflammatory arthritis—suspected infection, history of intravenous drug use, intractable pain despite therapy, or tenderness to palpation over a vertebral body. Additional proposed red flags include congenital findings, concomitant vascular disease in patients >50 years of age, abnormal labs (erythrocyte sedimentation rate, C-reactive protein level, white blood cell), and neurological deficits [10].

#### **CT Cervical Spine**

CT offers superior depiction of cortical bone and is more sensitive than radiographs in assessing facet degenerative disease, osteophyte formation, vacuum phenomenon, and joint capsular calcification [24]. Ultra-low-dose techniques are proposed for CT in other regions of the body [25]; however, currently this has not been directly compared to radiographs for evaluation of the neck and cervical spine.

#### **CT Myelography Cervical Spine**

In the absence of radiographic abnormalities or neurological symptoms, myelography is not an appropriate first-line imaging test.

#### **CTA Neck**

The literature search did not identify any studies regarding the use of CT angiography (CTA) in the evaluation of this clinical presentation.

#### **Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

#### **MRA Neck**

The literature search did not identify any studies regarding the use of MR angiography (MRA) in the evaluation of this clinical presentation.

#### **MRI Cervical Spine**

MRI is the most sensitive test for detecting soft abnormalities associated with neck pain; however, this is characterized by a high rate of abnormalities in asymptomatic individuals [22,23]. As such, MRI is not considered a first-line imaging modality in the setting of acute or worsening uncomplicated neck pain.

### **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

There is no current role for nuclear medicine studies as the initial examination in this scenario. Tc-99m bone scan lacks both resolution and specificity in detecting pathology related to acute or worsening neck pain in the absence of red flag symptoms; most commonly, these will be associated with degenerative spondylosis. A recent retrospective study of patients with nonconclusive MRI or CT findings demonstrated that hybrid single-photon emission computed tomography (SPECT)/CT imaging identified potential pain generators in 92% of cervical spine scans [26]; however, this is not a first-line examination.

### **Radiography Cervical Spine**

Radiographs are widely accessible and useful to diagnose spondylosis, degenerative disc disease, malalignment, or spinal canal stenosis. Flexion/extension radiographs have limited value in degenerative disease [27]. In the absence of red flag symptoms, therapy is rarely altered by radiographic findings [27-29].

### **Myelography Cervical Spine**

In the absence of radiographic abnormalities or neurological symptoms, myelography is not an appropriate first-line imaging test.

### **Variant 2: New or increasing nontraumatic cervical radiculopathy. No “red flags.” Initial imaging.**

Cervical radiculopathy is defined as a syndrome of pain or sensorimotor deficits that are due to dysfunction of a cervical spinal nerve, the roots of the nerve, or both. The most common clinical presentation is of the combination of neck pain with pain in one arm accompanied by varying degrees of sensory or motor function loss in the affected nerve-root distribution [30]. Cervical radiculopathy is less prevalent than cervical or neck pain, with one population-based study showing an average annual age-adjusted incidence of 83.2 per 100,000 people [31]. Radiculopathies may result from compressive causes related to narrowing of the neural foramina, such as by facet or uncovertebral joint hypertrophy, or from associated disc bulging or herniation and degenerative spondylosis in the absence of a history of diabetes or red flag symptoms [31]. A recent meta-analysis assessing the positive predictive value of physical examination tests in the setting of a clinical history of cervical radiculopathy concluded there was limited evidence for a correlation between physical examination findings and MRI evidence of cervical nerve root compression [32]. This may be due to a high rate of both false-positive and false-negative findings on MRI in the setting of suspected cervical radiculopathy [33]. Most cases of acute cervical neck pain with radicular symptoms resolve spontaneously or with conservative treatment measures [31,34].

In absence of red flag symptoms, imaging may not be required at time of initial presentation [1] as spondylotic changes are commonly identified on radiographs and MRI in patients >30 years of age and correlate poorly with the presence of neck pain [20-23]. Although the diagnostic accuracy of red flag symptoms is not validated for the cervical spine, the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders [1] recommended the adoption of a similar system for cervical and neck pain, with red flags that include trauma, malignancy, prior neck surgery, spinal cord injury, systemic diseases—including ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, inflammatory arthritis, suspected infection—history of intravenous drug use, intractable pain despite therapy, or tenderness to palpation over a vertebral body. Additional proposed red flags include congenital findings, concomitant vascular disease in patients >50 years of age, abnormal labs (erythrocyte sedimentation rate, C-reactive protein level, white blood cell), and neurological deficits [10].

### **CT Cervical Spine**

CT provides good definition of bony elements and is helpful in the assessment of neuroforaminal stenosis secondary to uncovertebral or facet hypertrophy and is helpful when C6 and C7 are not clearly seen on traditional lateral radiographic views. However, CT is shown to be less sensitive than MRI for evaluation of nerve root compression [35,36].

### **CT Myelography Cervical Spine**

MRI has mostly supplanted CT myelography as a first-line imaging modality for complex cervical radiculopathy [37]. However, studies have shown that CT myelography may prove useful in diagnosing foraminal stenosis, bony lesions, and nerve root compression [38] and can be considered in patients with clinically apparent radiculopathy and contraindication to MRI, or in the setting of equivocal MRI findings.

### **CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

### **Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

### **MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

### **MRI Cervical Spine**

MRI has become the preferred method to evaluate the cervical spine in the setting of suspected nerve root impingement [39] because of its superior intrinsic soft-tissue contrast and good spatial resolution. Brown et al [35] in a blinded, retrospective review studied 34 patients with clinically diagnosed cervical radiculopathy who underwent MRI prior to surgery and reported that MRI correctly predicted 88% of the lesions as opposed to 81% for CT myelography, 57% for plain myelography, and 50% for CT. However, as noted previously, degenerative findings on MRI are commonly observed in asymptomatic patients [21,23,40,41]. A prospective study evaluating MRI cervical spine in recent onset cervical radiculopathy found a high rate of both false-positive and false-negative findings [33].

### **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

Tc-99m bone scan lacks both resolution and specificity to detect pathology related to suspected nerve root compression.

### **Radiography Cervical Spine**

Approximately 65% of asymptomatic patients 50 to 59 years of age will have radiographic evidence of significant cervical spine degeneration, regardless of radiculopathy symptoms [42].

### **Myelography Cervical Spine**

CT myelography has supplanted fluoroscopic myelography in most circumstances; however, there may be times when fluoroscopic myelography is also performed prior to CT imaging. The ultimate judgment regarding the appropriateness of any specific procedure, lumbar versus cervical puncture route, amount of contrast, and the extent and modality of imaging coverage must be made by the radiologist, with appropriate documentation and coding [17].

### **Variant 3: Prior cervical spine surgery. New or increasing nontraumatic cervical or neck pain or radiculopathy. Initial imaging.**

Anterior cervical discectomy and fusion (ACDF) is a common modality for the treatment of radiculopathy and myelopathy that is due to cervical disc disease [43,44]. Potential risks associated with ACDF include pseudoarthrosis [45], acceleration of adjacent segment degeneration [46,47], and complications related to the hardware itself, all of which may manifest as new or increasing nontraumatic neck pain. If infection is suspected, please see Variant 4. Imaging of patients with myelopathy should be guided by the separate ACR Appropriateness Criteria® topic on “[Myelopathy](#)” [13].

### **CT Cervical Spine**

Multidetector CT scanning with high-quality multiplanar reformatted images have enhanced the efficacy of CT assessment and imaging findings, particularly around hardware. CT is the most sensitive and specific modality to assess spinal fusion [48-50] and can aid in detecting adjacent segment degeneration [51]. A recent review of 690 patients who underwent ACDF concluded that CT altered the treatment plan in 39% of patients who had persistent symptoms and altered the treatment plan for 60% of patients with persistent symptoms and abnormal radiographs or MRI. Furthermore, recent advances in dual-energy CT has shown promise to reduce beam-hardening metal artifact, which may improve the evaluation of hardware complications and adjacent segment degeneration in postoperative patients with new or worsening neck pain [52]. Whether imaging is informative for changes to improve outcome remains to be established. In one study, half of the symptomatic cohort did not have postoperative CT, and the majority recovered with 2 years of conservative therapy [53].

### **CT Myelography Cervical Spine**

CT myelography is not the first-line test of choice for complex cervical radiculopathy [37]. However, it can be considered in patients with radiculopathy, particularly if MRI is nondiagnostic related to hardware artifact.

### **CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

### **Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

### **MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

### **MRI Cervical Spine**

Metal artifact may limit assessment of the cervical hardware and complications related to position or integrity. There continues to be emerging techniques for metal artifact reduction, which is beyond the scope of this document [54]. MRI is the most sensitive imaging test for detecting soft-tissue abnormalities associated with neck pain but is characterized by a high rate of abnormalities in asymptomatic individuals [22,23]. Most cervical discectomies are performed by an anterior approach without transgression of the epidural space; therefore, epidural scar or granulation tissue formation is minimal, and contrast-enhanced imaging is not routinely used after ACDF [55]. Gadolinium-enhanced MRI may have a role in the setting of neck pain and prior posterior-approach cervical fusion/decompressive procedures, although the majority of the literature to date evaluates the use of gadolinium-based contrast in the differentiation of recurrent disc herniations (a potentially actionable finding) from epidural scar in the setting of lumbar spine surgery [56,57].

### **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

There is no current role for nuclear medicine studies as the initial examination in this scenario. The role of Tc-99m bone scan in the setting of new or worsening neck pain in the postsurgical patient is limited, as radionuclide scans may remain positive for a year or more in the region of the operative bed [58]. SPECT/CT may offer diagnostic information in the setting of suspected pseudoarthrosis or equivocal CT or MRI findings [59].

### **Radiography Cervical Spine**

Initial radiographic evaluation, including anteroposterior and lateral views, is useful to assess hardware integrity and detect adjacent segment disease, which may contribute to symptoms [60,61]. The addition of flexion/extension radiographs may be considered to improve detection of vertebral body nonunion or pseudoarthrosis [62] and may supplement conventional views following ACDF [63], cervical disc implantation, or posterior cervical fixation [64-66].

### **Myelography Cervical Spine**

CT myelography has supplanted fluoroscopic myelography in most circumstances; however, there may be times when fluoroscopic myelography is also performed prior to CT imaging. The ultimate judgment regarding the appropriateness of any specific procedure, lumbar versus cervical puncture route, amount of contrast, and the extent and modality of imaging coverage must be made by the radiologist, with appropriate documentation and coding [17].

### **Variant 4: Suspicion for infection with new or increasing nontraumatic cervical or neck pain or radiculopathy. Initial imaging.**

The coexistence of fever, leukocytosis, elevated erythrocyte sedimentation rate, or C-reactive protein levels or history of immunosuppression, immunocompromised, diabetes, long-term steroid use, renal or liver failure, or drug use raise the concern for infection as a cause for neck pain [67]. The incidence of spinal infection is 0.2 to 2 cases per 100,000 per year [68,69], including involvement of the marrow, disc, paraspinal soft tissues, epidural space, meninges, spinal cord, or nerve roots. Potential infectious etiologies include hematogenous disease spread, extension from a contiguous infection of the prevertebral or paravertebral structures, or prior surgery or trauma. The presence of clinical signs or symptoms suggesting meningitis or anterior neck infection should be managed based on clinical guidelines separate from this review of neck pain. Imaging of patients with myelopathy related to suspected spinal infection should be guided by the separate ACR Appropriateness Criteria® topic on "[Myelopathy](#)" [13].

### **CT Cervical Spine**

CT with and without contrast is superior to radiography for the detection of erosive changes, loss of fat planes, and paraspinal edema and fluid collections [69]. CT scanning also offers potential advantages in identifying the presence of gas within an abscess, the lack of gas within the disc space, or a sequestrum within the spinal canal [70]. CT with contrast is complementary to MRI.

### **CT Myelography Cervical Spine**

The literature search did not identify any studies regarding the use of CT myelography in the evaluation of this clinical presentation.

### **CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

### **Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

### **FDG-PET/CT Skull Base to Mid-Thigh**

PET using the tracer fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)/CT is the scintigraphic procedure of choice for spinal osteomyelitis [71-73].

### **Gallium-67 Scan Whole Body**

Specificity may be increased by combining Tc-99m methylene diphosphonate (MDP) with gallium-67 citrate [74], and higher sensitivity and resolution can be further achieved with SPECT/CT [75].

### **Indium-111 WBC Scan Whole Body**

Indium-labeled leucocytes have a low sensitivity in spinal infections (osteomyelitis and discitis). In these clinical scenarios, leucocytes are generally not used because of a reported 40% false-negative rate, which is manifested as normal uptake or photopenia. In the past, the preferred radionuclide imaging for spinal osteomyelitis was a combination of bone and gallium scans.

### **MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

### **MRI Cervical Spine**

MRI with and without contrast is considered the best modality for demonstrating spinal infections, with a sensitivity of 96%, specificity of 92%, and accuracy of 94% [68,69,76]. While bone marrow edema can be detected on noncontrast examinations [68,77-79], the addition of contrast improves detection and characterization of leptomeningeal involvement or the development of an epidural or paraspinal abscess [79,80].

### **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

Three-phase Tc-99m MDP scintigraphy is sensitive (90%) but not specific (78%) [76] for the identification of suspect cervical spine osteomyelitis.

### **Radiography Cervical Spine**

Radiographs lack sensitivity and specificity in the setting of discitis or osteomyelitis, as 30% to 40% of the vertebral bone must be destroyed before lytic changes can be identified [81,82]. Because of the low sensitivity and specificity, particularly in early phases of spine infection, a negative cervical spine radiograph should not be considered comprehensive imaging in this scenario.

### **Myelography Cervical Spine**

CT myelography has supplanted fluoroscopic myelography in most circumstances; however, there may be times when fluoroscopic myelography is also performed prior to CT imaging. The ultimate judgment regarding the appropriateness of any specific procedure, lumbar versus cervical puncture route, amount of contrast, and the extent and modality of imaging coverage must be made by the radiologist, with appropriate documentation and coding [17].

**Variant 5: Known malignancy. New or increasing nontraumatic cervical or neck pain or radiculopathy. Initial imaging.**

Although primary tumors of the spine are uncommon [83], an estimated 10% of cancer patients develop symptomatic spinal metastases during the course of their disease [84], making the spine the most common site of osseous metastatic disease [85]. Suspected spinal metastases are typically diagnosed using cross-sectional imaging with the dual goal of identifying potential metastases and characterizing the extent of malignancy. As such, the choice of imaging modality is often based on both the type of malignancy and the presenting clinical features, especially if referable to pathological fracture, cord compression, or nerve root impingement.

**CT Cervical Spine**

Because of its high spatial resolution, CT is more sensitive than conventional radiography for the detection of bone metastases and has shown good correlation with nuclear bone scans, particularly if coupled with concurrent CT examinations of the thorax, abdomen, and/or pelvis [86]. CT can help characterize lesions as lytic or blastic and may successfully assess paravertebral or intraspinal extension if intravenous contrast is used [87]. CT is also useful to obtain better structural definition of abnormal findings identified on scintigraphy or MRI [88], such as in the setting of suspected pathologic fracture. However, given that CT is relatively insensitive for tumors restricted to the marrow space, the sensitivity of CT is relatively low in early malignant bone involvement [87,89], and as such, MRI is favored as an initial diagnostic modality.

**CT Myelography Cervical Spine**

The literature search did not identify any studies regarding the use of CT myelography in the evaluation of this clinical presentation.

**CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

**Fluoride PET/CT whole body**

F-18-sodium fluoride (NaF) PET/CT has become an important tool for detecting and evaluating metastatic bone cancer [90,91] and may be a preferable modality for detecting metastatic bone disease in morbidly obese patients; however, there is currently no evidence supporting the validity of F-18 NaF PET/CT as a first-line test evaluating acute neck pain or radicular symptoms in patients with malignancy.

**Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

**FDG-PET/CT Whole Body**

FDG-PET/CT is sensitive for detection of metastatic disease and has been compared to detection rates of bone scans [92,93]. However, resolution of PET scans is limited for assessment of involvement of the spinal cord/meninges and exiting nerve roots, and as such, there is currently no evidence supporting the validity of FDG-PET/CT as a first-line test evaluating acute neck pain or radicular symptoms in patients with malignancy.

**MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

**MRI Cervical Spine**

MRI has high sensitivity and specificity for the detection and discrimination of malignant bone lesions [88], with the addition of contrast to delineate the extent of marrow, leptomeningeal, epidural, neuroforaminal, and paraspinal involvement. Furthermore, local spread of bone metastases and extension into the spinal canal is better assessed on MRI, particularly in the setting of clinical suspicion for nerve root or cord compression [94].

**Bone Scan Whole Body with SPECT or SPECT/CT Neck**

Although Tc-99m bone scan is the most commonly used technique for detecting suspected osseous metastasis, it has a high false-positive rate secondary to benign processes with increased bone turnover, such as degenerative osteoarthritis [95]. The addition of SPECT to the acquisition protocol of bone scintigraphy improves image contrast resolution [96] and, thus, diagnostic accuracy. Furthermore, adding a CT acquisition can increase this diagnostic accuracy with anatomic localization to the SPECT images resulting in SPECT/CT [36].



## **Radiography Cervical Spine**

Conventional radiography still plays an important role in the diagnostic evaluation of bone metastases as pathological changes in cortical bone are detectable by plain radiograph even if they are only a few millimeters wide [97]. Radiographs can also reveal osteolytic lesions at risk for superimposed pathological fracture. However, given that these osteolytic changes may only be detectable after 50% of the bone substance has been destroyed [87], and lesions up to 1 cm may not be detectable, radiographs alone are not sufficient to exclude metastases in the setting of neck pain in a patient with known malignancy.

## **Myelography Cervical Spine**

CT myelography has supplanted fluoroscopic myelography in most circumstances; however, there may be times when fluoroscopic myelography is also performed prior to CT imaging. The ultimate judgment regarding the appropriateness of any specific procedure, lumbar versus cervical puncture route, amount of contrast, and the extent and modality of imaging coverage must be made by the radiologist, with appropriate documentation and coding [17].

### **Variant 6: Cervicogenic headache and new or increasing nontraumatic cervical or neck pain. No neurologic deficit. Initial imaging.**

Cervicogenic headache is attributed to disorders of the bone, disc, and/or soft-tissue elements of the cervical spine, usually accompanied by neck pain [98]. Potential pain generators include the atlanto-occipital and atlantoaxial joints, C2-3 facet joints, C2-3 intervertebral disc, cervical myofascial trigger points, and the cervical spinal nerves [99]. Suspected cervicogenic headache presents a true diagnostic dilemma secondary to the myriad of structures that may be the causative factor of headache in the setting of neck pain and the absence of definitive radiographic findings, leading to a diagnosis of cervicogenic headache [100]. It is important to remember the possibility of dissection as a source of acute ipsilateral headache and neck pain [101,102], which is addressed in the ACR Appropriateness Criteria® topic on “[Headache](#)” [15].

## **CT Cervical Spine**

There is no evidence that medical imaging is diagnostic for the etiologies of cervicogenic headache; however, imaging may lend support to its diagnosis [103]. For example, in a study of 22 symptomatic and 20 control patients, there was no difference in the number of patients with cervical disc bulges or in the distribution of degenerative disc disease within the cervical spine [104].

## **CT Myelography Cervical Spine**

In the absence of radiographic abnormalities or neurological symptoms, CT myelography is not an appropriate first-line imaging test.

## **CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

## **Percutaneous Interventions**

The International Classification of Headache Disorders include “headache is abolished following diagnostic blockade of a cervical structure or its nerve supply” as part of one of their four causation criteria for cervicogenic headache [98]. However, this is not a first-line diagnostic procedure to be performed without establishing the levels and extent of degenerative changes and is not necessary to make the diagnosis. Recent literature is limited to diagnostic efficacy rather than focusing on treatment outcomes.

## **MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

## **MRI Cervical Spine**

There is no evidence that medical imaging is diagnostic for the etiologies of cervicogenic headache; however, imaging may lend support to its diagnosis [103]. For example, in a study of 22 symptomatic and 20 control patients, there was no difference in the number of patients with cervical disc bulges or in the distribution of degenerative disc disease within the cervical spine [104].

### **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

The role of Tc-99m bone scan in the setting of chronic neck pain is limited. The addition of SPECT to the acquisition protocol of bone scintigraphy improves image contrast resolution [105], and thus diagnostic accuracy. Some authors have advocated the use of SPECT imaging in identifying the pain source (ie, facet disease) [106]. Furthermore, adding a CT acquisition can increase this diagnostic accuracy with anatomic localization to the SPECT images resulting in SPECT/CT [36].

### **Radiography Cervical Spine**

There is no evidence that medical imaging is diagnostic for the etiologies of cervicogenic headache; however, imaging may lend support to its diagnosis [103]. For example, in a study of 22 symptomatic and 20 control patients, there was no difference in the number of patients with cervical disc bulges or in the distribution of degenerative disc disease within the cervical spine [104].

### **Myelography Cervical Spine**

In the absence of radiographic abnormalities or neurological symptoms, myelography is not an appropriate first-line imaging test.

### **Variant 7: Chronic cervical or neck pain. Initial imaging.**

Up to 50% of patients will continue to have residual or recurrent episodes of neck pain up to 1 year after initial presentation [9]. For some patients, this may overlap with content in the ACR Appropriateness Criteria® topic on [“Suspected Spine Trauma”](#) [11] related to whiplash-associated disorders.

### **CT Cervical Spine**

CT is not currently recommended as a first-line examination for chronic neck pain in the absence of red flags or neurological symptoms.

### **CT Myelography Cervical Spine**

CT myelography is not an appropriate test for chronic neck pain in the absence of radicular or myelopathic symptoms.

### **CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

### **Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

### **MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

### **MRI Cervical Spine**

MRI is the most sensitive test for detecting soft abnormalities associated with neck pain; however, it is characterized by a high rate of abnormalities in asymptomatic individuals [22,23]. As such, MRI is not considered appropriate as a first-line imaging modality in the setting of chronic, uncomplicated neck pain.

### **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

The role of Tc-99m bone scan in the setting of chronic neck pain is limited, though SPECT likely offers benefit over conventional planar imaging. Some authors have advocated SPECT imaging in identifying the pain source (ie, facet disease) [106]; however, is not considered appropriate as a first imaging modality in the setting of chronic, uncomplicated neck pain.

### **Radiography Cervical Spine**

Radiographs may be helpful in clarifying the clinical diagnosis of cervical spondylosis from mechanical, inflammatory, or metabolic processes in patients who otherwise have no red flag symptoms [107]. Radiographically visible degenerative changes, such as disc space narrowing, osteophyte formation, facet, and uncovertebral hypertrophy, are common [108] and may not correlate with symptoms or impact treatment.

## **Myelography Cervical Spine**

Myelography is not an appropriate test for chronic neck pain in the absence of radicular or myelopathic symptoms.

### **Variant 8: Chronic cervical or neck pain. No neurologic findings. Radiographs show degenerative changes. Next imaging study.**

Degenerative changes are commonly identified on radiographs with aging, and patients may present to a new provider with previously performed radiographs. The presence of degenerative changes alone in the setting of chronic, unchanging cervical or neck pain does not require cross-sectional imaging. For some patients, this may overlap with content in the ACR Appropriateness Criteria® topic on “[Suspected Spine Trauma](#)” [11] related to whiplash-associated disorders.

## **CT Cervical Spine**

Multidetector CT scans with high-quality multiplanar reformatted images have enhanced the efficacy of CT, which offers superior depiction of cortical bone and is more sensitive than radiographs in the assessment of facet degenerative disease, osteophyte formation, vacuum phenomenon, and joint capsular calcification [24].

## **CT Myelography Cervical Spine**

CT myelography is not an appropriate test for chronic neck pain in the absence of radicular or myelopathic symptoms.

## **CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

## **Percutaneous Interventions**

The use of provocative injections in the cervical spine to identify a pain source is controversial. The Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders concluded there was no evidence to support using cervical provocative discography or anesthetic facet or nerve blocks [1]. The use of facet injection as a diagnostic maneuver is limited by frequent anesthetic leakage into adjacent spaces, resulting in false-positive results [109,110].

## **MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

## **MRI Cervical Spine**

In patients with neck pain without neurologic symptoms, the relevance of specific MRI findings in the cervical spine should be considered in light of expected changes associated with aging. MRI is more sensitive than CT in identifying degenerative cervical disorders [111,112]. However, the presence of degenerative changes should be interpreted with caution. In a small series, Fryer et al [113] found little correlation between the presence of facet arthropathy and the side or level of symptoms in patients with acute, unilateral neck pain. Spondylotic changes on radiographs and MRI are common in patients over 30 years of age and have been shown to correlate poorly with the presence of neck pain [20-23,114,115]. Okada et al [112], in a 10-year longitudinal MRI study, showed that cervical disc degeneration progressed in 85% of patients, though symptoms developed in only 34% of patients. Most significantly, patients developing symptoms showed more frequent progression of disc degeneration on MRI, including anterior compression of the dura and spinal cord, posterior disc protrusion, disc space narrowing, and foraminal stenosis.

## **Bone Scan Whole Body with SPECT or SPECT/CT Neck**

The role of Tc-99m bone scan in the setting of chronic neck pain is limited, though SPECT likely offers benefit over conventional planar imaging. Some authors have advocated the use of SPECT imaging in identifying the pain source (ie, facet disease) [106]. A recent retrospective study of 25 patients with chronic cervical spine pain demonstrated that hybrid SPECT/CT imaging identified potential pain generators in 92% of patients [26], and as such may have a role in secondary workup.

## **Myelography Cervical Spine**

Myelography is not an appropriate test for chronic neck pain in the absence of radicular or myelopathic symptoms. Similar to more recent literature on MRI, asymptomatic degenerative changes have been described on myelograms [116].

**Variant 9: Chronic cervical or neck pain without or with radiculopathy. Radiographs show ossification in the posterior longitudinal ligament (OPLL). Next imaging study.**

Heterotopic ossification in the posterior longitudinal ligament (OPLL) predisposes the patient to progressive narrowing of the spinal canal and/or abutment of the spinal cord. OPLL commonly presents in the fifth or sixth decade of life with a 2:1 male-to-female ratio. OPLL of the cervical spine is more common than thoracic OPLL, which was confirmed in a survey of 1,058 patients with OPLL, of whom 3.2% demonstrated involvement of the cervical spine and 0.8%, the thoracic spine [117]. Although original estimates of OPLL prevalence were based on lateral radiographs of the spine, more recently reported prevalence rates based on CT report prevalence rates of cervical OPLL between 1.7% in the white United States population and 4.6% in the Korean population [118,119].

**CT Cervical Spine**

Although radiographs are helpful in the diagnosis of OPLL, particularly in the cervical region, CT is more reliable both in the identification of OPLL and in the evaluation of sequelae related to its diagnosis [120]. CT evaluation can show OPLL type, thickness, length of involved segments, and associated systemic diseases, such as diffuse idiopathic skeletal hyperostosis. The superior spatial resolution of CT helps identify regions of neuroforaminal and spinal canal narrowing and should be considered in any patient presenting with new or worsening radiculopathy in the setting of suspected OPLL.

**CT Myelography Cervical Spine**

CT myelography performed in flexion and extension has been described to help identify regions of position-dependent cord compression related to cervical spinal stenosis from OPLL [121], although it is not routinely used in clinical practice.

**CTA Neck**

The literature search did not identify any studies regarding the use of CTA in the evaluation of this clinical presentation.

**Percutaneous Interventions**

The literature search did not identify any studies regarding the use of cervical facet joint, medial branch blocks, or discography as a first-line test in the evaluation of this clinical presentation.

**MRA Neck**

The literature search did not identify any studies regarding the use of MRA in the evaluation of this clinical presentation.

**MRI Cervical Spine**

Detection of OPLL on MRI is limited, with reported sensitivity of 32% to 44.3% [122]. Therefore, the primary utility of MRI in the setting of OPLL is in the assessment of cord abutment/signal changes secondary to spinal canal narrowing. MRI also affords the ability to evaluate the exiting nerve roots in the setting of radiculopathy.

**Bone Scan Whole Body with SPECT or SPECT/CT Neck**

The literature search did not identify any studies regarding the use of bone scan as a first-line test in the evaluation of this clinical presentation.

**Myelography Cervical Spine**

CT myelography has supplanted fluoroscopic myelography in most circumstances; however, there may be times when fluoroscopic myelography is also performed prior to CT imaging. The ultimate judgment regarding the appropriateness of any specific procedure, lumbar versus cervical puncture route, amount of contrast, and the extent and modality of imaging coverage must be made by the radiologist, with appropriate documentation and coding [17].

**Summary of Recommendations**

- **Variant 1:** Radiographs of the cervical spine are usually appropriate for the initial imaging of patients with new or increasing nontraumatic cervical or neck pain and no red flags. The panel did not agree on recommending MRI cervical spine without IV contrast for individuals in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. The use of MRI cervical spine without IV contrast in this patient population is controversial but may be appropriate.

- **Variant 2:** MRI cervical spine without IV contrast is usually appropriate for the initial imaging of patients with new or increasing nontraumatic cervical radiculopathy and no red flags. The panel did not agree on recommending radiographs of the cervical spine in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. The use of radiographs of the cervical spine in this patient population is controversial but may be appropriate.
- **Variant 3:** Radiographs of the cervical spine or CT cervical spine without IV contrast is usually appropriate for the initial imaging of patients with prior cervical spine surgery and with new or increasing nontraumatic cervical or neck pain or radiculopathy. These procedures are equivalent alternatives. The panel did not agree on recommending MRI cervical spine without IV contrast or MRI cervical spine without and with IV contrast in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. The use of MRI cervical spine without IV contrast or MRI cervical spine without and with IV contrast in this patient population is controversial but may be appropriate.
- **Variant 4:** MRI cervical spine without and with IV contrast is usually appropriate for the initial imaging of patients with suspicion for infection with new or increasing nontraumatic cervical or neck pain or radiculopathy. The panel did not agree on recommending CT cervical spine without IV contrast, or MRI cervical spine with IV contrast, or radiographs of the cervical spine in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. The use of CT cervical spine without IV contrast, or MRI cervical spine with IV contrast, or radiographs of the cervical spine in this patient population is controversial but may be appropriate.
- **Variant 5:** MRI cervical spine without and with IV contrast or MRI cervical spine without IV contrast are usually appropriate for the initial imaging of patients with known malignancy and new or increasing nontraumatic cervical, or neck pain, or radiculopathy. The addition of contrast is preferred for assessment of the leptomeningeals and soft-tissues; however, a noncontrast MRI also provides diagnostic detail. The panel did not agree on recommending CT cervical spine with IV contrast, CT cervical spine without IV contrast, or MRI cervical spine with IV contrast in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. The use of CT cervical spine with IV contrast, CT cervical spine without IV contrast, or MRI cervical spine with IV contrast in this patient population is controversial but may be appropriate.
- **Variant 6:** Radiographs of the cervical spine, or CT cervical spine without IV contrast, or facet injection/medial branch block cervical spine may be appropriate for the initial imaging of patients with cervicogenic headache and new or increasing nontraumatic cervical or neck pain and with no neurologic deficit. The panel did not agree on recommending MRI cervical spine without IV contrast in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. The use of MRI cervical spine without IV contrast in this patient population is controversial but may be appropriate.
- **Variant 7:** Radiographs of the cervical spine is usually appropriate for the initial imaging of patients with chronic cervical or neck pain. The panel did not agree on recommending MRI cervical spine without IV contrast in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from this procedure. The use of MRI cervical spine without IV contrast in this patient population is controversial but may be appropriate.
- **Variant 8:** MRI cervical spine without IV contrast is usually appropriate as the next imaging study for patients with chronic cervical or neck pain with no neurologic findings when radiographs show degenerative changes.
- **Variant 9:** CT cervical spine without IV contrast is usually appropriate as the next imaging study for patients with chronic neck pain without or with radiculopathy and OPLL diagnosed on radiographs. The panel did not agree on recommending CT myelography cervical spine or MRI cervical spine without IV contrast in this clinical setting. There is insufficient medical literature to conclude whether or not these patients would benefit from these procedures. The use of CT myelography cervical spine or MRI cervical spine without IV contrast in this patient population is controversial but may be appropriate.

## Supporting Documents

The evidence table, literature search, and appendix for this topic are available at <https://acsearch.acr.org/list>. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents go to [www.acr.org/ac](http://www.acr.org/ac).

## Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

## Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document [123].

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
○	0 mSv	0 mSv
⊗	<0.1 mSv	<0.03 mSv
⊗⊗	0.1-1 mSv	0.03-0.3 mSv
⊗⊗⊗	1-10 mSv	0.3-3 mSv
⊗⊗⊗⊗	10-30 mSv	3-10 mSv
⊗⊗⊗⊗⊗	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.		

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.