American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Low Back Pain**

Variant 1: **Uncomplicated acute low back pain and/or radiculopathy, nonsurgical presentation. No red flags (red flags defined in text).**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	2		O
X-ray lumbar spine	2		☢ ☢ ☢
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without plain-film myelography.	☢ ☢ ☢ ☢
X-ray myelography lumbar spine	2		☢ ☢ ☢
Tc-99m bone scan with SPECT spine	2		☢ ☢ ☢
CT lumbar spine without contrast	2		☢ ☢ ☢
CT lumbar spine with contrast	2		☢ ☢ ☢
MRI lumbar spine without and with contrast	2		O
CT lumbar spine without and with contrast	1		☢ ☢ ☢ ☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 2: **Patient with one or more of the following: low-velocity trauma, osteoporosis, focal and/or progressive deficit, prolonged symptom duration, age >70 years.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢ ☢ ☢
X-ray lumbar spine	6		☢ ☢ ☢
Tc-99m bone scan with SPECT spine	4	SPECT/CT may be useful for anatomic localization and problem solving.	☢ ☢ ☢
MRI lumbar spine without and with contrast	3		O
CT lumbar spine with contrast	3		☢ ☢ ☢
CT lumbar spine without and with contrast	1		☢ ☢ ☢ ☢
Myelography and postmyelography CT lumbar spine	1	In some cases postinjection CT imaging may be done without plain-film myelography.	☢ ☢ ☢ ☢
X-ray myelography lumbar spine	1		☢ ☢ ☢
X-ray discography lumbar spine	1		☢ ☢
X-ray discography and post-discography CT lumbar spine	1		☢ ☢ ☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Clinical Condition: **Low Back Pain**

Variant 3: **Patient with one or more of the following: suspicion of cancer, infection, and/or immunosuppression.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with contrast	8	Contrast useful for neoplasia subjects suspected of epidural or intraspinal disease. See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI lumbar spine without contrast	7	Noncontrast MRI may be sufficient if there is low risk of epidural and/or intraspinal disease.	O
CT lumbar spine with contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
CT lumbar spine without contrast	6	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
X-ray lumbar spine	5		☢☢☢
Tc-99m bone scan whole body with SPECT spine	5	SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
CT lumbar spine without and with contrast	3		☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Myelography and postmyelography CT lumbar spine	2	In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: **Low Back Pain**

Variant 4: **Low back pain and/or radiculopathy. Surgery or intervention candidate.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	8		O
CT lumbar spine with contrast	5	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
CT lumbar spine without contrast	5	MRI preferred. CT useful if MRI is contraindicated or unavailable, and/or for problem solving.	☢☢☢
MRI lumbar spine without and with contrast	5	Indicated if noncontrast MRI is nondiagnostic or indeterminate. See statement regarding contrast in text under "Anticipated Exceptions."	O
Myelography and postmyelography CT lumbar spine	5	MRI preferred. May be indicated if MRI is contraindicated or nondiagnostic. In some cases postinjection CT imaging may be done without plain-film myelography.	☢☢☢☢
X-ray discography and post-discography CT lumbar spine	5		☢☢☢
X-ray lumbar spine	4	Usually not sufficient for decision making without MR and/or CT imaging.	☢☢☢
Tc-99m bone scan with SPECT spine	4	May be particularly useful for facet arthropathy, stress fracture, and spondylolysis. SPECT/CT may be useful for anatomic localization and problem solving.	☢☢☢
X-ray discography lumbar spine	4		☢☢
CT lumbar spine without and with contrast	3		☢☢☢☢
X-ray myelography lumbar spine	2		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: **Low Back Pain**

Variant 5: **Prior lumbar surgery.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without and with contrast	8	Can differentiate disc from scar. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT lumbar spine with contrast	6	Most useful in postfusion patients or when MRI is contraindicated or indeterminate.	☢ ☢ ☢
CT lumbar spine without contrast	6	Most useful in postfusion patients or when MRI is contraindicated or indeterminate.	☢ ☢ ☢
MRI lumbar spine without contrast	6	Contrast often necessary.	O
Myelography and postmyelography CT lumbar spine	5	In some cases postinjection CT imaging may be done without plain-film myelography.	☢ ☢ ☢ ☢
X-ray lumbar spine	5	Flex/extension may be useful.	☢ ☢ ☢
Tc-99m bone scan with SPECT spine	5	Helps detect and localize painful pseudoarthrosis. SPECT/CT may be useful for anatomic localization and problem solving.	☢ ☢ ☢
X-ray discography and post-discography CT lumbar spine	5		☢ ☢ ☢
X-ray discography lumbar spine	4		☢ ☢
CT lumbar spine without and with contrast	3		☢ ☢ ☢ ☢
X-ray myelography lumbar spine	2		☢ ☢ ☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 6: **Cauda equina syndrome, multifocal deficits or progressive deficit.**

Radiologic Procedure	Rating	Comments	RRL*
MRI lumbar spine without contrast	9	Use of contrast depends on clinical circumstances.	O
MRI lumbar spine without and with contrast	8	Use of contrast depends on clinical circumstances. See statement regarding contrast in text under "Anticipated Exceptions."	O
Myelography and postmyelography CT lumbar spine	6	Useful if MRI is nondiagnostic or contraindicated. In some cases postinjection CT imaging may be done without plain-film myelography.	☢ ☢ ☢ ☢
CT lumbar spine with contrast	5		☢ ☢ ☢
CT lumbar spine without contrast	5		☢ ☢ ☢
X-ray lumbar spine	4		☢ ☢ ☢
CT lumbar spine without and with contrast	3		☢ ☢ ☢ ☢
Tc-99m bone scan with SPECT spine	2		☢ ☢ ☢
X-ray myelography lumbar spine	2		☢ ☢ ☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

LOW BACK PAIN

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Summary of Literature Review

Introduction

Acute low back pain (LBP) with or without radiculopathy is one of the most common health problems in the United States and is the leading cause of disability for persons younger than age 45. The cost of evaluating and treating acute LBP runs into billions of dollars annually, not including time lost from work [1-2].

Because of the high prevalence and high cost of dealing with this problem, government agencies and other groups have sponsored extensive studies that are now part of the growing body of literature on this subject. It is now clear that *uncomplicated* acute LBP and/or radiculopathy is a benign, self-limited condition that does not warrant any imaging studies [3-7]. Guidelines from the American College of Physicians and the American Pain Society [7-8] emphasize a focused history and physical examination, reassurance, initial pain management medications if necessary (acetaminophen or nonsteroidal anti-inflammatory drugs), and consideration of physical therapies without routine imaging in patients with nonspecific LBP. Imaging is considered for those without improvement after 6 weeks and for those with red flags as listed below, generally in categories of cauda equina syndrome, cancer, fracture, progressive or severe neurologic deficit(s), ankylosing spondylitis, symptomatic spinal stenosis, and/or infection [7-9]. Adding to this controversy is the fact that nonspecific lumbar disc abnormalities are common in asymptomatic patients and can be demonstrated readily on myelography, computed tomography (CT), and magnetic resonance imaging (MRI) [10-13].

The challenge for the clinician, therefore, is to distinguish the small segment within this large patient population that should be evaluated further because of suspicion of a more serious problem.

Indications of a more complicated status include back pain/radiculopathy in the following settings [14-15]:

1. Trauma, cumulative trauma.
2. Unexplained weight loss, insidious onset.
3. Age >50 years, especially women, and males with osteoporosis or compression fracture.
4. Unexplained fever, history of urinary or other infection.
5. Immunosuppression, diabetes mellitus.
6. History of cancer.
7. Intravenous drug use.
8. Prolonged use of corticosteroids, osteoporosis.
9. Age >70 years.
10. Focal neurologic deficit(s) with progressive or disabling symptoms, cauda equina syndrome.
11. Duration longer than 6 weeks.
12. Prior surgery.

Radiographs

Radiographs may be useful in any of the categories above. Lumbar radiographs may be sufficient for the initial evaluation of the following red flags [16-17], with further imaging indicated for treatment planning if findings are abnormal or inconclusive:

- Recent significant trauma (at any age).
- Osteoporosis.
- Age >70 years.

The initial evaluation of the LBP patient may also require further imaging if other red flags such as suspicion of cancer or infection are present [16-17]. Radiographs have a role in evaluation of alignment, instability, and scoliosis, and in postoperative evaluation of instrumentation and fusion.

Magnetic Resonance Imaging

LBP complicated by the red flags listed above may justify early use of CT or MRI even if radiographs are negative [16]. The most common indication for the use of these imaging procedures, however, is the clinical setting of LBP complicated by radiating pain (radiculopathy, sciatica), as well as in cauda equina syndrome (bilateral leg weakness, urinary retention, saddle anesthesia), neurogenic claudication, spinal stenosis, and/or risk factors as above. MRI of the lumbar spine has become the initial imaging modality of choice in complicated LBP, displacing myelography and CT in recent years.

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Multidisciplinary agreement on terminology facilitates reporting of MRI findings [18], although interrater reliability of reporting using lumbar disc terminology has achieved only modest agreement [19-21].

Although disc abnormalities are common on MRI in asymptomatic persons, acute back pain with radiculopathy suggests the presence of demonstrable nerve root compression on MRI [22]. MRI findings of Modic endplate change, especially type 1 [23], anterolisthesis, or disc extrusion are more strongly associated with LBP than findings of disc degeneration without endplate change [24-28]. MRI is efficacious for detecting red flag diagnoses, particularly using the short-tau inversion recovery (STIR) and fat-saturated T2 fast-spin-echo sequences as well as for evaluating facet arthropathy and edema [29]. MRI with contrast is useful for suspected infection and neoplasia. In postoperative patients, enhanced MRI allows distinction between disc and scar when tissue extends beyond the interspace.

Computed Tomography

CT scans provide superior bone detail but are not as useful in depicting extradural soft-tissue pathologies such as disc disease when compared with multiplanar MRI. Intradural and cord pathologies are poorly depicted on CT. CT with multiplanar reformatted sagittal and coronal planes is useful for depicting bone structural problems such as spondylolysis, pseudoarthrosis, fracture, scoliosis, and stenosis and for postsurgical evaluation of bone graft integrity, surgical fusion, and instrumentation [30].

Myelography, Myelography/CT

"Plain" myelography was the mainstay of lumbar herniated disc diagnosis for decades. It is now usually combined with postmyelography CT. The *combined* study is complementary to plain CT or MRI and occasionally more accurate in diagnosing disc herniation, but it suffers the disadvantage of requiring lumbar puncture and intrathecal contrast injection [31-34]. It may also be useful in surgical planning. Weight-bearing and flexion extension views are also possible on myelography.

Discography, CT Discography

Discography may have a role in localizing the source of back pain that is indeterminate with other less invasive studies as well as in patients with multifocal abnormalities on MRI [35]. Although radiographs, MRI, and postinjection CT images may depict nonspecific aging or degenerative changes, the injection itself may reproduce or provoke the patient's pain, which may have diagnostic value. Limitations include the necessity of disc space injections, variability of patient response, and limited specificity [36-38]. A recent correlative MRI and discography study found Type 1 Modic signal intensity changes on MRI to have a high positive predictive value in identification of a pain generator at discography [39], while other studies have found a less consistent role for MRI in prediction of discography findings.

Isotope Bone Scans

The role of the isotope bone scan in patients with acute LBP has changed in recent years with the wide availability of MRI and especially contrast-enhanced MRI. The bone scan is a moderately sensitive test for detecting the presence of tumor, infection, or occult fractures of the vertebrae but not for specifying the diagnosis [16-17]. For spondylolysis or stress fracture in athletes, bone scintigraphy with single photon emission computed tomography (SPECT), followed by limited CT if scintigraphy is positive, is more sensitive than MRI [40]. Bone scintigraphy with SPECT can be useful to identify symptomatic facet disease in patients treated with facet injection [41].

High-resolution isotope imaging, including SPECT, may localize the source of pain in patients with articular facet osteoarthritis prior to therapeutic facet injection [42]. Similar scans may be helpful in detecting and localizing the site of painful pseudoarthrosis following lumbar spinal fusion [43]. SPECT/CT offers matched anatomic localization for SPECT abnormalities [44]. Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG) positron emission tomography/computed tomography (PET/CT) may prove useful for detecting lesions that appear photopenic with SPECT [45].

Plain and contrast-enhanced MRI has the ability to demonstrate inflammatory, neoplastic, and most traumatic lesions as well as to show anatomic detail not available on isotope studies [46]. Gadolinium-enhanced MRI reliably shows the presence and extent of spinal infection and is useful in assessing therapy [47]. MRI has therefore taken over the role of the isotope scan in many cases where the location of the lesion is known. The isotope scan remains invaluable when a survey of the entire skeleton is indicated (eg, for metastatic disease).

Summary

- Acute uncomplicated LBP without red flags is a benign, self-limited condition that does not require imaging evaluation.
- MR has displaced CT and myelography as the initial imaging modality of choice in complicated LBP, with contrast useful for neoplasia, infection, and postoperative evaluation.
- CT is useful in patients with surgical fusion/instrumentation or bone structural abnormalities, and in patients with MRI contraindications.
- Myelography/CT, discography/CT, and radioisotope bone scans are useful in selected patients for problem solving.
- Advanced imaging techniques such as SPECT/CT and PET/CT have value in selected patients but are not considered routine clinical practice at this time.
- Also see the ACR Appropriateness Criteria® on "Myelopathy" and the ACR Appropriateness Criteria® on "Suspected Spine Trauma."

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the

administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [48].

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, both because of 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 to 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 (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Procedure Information
- Evidence Table

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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.

Appendix 1. Definitions

Acute low back pain	Lumbosacral pain of less than 6-weeks duration.
Radiculopathy	Dysfunction of a nerve root, usually caused by compression or irritation of the root.
Spinal stenosis	Narrow bony canal that may cause radiculopathy, or cauda equina syndrome.
Herniated disc	Herniation of the disc material beyond the confines of the interspace.
Sciatica	Pain radiating down the leg(s) below the knee along the distribution of the sciatic nerve, usually due to mechanical pressure and/or inflammation of lumbosacral nerve root(s).
Cauda equina syndrome	Compression of multiple nerve roots, often resulting in bilateral motor weakness (legs), urine retention, saddle anesthesia.