American College of Radiology
ACR Appropriateness Criteria®
Thoracic Back Pain

Variant: 1 Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography thoracic spine	Usually Not Appropriate	☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
MRI thoracic spine without and with IV contrast	Usually Not Appropriate	O
MRI thoracic spine without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
Bone scan with SPECT or SPECT/CT thoracic spine	Usually Not Appropriate	☢☢☢
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT thoracic spine without IV contrast	Usually Not Appropriate	☢☢☢
CT myelography thoracic spine	Usually Not Appropriate	☢☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 2 Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography thoracic spine	May Be Appropriate (Disagreement)	☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
MRI thoracic spine without and with IV contrast	Usually Not Appropriate	O
MRI thoracic spine without IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
Bone scan with SPECT or SPECT/CT thoracic spine	Usually Not Appropriate	☢☢☢
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT thoracic spine without IV contrast	Usually Not Appropriate	☢☢☢
CT myelography thoracic spine	Usually Not Appropriate	☢☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 3 Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI thoracic spine without IV contrast	Usually Appropriate	O
Radiography thoracic spine	May Be Appropriate	☢☢☢
MRI thoracic spine without and with IV contrast	May Be Appropriate (Disagreement)	O
CT thoracic spine without IV contrast	May Be Appropriate (Disagreement)	☢☢☢
CT myelography thoracic spine	May Be Appropriate	☢☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢

Bone scan with SPECT or SPECT/CT thoracic spine	Usually Not Appropriate	☢☢☢
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 4 **Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
Radiography thoracic spine	Usually Appropriate	☢☢☢
MRI thoracic spine without IV contrast	Usually Appropriate	O
CT thoracic spine without IV contrast	Usually Appropriate	☢☢☢
MRI thoracic spine without and with IV contrast	May Be Appropriate	O
Bone scan whole body	May Be Appropriate	☢☢☢
Bone scan with SPECT or SPECT/CT thoracic spine	May Be Appropriate	☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT myelography thoracic spine	Usually Not Appropriate	☢☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 5 **Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI thoracic spine without and with IV contrast	Usually Appropriate	O
MRI thoracic spine without IV contrast	Usually Appropriate	O
Radiography thoracic spine	May Be Appropriate	☢☢☢
CT thoracic spine without IV contrast	May Be Appropriate	☢☢☢
CT myelography thoracic spine	May Be Appropriate	☢☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
Bone scan with SPECT or SPECT/CT thoracic spine	Usually Not Appropriate	☢☢☢
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 6 **Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI thoracic spine without and with IV contrast	Usually Appropriate	O
MRI thoracic spine without IV contrast	Usually Appropriate	O
CT thoracic spine without IV contrast	Usually Appropriate	☢☢☢
CT myelography thoracic spine	May Be Appropriate	☢☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢

Bone scan with SPECT or SPECT/CT thoracic spine	Usually Not Appropriate	☢☢☢
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

Variant: 7 Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography thoracic spine	Usually Appropriate	☢☢☢
MRI thoracic spine without and with IV contrast	Usually Appropriate	O
MRI thoracic spine without IV contrast	Usually Appropriate	O
CT thoracic spine without IV contrast	Usually Appropriate	☢☢☢
CT myelography thoracic spine	May Be Appropriate	☢☢☢☢
MRI thoracic spine with IV contrast	Usually Not Appropriate	O
Bone scan whole body	Usually Not Appropriate	☢☢☢
Bone scan with SPECT or SPECT/CT thoracic spine	Usually Not Appropriate	☢☢☢
CT thoracic spine with IV contrast	Usually Not Appropriate	☢☢☢
CT thoracic spine without and with IV contrast	Usually Not Appropriate	☢☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Not Appropriate	☢☢☢☢

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Summary of Literature Review

Introduction/Background

In the United States, spinal pain is one of the leading causes of disability, health care costs, and emergency room visits [1,2]. The lumbar and cervical spine regions have been extensively studied and have well-established associations with pain and disability. Comparatively, thoracic back pain (TBP) has received less attention in terms of genetic and epidemiological research [3]. However, the thoracic spine is a common site for inflammatory, neoplastic, metabolic, infectious, and degenerative conditions [3]. Therefore, TBP may be equally disabling and associated with significant morbidity.

For the purposes of this document, TBP is defined as pain experienced in the region of the thoracic spine and emanating from pain generators in the thoracic spine (T1–T12) or thoracic paraspinous soft tissues. Although there is great variability in the definition of acute and subacute back pain, this document will use definitions of 0 to 4 weeks for acute TBP, 4 to 12 weeks for subacute TBP, and >12 weeks for chronic TBP [4].

Uncomplicated acute TBP and/or radiculopathy may be a benign, self-limited condition that does not warrant any imaging studies [5-8]. Imaging may be considered in those patients who have had up to 6 weeks of medical management and physical therapy that resulted in little or no improvement in their back pain. Imaging may also be considered for those patients presenting with red flags, raising suspicion for a serious underlying condition, such as symptomatic spinal canal stenosis, cord deformity or compression, malignancy, fracture, or infection [9,10].

For those patients with significant trauma, myelopathy, or prior thoracic spine fusion, early imaging may also be warranted [11-14]. Because the thoracic spine is a common site for osteoporotic compression fractures [15-17], early imaging should also be considered in patients with known osteoporosis or risk factors such as >65 years of age or chronic steroid use [18].

For those patients without neurologic compromise and who present with minor risk factors for cancer, inflammatory back disease (eg, ankylosing spondylitis), vertebral compression fracture, or symptomatic spinal stenosis, imaging may be considered after a trial of therapy.

Other nonspine causes of TBP can overlap in clinical presentation, including inflammatory arthritis and other systemic conditions, such as intrathoracic, renal, vascular, or gastrointestinal etiologies. If an inflammatory etiology is suspected as the cause of TBP, such as ankylosing spondylitis, psoriatic spondylitis, reactive arthritis, or inflammatory bowel disease–related spine disorders, see the ACR Appropriateness Criteria® topic on "Inflammatory Back Pain: Known or Suspected Axial Spondyloarthropathy" [19].

Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (i.e., only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (i.e., more than one procedure is ordered as a set or simultaneously wherein each procedure provides unique clinical information to effectively manage the patient's care).

Discussion of Procedures by Variant
Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.

There is a lack of evidence supporting or refuting imaging early or before conservative treatment for TBP [3,20]. However, extrapolating from the low back pain (LBP) evidence, imaging is typically

not warranted in this setting. Acute (<4 weeks duration), uncomplicated (no red flags) LBP with or without radiculopathy, is considered a self-limiting condition that is responsive to medical management and physical therapy in most patients [5-8]. Numerous studies have shown routine imaging provides no clinical benefit in this LBP group [6].

Thoracic disc disease is less common than in the cervical or lumbar spine [21]. This may be due to the fact that the thoracic spine is the only portion of the spine with additional structures (ie, ribs) to help in weight-bearing. There is also relatively limited mobility in the thoracic spine as the costovertebral joint limits flexion, the rib cage limits rotation and lateral bending, and the discs are relatively small in size compared to the cervical or lumbar spine. Symptomatic thoracic disc disease occurs most frequently below the level of T7. Thoracic disc abnormalities such as herniations, bulges, annular fissures, and cord contour deformity are common in asymptomatic patients [22]. Thoracic disc imaging abnormalities can therefore be seen in a substantial number of people without mid back pain.

With regards to thoracic facet joints, as in the lumbar spine, morphologic imaging changes of osteoarthritis do not correlate with pain [23].

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
A. Bone scan whole body

There is no relevant literature to support the use of bone scans whole body in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
B. Bone scan with SPECT or SPECT/CT thoracic spine

There is no relevant literature to support the use of bone scans with single-photon emission CT (SPECT) or SPECT/CT thoracic spine in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
C. CT myelography thoracic spine

There is no relevant literature to support the use of CT myelography thoracic spine in the initial evaluation of acute uncomplicated TBP. No radiologic distinction has been noted between asymptomatic and symptomatic discs on postmyelographic CT [24].

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with intravenous (IV) contrast in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red

flags. No prior management. Initial imaging.
E. CT thoracic spine without and with IV contrast

There is no relevant literature to support the use of CT thoracic spine without and with IV contrast in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
F. CT thoracic spine without IV contrast

There is no relevant literature to support the use of CT thoracic spine without IV contrast in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET/CT skull base to mid-thigh in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
H. MRI thoracic spine with IV contrast

There is no relevant literature to support the use of MRI thoracic spine with IV contrast in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
I. MRI thoracic spine without and with IV contrast

There is no relevant literature to support the use of MRI thoracic spine without and with IV contrast in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
J. MRI thoracic spine without IV contrast

There is no relevant literature to support the use of MRI thoracic spine without IV contrast in the initial evaluation of acute uncomplicated TBP.

Variant 1: Adult. Acute thoracic back pain without myelopathy or radiculopathy. No red flags. No prior management. Initial imaging.
K. Radiography thoracic spine

There is no relevant literature to support the use of radiography in the initial evaluation of acute uncomplicated TBP.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.

As with acute TBP, few studies support or refute imaging for patients with subacute or chronic midback pain without neurologic symptoms. However, as with LBP, imaging is typically not considered useful in this setting [6,7]. For patients with subacute (4-12 weeks duration) or chronic (>12 weeks duration) TBP without red flags or prior management, conservative therapy should still be considered first-line [25].

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
A. Bone scan whole body

There is no relevant literature to support the use of bone scans whole body in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
B. Bone scan with SPECT or SPECT/CT thoracic spine

There is no relevant literature to support the use of bone scans with SPECT or SPECT/CT thoracic spine in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
C. CT myelography thoracic spine

There is no relevant literature to support the use of CT myelography thoracic spine in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with IV contrast in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
E. CT thoracic spine without and with IV contrast

There is no relevant literature to support the use of CT thoracic spine without and with IV contrast in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
F. CT thoracic spine without IV contrast

There is no relevant literature to support the use of CT thoracic spine without IV contrast in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.

G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT skull base to mid-thigh in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
H. MRI thoracic spine with IV contrast

There is no relevant literature to support the use of MRI thoracic spine with IV contrast in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
I. MRI thoracic spine without and with IV contrast

There is no relevant literature to support the use of MRI thoracic spine without and with IV contrast in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
J. MRI thoracic spine without IV contrast

There is no relevant literature to support the use of MRI thoracic spine without IV contrast in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 2: Adult. Subacute or chronic thoracic back pain without myelopathy or radiculopathy. No red flags. Failed conservative management. Initial imaging.
K. Radiography thoracic spine

There is no relevant literature to support the use of radiography in the initial evaluation of subacute or chronic TBP without red flags or neurologic deficits.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.

The goal of imaging is to identify potential actionable pain generators that could be targeted for medical treatment, intervention, or surgery. MRI of the thoracic spine has become the initial imaging modality of choice in these patients [13,26,27].

Thoracic myelopathy is most commonly due to compressive etiologies, including structural causes resulting in spinal canal stenosis, cord compression/deformity, or other inflammatory, infectious, vascular, or neoplastic etiologies [28]. Spinal stenosis is a common cause of myelopathy, typically from disc herniations (including giant calcified disc herniations), usually below T7, facet arthropathy, or ligamentum flavum ossification [29].

Symptomatic thoracic disc herniations are more common in patients in their third to fifth decades of life and, in more than one-third of patients, are associated with a history of trauma. On imaging, these are often calcified (20%-65%) and sometimes intradural (5%-10%) [30]. Patients with

symptomatic thoracic disc herniations may have thoracic midback pain (76%), motor/sensory deficit (61%), spasticity/hyperreflexia (58%), positive Babinski sign (55%), or bladder dysfunction (24%). Symptomatic thoracic disc herniations requiring surgery are rare, accounting for 1% to 2% of all discectomies [31]. Indication for surgery is usually severe, intractable pain, or progressive/severe myelopathy.

Thoracic radiculopathy is most commonly due to mechanical nerve root compression from degenerative, metabolic, infectious, or neoplastic causes.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.
A. Bone scan whole body

There is no relevant literature to support the use of whole-body bone scans in the initial imaging of TBP and myelopathy or radiculopathy.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.
B. Bone scan with SPECT or SPECT/CT thoracic spine

There is no relevant literature to support the use of bone scan with SPECT or SPECT/CT in the initial imaging of TBP and myelopathy or radiculopathy.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.
C. CT myelography thoracic spine

CT myelography of the thoracic spine can be useful in assessing the patency of the spinal canal/thecal sac. CT myelography may also be complementary to MRI for identifying and differentiating between certain causes of myelopathy, such as ventral cord herniation versus dorsal thoracic arachnoid web or cyst, and also for presurgical or preradiation treatment planning due to its high detail and exquisite resolution of the contents of the spinal canal [32]. CT myelography has the disadvantage of requiring lumbar puncture for intrathecal injection of myelographic contrast.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.
D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with IV contrast in the initial imaging of TBP and myelopathy or radiculopathy.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.
E. CT thoracic spine without and with IV contrast

There is no relevant literature to support the use of CT thoracic spine without and with IV contrast in the initial imaging of TBP and myelopathy or radiculopathy.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging.
F. CT thoracic spine without IV contrast

There is no relevant literature to support the use of CT thoracic spine without IV contrast in the initial imaging of TBP and myelopathy or radiculopathy. However, CT thoracic spine without IV contrast may be useful for preoperative planning. CT delineates osseous structures and anatomy

with high resolution and can aid in trajectory planning for hardware fixation.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging. G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT skull base to mid-thigh in the initial imaging of TBP and myelopathy or radiculopathy.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging. H. MRI thoracic spine with IV contrast

MRI thoracic spine with IV contrast is not typically performed independently as an initial study, because its interpretation is most informative when correlated with standard noncontrast sequences included in MRI thoracic spine with and without IV contrast.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging. I. MRI thoracic spine without and with IV contrast

MRI thoracic spine without and with IV contrast may be the preferred initial study of choice in patients with TBP and myelopathy/radiculopathy when underlying malignancy, infection, or inflammation is clinically suspected.

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging. J. MRI thoracic spine without IV contrast

MRI thoracic spine without IV contrast may be useful as an initial study of choice in patients with TBP and myelopathy/radiculopathy when structural/mechanical causes of compressive myelopathy or radiculopathy are clinically suspected. MRI thoracic spine without IV contrast is most useful in evaluating compressive myelopathy or radiculopathy because of its ability to accurately depict soft tissue pathology, assess vertebral marrow, and assess the spinal canal patency [20]. Heavily T2-weighted sequences such as CISS/FIESTA may be helpful to assess for structural etiologies such as dorsal thoracic arachnoid webs or for reducing metallic artifacts in patients with thoracic spinal hardware [33].

Variant 3: Adult. Thoracic back pain with myelopathy or radiculopathy. Initial imaging. K. Radiography thoracic spine

There is no relevant literature to support the use of thoracic spine radiography in the initial evaluation of patients with TBP and myelopathy. Radiography alone is not usually sufficient for diagnosing the specific pain generator in these patients or for guiding surgical or interventional options without MRI and/or CT imaging. However, it can provide complementary information that can be helpful in treatment planning, including for presurgical planning and postoperative assessment [11].

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.

Elderly (>65 years of age) individuals, those with known osteoporosis, prior benign nontraumatic

compression fracture, or chronic steroid use are at risk for additional compression fractures even with minimal to no trauma [34,35].

Patients with low-velocity trauma, and without risk factors for osteoporosis, may not need dedicated thoracic spine imaging if asymptomatic.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
A. Bone scan whole body

Whole-body bone scans may be helpful in the setting of compression fracture(s) to help identify fracture acuity and to appropriately select patients for intervention [36], particularly if MRI cannot be safely/easily obtained.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
B. Bone scan with SPECT or SPECT/CT thoracic spine

Bone scan with SPECT or SPECT/CT may be helpful in the setting of compression fracture(s) to help identify fracture acuity and to appropriately select patients for intervention [36].

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
C. CT myelography thoracic spine

There is no relevant literature to support the use of CT myelography thoracic spine in the initial imaging assessment of this group.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with IV contrast in the initial imaging assessment of this group.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
E. CT thoracic spine without and with IV contrast

There is no relevant literature to support the use of CT thoracic spine without and with IV contrast in the initial imaging assessment of this group.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic

steroid use. Initial imaging.
F. CT thoracic spine without IV contrast

CT thoracic spine without IV contrast may be useful as an initial study in the emergency room setting or for presurgical planning, particularly if radiographs are negative [36].

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT skull base to mid-thigh in the initial imaging assessment of this group.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
H. MRI thoracic spine with IV contrast

MRI thoracic spine with IV contrast is not typically performed independently as an initial study, because its interpretation is most informative when correlated with standard noncontrast sequences included in MRI thoracic spine with and without IV contrast.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
I. MRI thoracic spine without and with IV contrast

MRI thoracic spine without and with IV contrast is not typically performed as an initial study in this group unless there is concern for underlying neoplasm, infection, or inflammation.

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
J. MRI thoracic spine without IV contrast

MRI thoracic spine without IV contrast may be useful as an initial study in this group due to its excellent soft tissue resolution, particularly if there is concern for soft tissue or neurologic compressive injury, to identify a compression fracture (even if radiographs are negative), or to plan intervention (identify marrow edema) [36].

Variant 4: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: low-velocity trauma, osteoporosis, elderly individual, or chronic steroid use. Initial imaging.
K. Radiography thoracic spine

Radiography may be useful as an initial screening study in TBP with risk factors for osteoporotic fractures in patients without neurologic deficits [35]. However, it should be noted that thoracic vertebral body fractures seen on radiographs may be difficult to estimate in terms of chronicity without priors to compare to. In those cases, MRI or bone scan may be needed to age the fracture

acuity.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging.

In patients with TBP and red flag symptoms or a known history of cancer, infection, or immunosuppression, imaging plays an important role in identifying actionable and treatable causes of the patient's symptoms. In particular, imaging is useful for diagnosing the absence or presence of infection or neoplasm and its associated complications such as osseous destruction, change in alignment, and spinal canal or paraspinal soft tissue abscesses. The presence or absence of canal stenosis and cord compression or cord signal abnormality can also be important to identify in these patients.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. A. Bone scan whole body

There is no relevant literature to support the use of whole-body bone scan in the initial imaging assessment of this group.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. B. Bone scan with SPECT or SPECT/CT thoracic spine

There is no relevant literature to support the use of bone scans with SPECT or SPECT/CT in the initial imaging assessment of this group.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. C. CT myelography thoracic spine

CT myelography of the thoracic spine may be helpful in patients or for treatment planning (surgery, radiation).

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with IV contrast in the initial imaging assessment of this group.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. E. CT thoracic spine without and with IV contrast

There is no relevant literature to support the use of CT thoracic spine without and with IV contrast in the initial imaging assessment of this group.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging.

F. CT thoracic spine without IV contrast

CT thoracic spine without IV contrast may be helpful for presurgical planning or to delineate the osseous anatomy, particularly if there is osseous destruction [37].

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT skull base to mid-thigh in the initial imaging assessment of this group.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. H. MRI thoracic spine with IV contrast

MRI thoracic spine with IV contrast is not typically performed independently as an initial study, because its interpretation is most informative when correlated with standard noncontrast sequences included in MRI thoracic spine with and without IV contrast.

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. I. MRI thoracic spine without and with IV contrast

MRI without and with IV contrast is the initial imaging modality of choice in patients with TBP and suspected neoplasm or infection [36,38-42].

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. J. MRI thoracic spine without IV contrast

MRI without IV contrast may be useful in this setting to identify marrow replacing lesions, osseous destruction, canal compromise, and cord signal abnormality. However, the addition of postcontrast sequences would be more sensitive in identifying thoracic spinal infection and its complications, assessing small marrow replacing lesions, and identifying intradural disease [39-44].

Variant 5: Adult. Thoracic back pain without or with myelopathy or radiculopathy. One or more of the following: suspicion of cancer, infection, or immunosuppression. Initial imaging. K. Radiography thoracic spine

Radiographs have low sensitivity but may be useful in the urgent/emergent setting to identify osseous destruction or change in alignment in patients with TBP and suspected infection or neoplasm [45].

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study.

In patients with TBP and osseous destruction or spinal deformity the role of imaging is to delineate osseous detail and anatomy and assess the integrity of the soft tissue and neural structures, particularly that of the spinal canal. Additionally, if spinal hardware is present, assessing hardware

integrity and position is also a common indication for imaging. More than one imaging modality may be indicated for diagnosis and treatment planning.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. A. Bone scan whole body

There is no relevant literature to support the use of whole body bone scans in the initial imaging assessment of this group.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. B. Bone scan with SPECT or SPECT/CT thoracic spine

There is no relevant literature to support the use of bone scan with SPECT or SPECT/CT in the initial imaging assessment of this group.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. C. CT myelography thoracic spine

CT myelography may be useful in this setting in patients with spinal hardware.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with IV contrast in the initial imaging assessment of this group.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. E. CT thoracic spine without and with IV contrast

CT thoracic spine without and with IV contrast may be useful in this clinical scenario.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. F. CT thoracic spine without IV contrast

In patients with TBP with or without myelopathy or radiculopathy when there is evidence of osseous destruction or spinal deformity on radiographs, both MRI and CT may be useful as an initial imaging modality [11,46]. CT can better depict the osseous detail, and MRI is more useful for assessing the integrity of the soft tissue and neural structures, particularly that of the spinal canal.

Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study. G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT skull base to mid-thigh in the

initial imaging assessment of this group.

**Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study.
H. MRI thoracic spine with IV contrast**

MRI thoracic spine with IV contrast is not typically performed independently as an initial study, because its interpretation is most informative when correlated with standard noncontrast sequences included in MRI thoracic spine with and without IV contrast.

**Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study.
I. MRI thoracic spine without and with IV contrast**

MRI thoracic spine without and with IV contrast may be useful as an imaging study in patients with TBP and evidence of spinal deformity or osseous destruction on radiography, particularly if there is concern for infection or neoplasm [44].

**Variant 6: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Radiograph shows bone destruction or fracture or spinal deformity. Next imaging study.
J. MRI thoracic spine without IV contrast**

MRI without IV contrast may be useful in this setting to identify marrow replacing lesions, osseous destruction, canal compromise, and cord signal abnormality [27]. However, the addition of postcontrast sequences would be more sensitive in identifying thoracic spinal infection and its complications, assessing small marrow replacing lesions, and identifying intradural disease.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.

In patients with TBP and a history of spinal fixation, imaging plays an important role in assessing hardware position and integrity, assessing spinal alignment, assessing fusion, identifying findings suspicious for infection, and assessing for postoperative complications, including, but not limited to, postoperative collections, scarring, adjacent segment degeneration, and spinal deformity [47].

Several imaging modalities may be useful and complementary in the initial assessment of patients with TBP and a history of instrumented spinal fixation [43,45,47].

**Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
A. Bone scan whole body**

There is no relevant literature to support the use of whole-body bone scans in the initial imaging assessment of this group.

**Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
B. Bone scan with SPECT or SPECT/CT thoracic spine**

There is limited literature to support the use of bone scan with SPECT or SPECT/CT thoracic spine in the initial imaging assessment of this group.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
C. CT myelography thoracic spine

CT myelography may also be helpful in patients in whom a compressive etiology of their symptoms is clinically suspected.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
D. CT thoracic spine with IV contrast

There is no relevant literature to support the use of CT thoracic spine with IV contrast in the initial imaging assessment of this group.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
E. CT thoracic spine without and with IV contrast

There is no relevant literature to support the use of CT thoracic spine without and with IV contrast in the initial imaging assessment of this group.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
F. CT thoracic spine without IV contrast

CT thoracic spine without IV contrast may be useful in assessing the integrity of fusion, identifying hardware position and integrity, and assessing alignment.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
G. FDG-PET/CT skull base to mid-thigh

There is no relevant literature to support the use of FDG-PET/CT skull base to mid-thigh in the initial imaging assessment of this group.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
H. MRI thoracic spine with IV contrast

MRI thoracic spine with IV contrast is not typically performed independently as an initial study, because its interpretation is most informative when correlated with standard noncontrast sequences included in MRI thoracic spine with and without IV contrast.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
I. MRI thoracic spine without and with IV contrast

MRI thoracic spine without and with IV contrast may be helpful in assessing for postoperative infection, hematoma, postoperative collections, or canal compromise. Many of these patients may benefit from scanning on mid field or 1.5T MRI scanners with metallic susceptibility artifact reduction protocols [46,47].

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
J. MRI thoracic spine without IV contrast
MRI thoracic spine without IV contrast may help assess for postoperative hematoma or other collections, neurologic injury, residual foramina or canal stenosis, or cord compression.

Variant 7: Adult. Thoracic back pain without or with myelopathy or radiculopathy. Post thoracic spine surgery. Follow-up imaging.
K. Radiography thoracic spine

Radiographs may be useful for assessing the integrity of fusion, confirming hardware position and integrity, identifying adjacent level degeneration, and assessing alignment.

Summary of Highlights

- **Variant 1**: In an adult with acute TBP without myelopathy, radiculopathy, or red flags, imaging is not typically indicated. There is a lack of evidence supporting or refuting imaging early or before conservative treatment for TBP. However, extrapolating from the LBP evidence, imaging is typically not warranted in this setting.
- **Variant 2**: In an adult with subacute or chronic TBP without myelopathy, radiculopathy, or red flags, imaging is not typically indicated. As with acute TBP, few studies support or refute imaging for patients with subacute or chronic mid back pain without neurologic symptoms. However, as with LBP, imaging is typically not considered useful in this setting, but radiography of the thoracic spine may be appropriate.
- **Variant 3**: In an adult with TBP with myelopathy or radiculopathy, an MRI of the thoracic spine without IV contrast is usually appropriate for initial imaging. This modality allows for evaluating potential compressive etiologies upon the spinal cord, leading to myelopathy, or upon the nerve roots, leading to radiculopathy. In some cases, thoracic spine radiography, MRI of the thoracic spine without and with IV contrast, CT of the thoracic spine without IV contrast, and CT myelography of the thoracic spine may be appropriate.
- **Variant 4**: In an adult with TBP with one or more of the following low-velocity trauma, osteoporosis, advanced age, or chronic steroid use, thoracic spine radiography or MRI or CT of the thoracic spine without IV contrast is usually appropriate. Elderly (>65 years of age) individuals, those with known osteoporosis, prior benign nontraumatic compression fracture, or chronic steroid use are at risk for additional compression fractures even with minimal to no trauma. In this scenario, an MRI of the thoracic spine without and with IV contrast, whole body bone scan, and bone scan with SPECT or SPECT/CT may be appropriate for initial imaging.
- **Variant 5**: In an adult with suspicion of cancer, infection, or immunosuppression who is experiencing TBP, either an MRI of the thoracic spine without and with IV contrast or an MRI of the thoracic spine without IV contrast is usually appropriate for initial imaging. These modalities are useful for diagnosing the absence or presence of infection or neoplasm and its

associated complications, such as osseous destruction, change in alignment, and spinal canal or paraspinal soft tissue abscesses. In some cases, thoracic spine radiography, CT of the thoracic spine without IV contrast, and CT myelography of the thoracic spine may be appropriate.

- **Variant 6**: In an adult whose radiograph shows bone destruction or fracture or spinal deformity, an MRI of the thoracic spine, either with and without IV contrast or without IV contrast, is usually appropriate as the next imaging study. In addition, a CT of the thoracic spine without IV contrast is usually appropriate for the next imaging study because more than one imaging modality may be indicated for diagnosis and treatment planning. In some cases, CT myelography of the thoracic spine may be appropriate in this scenario.
- **Variant 7**: In an adult with instrumented spinal fixation history, several imaging modalities may be useful and complementary in assessing patients with TBP. Imaging plays an important role in assessing hardware position and integrity, assessing spinal alignment, assessing fusion, identifying findings suspicious for infection, and assessing for postoperative complications. In this scenario, an MRI of the thoracic spine, either with and without IV contrast or without IV contrast, CT of the thoracic spine without IV contrast, or thoracic spine radiography is usually appropriate as the next imaging study. In some cases, CT myelography of the thoracic spine may be appropriate in this scenario.

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, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

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.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	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 (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies.”

References

1. Johnson SM, Shah LM. Imaging of Acute Low Back Pain. [Review]. Radiologic Clinics of North America. 57(2):397-413, 2019 Mar.
2. Murray CJ, Lopez AD. Measuring the global burden of disease. N Engl J Med. 2013;369(5):448-457.
3. Briggs AM, Smith AJ, Straker LM, Bragge P. Thoracic spine pain in the general population: prevalence, incidence and associated factors in children, adolescents and adults. A systematic review. [Review] [85 refs]. BMC Musculoskeletal Disorders. 10:77, 2009 Jun 29.
4. Institute for Clinical Systems Improvement. Adult Acute and Subacute Low Back Pain. Available at: https://www.icsi.org/wp-content/uploads/2021/11/March-2018-LBP-Interactive2.pdf.
5. Chou R, Qaseem A, Owens DK, Shekelle P. Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. Annals of Internal Medicine. 154(3):181-9, 2011 Feb 01.
6. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. JAMA. 313(11):1143-53, 2015 Mar 17.
7. Jarvik JG, Hollingworth W, Martin B, et al. Rapid magnetic resonance imaging vs radiographs for patients with low back pain: a randomized controlled trial. JAMA. 289(21):2810-8, 2003 Jun 04.
8. Modic MT, Obuchowski NA, Ross JS, et al. Acute low back pain and radiculopathy: MR imaging findings and their prognostic role and effect on outcome. Radiology. 237(2):597-604, 2005 Nov.
9. AHCPR Publication No. 95-0642. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services. December 1994. Available at: http://d4c2.com/d4c2-000038.htm.
10. Finucane LM, Downie A, Mercer C, et al. International Framework for Red Flags for Potential Serious Spinal Pathologies. J Orthop Sports Phys Ther. 50(7):350-372, 2020 07.
11. Epstein O, Ludwig S, Gelb D, Poelstra K, O'Brien J. Comparison of computed tomography and plain radiography in assessing traumatic spinal deformity. J Spinal Disord Tech. 22(3):197-201, 2009 May.
12. Khurana B, Sheehan SE, Sodickson A, Bono CM, Harris MB. Traumatic thoracolumbar spine injuries: what the spine surgeon wants to know. Radiographics. 33(7):2031-46, 2013 Nov-Dec.
13. Rajasekaran S, Vaccaro AR, Kanna RM, et al. The value of CT and MRI in the classification and surgical decision-making among spine surgeons in thoracolumbar spinal injuries.

European Spine Journal. 26(5):1463-1469, 2017 05.

14. Splendiani A, Bruno F, Patriarca L, et al. Thoracic spine trauma: advanced imaging modality. Radiologia Medica. 121(10):780-92, 2016 Oct.

15. Marinova M, Edon B, Wolter K, Katsimbari B, Schild HH, Strunk HM. Use of routine thoracic and abdominal computed tomography scans for assessing bone mineral density and detecting osteoporosis. Curr Med Res Opin. 31(10):1871-81, 2015.

16. Wang P, She W, Mao Z, et al. Use of routine computed tomography scans for detecting osteoporosis in thoracolumbar vertebral bodies. Skeletal Radiol. 50(2):371-379, 2021 Feb.

17. Zou D, Ye K, Tian Y, et al. Characteristics of vertebral CT Hounsfield units in elderly patients with acute vertebral fragility fractures. European Spine Journal. 29(5):1092-1097, 2020 05.Eur Spine J. 29(5):1092-1097, 2020 05.

18. Osteoporosis or low bone mass at the femur neck or lumbar spine in older adults, United States, 2005-2008. In: National Center for Health S, ed. U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2012. Available at: https://stacks.cdc.gov/view/cdc/12136.

19. Czuczman GJ, Mandell JC, Wessell DE, et al. ACR Appropriateness Criteria® Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis: 2021 Update. J Am Coll Radiol 2021;18:S340-S60.

20. Elliott JM, Flynn TW, Al-Najjar A, Press J, Nguyen B, Noteboom JT. The pearls and pitfalls of magnetic resonance imaging for the spine. [Review]. J Orthop Sports Phys Ther. 41(11):848-60, 2011 Nov.

21. McInerney J, Ball PA. The pathophysiology of thoracic disc disease. [Review] [20 refs]. Neurosurgical Focus. 9(4):e1, 2000 Oct 15.

22. Wood KB, Garvey TA, Gundry C, Heithoff KB. Magnetic resonance imaging of the thoracic spine. Evaluation of asymptomatic individuals. Journal of Bone & Joint Surgery - American Volume. 77(11):1631-8, 1995 Nov.

23. Verdoorn JT, Lehman VT, Diehn FE, Maus TP. Increased 99mTc MDP activity in the costovertebral and costotransverse joints on SPECT-CT: is it predictive of associated back pain or response to percutaneous treatment?. Diagnostic & Interventional Radiology. 21(4):342-7, 2015 Jul-Aug.

24. Awwad EE, Martin DS, Smith KR, Jr., Baker BK. Asymptomatic versus symptomatic herniated thoracic discs: their frequency and characteristics as detected by computed tomography after myelography. Neurosurgery 1991;28:180-6.

25. Last AR, Hulbert K. Chronic low back pain: evaluation and management. American Family Physician. 79(12):1067-74, 2009 Jun 15.

26. Winklhofer S, Thekkumthala-Sommer M, Schmidt D, et al. Magnetic resonance imaging frequently changes classification of acute traumatic thoracolumbar spine injuries. Skeletal Radiology. 42(6):779-86, 2013 Jun.

27. Hurley P, Azzopardi C, Botchu R, Grainger M, Gardner A. Can MRI be used as a safe and expedient option for calculating Spinal Instability Neoplastic Score for patients with metastatic spinal cord compression?. Bone Joint J. 103-B(5):971-975, 2021 May.

28. Laxpati N, Malcolm JG, Tsemo GB, et al. Spinal Arachnoid Webs: Presentation, Natural

History, and Outcomes in 38 Patients. Neurosurgery. 89(5):917-927, 2021 10 13.Neurosurgery. 89(5):917-927, 2021 10 13.

29. Chen ZQ, Sun CG, Spine Surgery Group of Chinese Orthopedic Association. Clinical Guideline for Treatment of Symptomatic Thoracic Spinal Stenosis. Orthop Surg. 7(3):208-12, 2015 Aug.

30. Stillerman CB, Chen TC, Couldwell WT, Zhang W, Weiss MH. Experience in the surgical management of 82 symptomatic herniated thoracic discs and review of the literature. [Review] [77 refs]. Journal of Neurosurgery. 88(4):623-33, 1998 Apr.

31. Brown CW, Deffer PA Jr, Akmakjian J, Donaldson DH, Brugman JL. The natural history of thoracic disc herniation. Spine. 17(6 Suppl):S97-102, 1992 Jun.

32. Schultz R, Jr., Steven A, Wessell A, et al. Differentiation of idiopathic spinal cord herniation from dorsal arachnoid webs on MRI and CT myelography. J Neurosurg Spine 2017;26:754-59.

33. Li Z, Chen YA, Chow D, Talbott J, Glastonbury C, Shah V. Practical applications of CISS MRI in spine imaging. Eur J Radiol Open 2019;6:231-42.

34. Yu JS, Krishna NG, Fox MG, et al. ACR Appropriateness Criteria® Osteoporosis and Bone Mineral Density: 2022 Update. J Am Coll Radiol 2022;19:S417-S32.

35. Khan MA, Jennings JW, Baker JC, et al. ACR Appropriateness Criteria® Management of Vertebral Compression Fractures: 2022 Update. J Am Coll Radiol 2023;20:S102-S24.

36. Ramachandran S, Clifton IJ, Collyns TA, Watson JP, Pearson SB. The treatment of spinal tuberculosis: a retrospective study. Int J Tuberc Lung Dis. 9(5):541-4, 2005 May.

37. Liu JB, Zuo R, Zheng WJ, Li CQ, Zhang C, Zhou Y. The accuracy and effectiveness of automatic pedicle screw trajectory planning based on computer tomography values: an in vitro osteoporosis model study. BMC Musculoskelet Disord. 23(1):165, 2022 Feb 21.

38. Algra PR, Bloem JL, Tissing H, Falke TH, Arndt JW, Verboom LJ. Detection of vertebral metastases: comparison between MR imaging and bone scintigraphy. Radiographics. 11(2):219-32, 1991 Mar.

39. Bredella MA, Essary B, Torriani M, Ouellette HA, Palmer WE. Use of FDG-PET in differentiating benign from malignant compression fractures. Skeletal Radiology. 37(5):405-13, 2008 May.

40. Hong SH, Choi JY, Lee JW, Kim NR, Choi JA, Kang HS. MR imaging assessment of the spine: infection or an imitation?. [Review] [42 refs]. Radiographics. 29(2):599-612, 2009 Mar-Apr.

41. Shah LM, Salzman KL. Imaging of spinal metastatic disease. International Journal of Surgical Oncology Print. 2011:769753, 2011.

42. Chantry A, Kazmi M, Barrington S, et al. Guidelines for the use of imaging in the management of patients with myeloma. Br J Haematol. 178(3):380-393, 2017 08.

43. Afolayan JO, Shafafy R, Maher M, Moon KH, Panchmatia JR. Assessment and management of adult spinal deformities. [Review]. Br J Hosp Med (Lond). 79(2):79-85, 2018 Feb 02.

44. Kim YH, Kim J, Chang SY, Kim H, Chang BS. Treatment Strategy for Impending Instability in Spinal Metastases. Clin. orthop. surg.. 12(3):337-342, 2020 Sep.

45. Greif DN, Ghasem A, Butler A, Rivera S, Al Maaieh M, Conway SA. Multidisciplinary

Management of Spinal Metastasis and Vertebral Instability: A Systematic Review. World Neurosurg. 128:e944-e955, 2019 Aug.

46. Zhu S, Wang Y, Yin P, Su Q. A systematic review of surgical procedures on thoracic myelopathy. Journal of Orthopaedic Surgery. 15(1):595, 2020 Dec 10.J. ORTHOP. SURG.. 15(1):595, 2020 Dec 10.

47. Kato S. Complications of thoracic spine surgery - Their avoidance and management. [Review]. J Clin Neurosci. 81:12-17, 2020 Nov.

48. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: https://edge.sitecorecloud.io/americancoldf5f-acrorgf92a-productioncb02-3650/media/ACR/Files/Clinical/Appropriateness-Criteria/ACR-Appropriateness-Criteria-Radiation-Dose-Assessment-Introduction.pdf.

Disclaimer

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