

The American College of Radiology, with more than 30,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

The American College of Radiology will periodically define new practice guidelines and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

2002 (Res. 29)
Amended 2006 (Res. 17, 35)
Revised 2007 (Res. 39)
Effective 10/01/07

ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF SPINE RADIOGRAPHY IN CHILDREN AND ADULTS

PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to

always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment.

Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

I. INTRODUCTION

Radiography of the spine is a proven and useful procedure for evaluating the vertebrae, disk spaces, neural foramina, and paravertebral soft tissues. This guideline outlines the principles for performing high-quality radiography of the cervical, thoracic, lumbosacral spine, and coccyx.

All radiographic examinations should be performed in accordance with the [ACR Practice Guideline for General Radiography](#).

II. GOAL

The goal of these radiographic examinations is to identify or exclude anatomic abnormalities or disease processes of the spine. The examinations should be performed with the minimum radiation necessary to produce a diagnostic study.

III. INDICATIONS

Indications are divided into two groups: general that apply to all anatomic regions, and specific, that apply to one or two regions.

A. General indications include, but are not limited to, the evaluation of:

1. Pain or limitation of motion.
2. Spinal trauma (symptomatic or at risk patients).
3. Surgical planning.
4. Previous surgery.
5. Suspected malignancy.
6. Congenital anomalies.
7. Previously detected spinal abnormality.
8. Alignment abnormalities, including scoliosis and kyphosis.

B. Specific indications include, but are not limited to, the evaluation of:

1. Shoulder or arm pain from suspected cervical radiculopathy.
2. Occipital headache.
3. Pain radiating around the chest wall.
4. Pain radiating into the buttock, hip, or groin.
5. Compression fractures.

All imaging facilities should have policies and procedures to reasonably attempt to identify pregnant patients prior to the performance of any examination involving ionizing radiation. If the patient is known to be pregnant, the potential radiation risks to the fetus and clinical benefits of the procedure should be considered before proceeding with the study. (1995, 2005 - ACR Resolution 1a)

IV. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the [ACR Practice Guideline for General Radiography](#).

V. SPECIFICATIONS OF EXAMINATION

The written or electronic request for spine radiography should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care

provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state scope of practice requirements. (2006 - ACR Resolution 35)

This section discusses radiographic evaluation of the spine. In all areas, further imaging examinations may be indicated based on the clinical assessment and/or evaluation of the radiographs.

A. Cervical Spine Examination in Adults

1. A complete examination should include the entire cervical spine from the craniocervical junction to the superior end plate of T1.
2. A standard examination includes anteroposterior (AP), lateral and open mouth views. A swimmer's lateral view should be performed if necessary to assess the lower cervical segments and C7-T1 alignment.
3. In cases in which there is a significant clinical suspicion of cervical spine injury (major trauma, abnormal neurological exam, intoxication, or unresponsiveness), cross-table lateral, AP, and open mouth odontoid (if patient is cooperative), or submental views may be obtained prior to moving the patient for further examination. In some institutions, computed tomography (CT) has replaced radiography in the initial assessment of patients at high risk for cervical spine injury.
4. Additional evaluation may be needed in some clinical circumstances and may include some or all of the following:
 - a. Bilateral oblique views: When assessment of the neural foramina is necessary, oblique views can be obtained.
 - b. Flexion-extension lateral views: When assessment of cervical instability is necessary, lateral views in flexion and extension can be obtained. If a cervical spine collar is present, it is the responsibility of the referring physician or referring physician's designees to remove the cervical spine collar and then replace the collar until the radiographs are interpreted by the radiologist. The patient should be solely responsible for head movement while these views are obtained. If the patient has limited cervical range of motion on physical examination, flexion and extension on the radiographs will be inadequate to exclude instability.

B. Cervical Spine Examination in Infants and Children

1. In the pediatric population, AP, odontoid, and lateral radiographs are sufficient for most clinical

indications. For infants and young children, AP and lateral radiographs without a specific odontoid projection may be adequate depending on the clinical indication for the examination.

2. Additional evaluation is less often necessary than in adults. In the event additional imaging is needed, CT or magnetic resonance imaging (MRI) should be obtained.

C. Examination of Pediatric Patients at High Risk for Cervical Spine Instability (e.g., Down Syndrome)

1. Lateral radiographs of the cervical spine centered at the craniocervical junction are taken in two positions: active flexion and active extension. No passive or forceful efforts at positioning should be attempted, although some immobilization of the uncooperative pediatric patient may be necessary.
2. MR imaging is preferred over CT scanning if additional evaluation is required, as in patients with positive radiographs or in whom surgery is being considered.

D. Thoracic Spine Examination

1. A standard examination includes AP and lateral views. Lower cervical or upper lumbar anatomy should be visualized to assure accurate numbering of thoracic levels.
2. Additional evaluation may be needed in some clinical circumstances and may include some or all of the following:
 - a. Swimmer's lateral view of the upper thoracic region.
 - b. Oblique views.
 - c. Thoracolumbar or other coned views.

E. Lumbosacral Spine Examination

1. A standard examination includes AP and lateral views. Some may choose a posterior/anterior (PA) view instead of an AP view to reduce radiation dosage.
2. In many adults and occasionally in older children, additional evaluation may be needed and may include some or all of the following:
 - a. Both oblique views.
 - b. Coned lateral view of L5-S1.
 - c. Angled AP view of L5-S1.
 - d. Flexion and extension lateral views.

F. Scoliosis Examination

For evaluation of scoliosis, erect PA (or AP) views of the entire thoracolumbar spine should be obtained. PA technique decreases dose to breast, gonads, and thyroid.

The erect view should include the iliac crests. A lateral view may be obtained. If the patient is not able to stand, then sitting films should be obtained. AP technique may be used for those unable to stand. Appropriate shielding should be applied when possible. (See the [ACR Practice Guideline for the Performance of Radiography of Scoliosis in Children](#)).

G. Sacrum and Coccyx Examination

The upper part of the sacrum is included in the standard lumbosacral examination. However, in some circumstances more complete evaluation of the sacrum and coccyx is needed, either alone or in conjunction with lumbar evaluation. A standard examination includes a cephalad-angled AP view of the sacrum and a lateral view of the sacrum and coccyx. If specific examination of the sacroiliac joints is needed, bilateral oblique views may be added.

H. Limited Examinations

For some clinical indications (e.g., intraoperative or post-surgical follow-up), a limited examination of the area of clinical concern will provide sufficient information, while limiting patient radiation exposure.

I. Radiographic Quality Control

1. Examinations of the spine should completely demonstrate the designated portion(s) of the spine or the levels of clinical interest in a limited examination.
2. Images not of diagnostic quality should be repeated as necessary.
3. Each image should be permanently labeled in accordance with the [ACR Practice Guideline for General Radiography](#).

J. Correlation

If prior spine studies are available, they should be compared. Correlation with CT, MRI, or nuclear medicine studies should also be performed when appropriate.

VI. DOCUMENTATION

Reporting should be in accordance with the [ACR Practice Guideline for Communication of Diagnostic Imaging Findings](#).

VII. EQUIPMENT SPECIFICATIONS

See the [ACR Practice Guideline for General Radiography](#).

VIII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, radiologic technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This is the concept “As Low As Reasonably Achievable (ALARA).”

Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active; or if not, manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Patient radiation doses should be periodically measured by a medical physicist in accordance with the appropriate ACR Technical Standard. (2006 - ACR Resolution 17)

IX. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiologic and Fluoroscopic Equipment](#).

ACKNOWLEDGEMENTS

This guideline was revised according to the process described in the ACR Practice Guidelines and Technical Standards book by the Committee on Musculoskeletal Imaging of the Commission on Body Imaging.

Principal Reviewers: Leanne L. Seeger, MD
 M. Ines Boechat, MD

Committee on Musculoskeletal Imaging

Mark J. Kransdorf, MD, Chair
Mark W. Anderson, MD
Murray K. Dalinka, MD
Arthur A. De Smet, MD
David G. Disler, MD
Jon A. Jacobson, MD
Jeremy J. Kaye, MD

Mark D. Murphey, MD
Leanne L. Seeger, MD
Lynne S. Steinbach, MD
N. Reed Dunnick, MD, Chair, Commission

Comments Reconciliation Committee

Harry C. Knipp, MD, Chair
Lori L. Barr, MD
M. Ines Boechat, MD
Murray K. Dalinka, MD
N. Reed Dunnick, MD
Kate A. Feinstein, MD
Mark J. Kransdorf, MD
Christine R. Kurland, MD
David C. Kushner, MD
Paul A. Larson, MD
Lawrence A. Liebscher, MD
Leanne L. Seeger, MD
Lynne S. Steinbach, MD
Richard A. Szucs, MD
Julie K. Timins, MD

REFERENCES

1. Almen AJ, Mattsson S. Dose distribution at radiographic examination of the spine in pediatric radiology. *Spine* 1996;21:750-756.
2. Berry GE, Adams S, Harris MB, et al. Are plain radiographs of the spine necessary during evaluation after blunt trauma? Accuracy of screening torso computed tomography in thoracic/lumbar spine fracture diagnosis. *J Trauma* 2005;59:1410-1413.
3. Brockmeyer D. Down syndrome and craniovertebral instability: Topic review and treatment recommendations. *Pediatr Neurosurg* 1999;31:71-77.
4. Freemyer B, Knopp R, Piche J, Wales L, Williams J. Comparison of five-view and three-view cervical spine series in the evaluation of patients with cervical trauma. *Ann Emerg Med* 1989;18:818-821.
5. Gale SC, Gracias VH, Reilly PM, Schwab CW. The inefficiency of plain radiography to evaluate the cervical spine after blunt trauma. *J Trauma* 2005;59:1121-1125.
6. Gialousis GI, Yakoumakis EN, Papadopoulou DI, et al. Differences in effective dose and energy imparted estimation from PA-AP, RLAT-LLAT projections in pediatric full spine X-ray examination using the Monte Carlo technique. *Phys Med Biol* 2006;51:287-297.
7. Griffen MM, Frykberg ER, Kerwin AJ, et al. Radiographic clearance of blunt cervical spine injury: plain radiograph or computed tomography scan? *J Trauma* 2003;55:222-226.
8. Holmes JF, Akkinpalli R. Computed tomography versus plain radiography to screen for cervical spine injury: a meta-analysis. *J Trauma* 2005;58:902-905.
9. Insko EK, Gracias VH, Gupta R, Goettler CE, Gaieski DF, Dalinka MK. Utility of flexion and

- extension radiographs of the cervical spine in the acute evaluation of blunt trauma. *J Trauma* 2002;53:426-429.
10. McCulloch PT, France J, Jones DL, et al. Helical computed tomography alone compared with plain radiographs with adjunct computed tomography to evaluate the cervical spine after high-energy trauma. *J Bone Joint Surg Am* 2005;87:2388-2394.
 11. McNamara RM, Heine E, Esposito B. Cervical spine injury and radiography in alert, high-risk patients. *J Emerg Med* 1990;8:177-182.
 12. Mirvis SE, Diaconis JN, Chirico PA, Reiner BI, Joslyn JN, Militello P. Protocol-driven radiologic evaluation of suspected cervical spine injury: efficacy study. *Radiology* 1989;170:831-834.
 13. Mower WR, Hoffman JR, Pollack CV Jr, et al. Use of plain radiography to screen for cervical spine injuries. *Ann Emerg Med* 2001;38:1-7.
 14. Offerman SR, Holmes JF, Katzberg RX, Richards JR. Utility of supine oblique radiographs in detecting cervical spine injury. *J Emerg Med* 2006;30:189-195.
 15. Pollack CV Jr, Hendey GW, Martin DR, Hoffman JR, Mower WR, NEXUS Group. Use of flexion-extension radiographs of the cervical spine in blunt trauma. *Ann Emerg Med* 2001;38:8-11.
 16. Radiographic assessment of the cervical spine in asymptomatic trauma patients. *Neurosurgery* 2002;50:S30-S35.
 17. Ralston ME, Ecklund K, Emans JB, Torrey SB, Bailey MC, Schutzman SA. Role of oblique radiographs in blunt pediatric cervical spine injury. *Pediatr Emerg Care* 2003;19:68-72.
 18. Ralston ME, Chung K, Barnes PD, Emans JB, Schutzman SA. Role of flexion-extension radiographs in blunt pediatric cervical spine injury. *Acad Emerg Med* 2001;8:237-245.
 19. Reinus WR, Strome G, Zwemer FL Jr. Use of lumbosacral spine radiographs in a level II emergency department. *AJR* 1998;170:443-447.
 20. Ross SE, O'Malley KF, DeLong WG, Born CT, Schwab CW. Clinical predictors of unstable cervical spinal injury in multiply injured patients. *Injury* 1992;23:317-319.
 21. Swischuk LE, John SD, Hendrick EP. Is the open-mouth odontoid view necessary in children under 5 years? *Pediatr Radiol* 2000;30:186-189.