ACR–ASSR–SPR–SSR PRACTICE PARAMETER FOR THE PERFORMANCE OF SPINE RADIOGRAPHY

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care[1]. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents 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 practitioner considering all the circumstances presented. Thus, an approach that differs from the guidance in this document, 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 this document when, in the reasonable judgment of the practitioner, such course of action is indicated by variables such as the condition of the patient, limitations of available resources, or advances in knowledge or technology after publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document may consider documenting in the patient record information sufficient to explain the approach taken.

The practice of medicine involves the science, and 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 the guidance in this document 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 purpose of this document is to assist practitioners in achieving this objective.

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[1] *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 831 N.W.2d 826 (Iowa 2013) Iowa Supreme Court refuses to find that the "ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures (Revised 2008)" sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, Stanley v. McCarver, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.*

I. INTRODUCTION

This practice parameter was revised collaboratively by the American College of Radiology (ACR), the American Society of Spine Radiology (ASSR), the Society for Pediatric Radiology (SPR), and the Society of Skeletal Radiology (SSR).

Radiography of the spine is a proven and useful procedure for evaluating the vertebrae, disk spaces, facet and uncovertebral joints, neural foramina, and paravertebral soft tissues. This practice parameter outlines the principles for performing high-quality radiography of the cervical, thoracic, lumbar, sacral, and coccygeal spine and related osseous and soft-tissue structures to the extent they are visualized with radiography.

In many circumstances, especially when there is significant risk for spine injury, computed tomography (CT) or magnetic resonance imaging (MRI) is the initial imaging modality [1].

In patients with a clinical suspicion for spinal cord injury or compromise as well as ligamentous injuries, particularly in the cervical spine, MRI is preferred over CT and radiography.

The goal of these radiographic examinations is to identify or exclude anatomic abnormalities or disease processes of the spine and related tissues. The examinations should be performed with the minimum radiation exposure [2,3] necessary to produce a diagnostic study.

All radiographic examinations should be performed in accordance with the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [4].

II. INDICATIONS

Indications include, but are not limited to, the evaluation of the spine for [5-26]:

1. Spinal Trauma and Fracture
    a. Pain
    b. Neurologic symptoms
    c. Instability
    d. Limitation of motion
    e. Nontraumatic (insufficiency and stress) fractures
    f. Pathologic fractures
2. Spinal arthropathy
    a. Degenerative arthropathy
    b. Inflammatory arthropathy
    c. Neuropathic arthropathy
    d. Crystal-induced arthropathy
3. Spinal infection
    a. Discitis
    b. Osteomyelitis
4. Spinal neoplasms and tumor-like conditions
    a. Primary bone and soft tissue tumors
    b. Metastatic disease
    c. Multiple myeloma
    d. Paget's disease
    e. Aneurysmal bone cysts
    f. Sarcoidosis, Langerhans cell histiocytosis, and other granulomatous conditions
5. Metabolic disorders
    a. Osteoporosis
    b. Renal osteodystrophy and complications related to dialysis
6. Congenital and acquired disorders
    a. Scoliosis, kyphosis, flatback, truncal imbalance
    b. Spondylolysis and spondylolisthesis
    c. Congenital anomalies
    d. Basilar invagination
7. Surgical and preprocedure planning, including intraoperative localizing images
8. Postoperative and postprocedural evaluation

For the pregnant or potentially pregnant patient, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [27].

III. QUALIFICATIONS AND RESPONSIBILITIES

See the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [4].

IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for a Spine Radiograph 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's scope of practice requirements. (ACR Resolution 35 adopted in 2006 – revised in 2016, Resolution 12-b)

This section discusses radiographic evaluation of the spine. Spinal radiography should be performed with appropriate collimation. Further imaging examinations may be indicated based on the clinical assessment and/or evaluation of the radiographs.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Cervical Spine Examination

1. Adults [22,23,26,28-31]
    a. Routine examination consists of anteroposterior (AP) and lateral views. More limited examinations may be performed for specific indications. A swimmer's lateral view should be performed if necessary to assess the lower cervical segments and cervicothoracic junction alignment.
    b. In patients who have had trauma, and for whom cervical spine CT is nondiagnostic or otherwise unavailable, the entire cervical spine from the craniocervical junction to at least the superior end plate of T1 should be performed to assess for multiple fractures or associated traumatic listhesis [31]. Upright views are preferred but may not be possible if the patient's condition does not permit.
    c. In some clinical circumstances, additional evaluation may include some or all of the following: open mouth view (for assessment of dens and atlantoaxial association), closed mouth odontoid AP view (Fuchs view), oblique views (for assessment of the neural foramina), pillar views (for assessment of the facets), and flexion and extension lateral views (for assessment of cervical instability).
    d. If the patient has limited cervical range of motion on physical examination, flexion and extension radiographs may be inadequate to exclude instability and MRI should be obtained.
    e. If a cervical spine collar is present, it is the responsibility of the referring physician or referring physician's designee to remove the cervical spine collar and replace as appropriate.
2. Children [1,8,19,20,23-25,32-39]
    a. Routine examination includes AP and lateral views. Lateral radiographs should be obtained in true lateral position with the neck in extension if possible, and preferably during inspiration. Some pediatric centers omit the frontal view.
    b. Oblique views are not recommended due to the added radiation and low diagnostic yield.
    c. Flexion and extension lateral views are often not possible in younger children but may be useful to assess for ligament laxity in older children [40].
    d. Odontoid views are difficult to acquire in children younger than 5 years because of their short necks and imposition of the mandible on the spine and are not recommended [23].
    e. Cervical spine injury in young children (younger than 9 years old) [41] most commonly occurs from the occiput through C3 and has a propensity for ligamentous or cartilaginous rather than osseous injury. Therefore, normal cervical spine radiographs do not exclude ligamentous or spinal cord injury [24,25].
    f. In older children with chronic cervical instability (especially those with Down syndrome), lateral radiographs of the cervical spine centered at the craniocervical junction are taken in 3 positions: active flexion, active extension, and the standard neutral view [8,33-36].
    g. In the event additional imaging is needed, MRI, or occasionally CT, may be considered [12,29,42].

Radiation dose, magnetic safety, and potential sedation needs should be considered if these alternate imaging modalities are used.

IV. SPECIFICATIONS OF THE EXAMINATION

B. Thoracic Spine Examination

1. Adults
    a. A standard routine examination includes AP and lateral views. Lower cervical or upper lumbar anatomy should be visualized to assure accurate numbering of thoracic levels.
    b. Additional evaluation may be needed in some clinical circumstances and may include some or all of the following: swimmer's lateral view of the upper thoracic region, oblique views, flexion-extension lateral views, lateral bending views, and coned view of the thoracolumbar junction.
2. Children
    a. Routine examination includes AP and lateral views.
    b. Additional views may be obtained for specific clinical indications [16].

IV. SPECIFICATIONS OF THE EXAMINATION

C. Lumbosacral Spine Examination in Adults and Children

1. Adults
    a. 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.
    b. In many adults and occasionally in older children, additional evaluation may be needed and may include some or all of the following: Both oblique views, coned lateral view of the lumbosacral junction, angled AP view of the lumbosacral junction, and upright flexion and extension lateral views may be particularly helpful to assess for abnormal motion.
    c. he upper part of the sacrum is included in the standard lumbosacral examination. When a more complete evaluation of the sacrum, coccyx, or sacroiliac joints is needed, a cephalad-angled AP (Ferguson) view of the sacrum and bilateral oblique/sacroiliac views may be obtained [21,43]. In select patients, dynamic coccygeal views or lateral seated position radiographs may demonstrate hypermobility or ligament laxity [44].
2. Children
    a. Standard examination includes AP and lateral views. A PA view may be used to reduce radiation dose.
    b. Oblique views are not recommended because of the added radiation and low diagnostic yield.
    c. Additional evaluation may be obtained for specific clinical indications.

IV. SPECIFICATIONS OF THE EXAMINATION

D. Scoliosis/Spine Deformity Examination in Adults and Children

1. Adults
    a. Erect PA (or AP) views of the entire thoracolumbar spine should be obtained, either with a single long computed radiography (CR) or screen-film cassette or with separate computed radiography, digital radiography, or screen-film captures physically or electronically stitched together. Some centers may use biplanar low-dose radiography to avoid stitching error and reduce whole body dose [45,46], which is becoming standard of care.
    b. Additional evaluation may be obtained for operative planning or post-operative evaluation.
2. Children
    a. See the ACR–SPR–SSR Practice Parameter for the Performance of Radiography for Scoliosis in Children [47].

IV. SPECIFICATIONS OF THE EXAMINATION

E. Examination of Infants

1. Neonates and infants are usually evaluated with ultrasound [48,49] (see the ACR–AIUM–SPR–SRU Practice Parameter for the Performance of an Ultrasound Examination of the Neonatal and Infant Spine) [50] or MRI if congenital abnormality or trauma is highly suspected clinically or based on other imaging [51].
2. Interpretation of cervical spine radiography is difficult in infants because of epiphyseal variants, incomplete ossification of synchondroses including the apex of the odontoid, normal ligamentous laxity resulting in pseudosubluxation of C2 on C3, and the propensity of ligamentous rather than osseous injury. Normal lack of ossification of the anterior arch of C1 precludes radiographic evaluation of the atlantodental interval. MRI should be considered if there is concern for cervical spine injury.
3. Frontal and lateral views of the cervical spine, and combined frontal and lateral views of the thoracic and lumbar spine may be performed. These views are most frequently used in the setting of a skeletal survey for nonaccidental trauma or in the evaluation of skeletal dysplasia or congenital vertebral anomalies.

IV. SPECIFICATIONS OF THE EXAMINATION

F. Limited Examinations

1. For some clinical indications (eg, intraoperative or postsurgical follow-up), a limited examination of the area of clinical concern may provide sufficient information.
2. The goal is to limit patient radiation exposure.

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [52].

VI. EQUIPMENT SPECIFICATIONS

See the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [4].

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiographic Equipment [40].
Radiographic Quality Control in Adults and Children

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.
3. Each image should be permanently labeled in accordance with the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [4].

VII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, non-physician radiology providers**,** radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel who work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients (justification, optimization including the use of dose reference levels). https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unnecessary radiation exposure.
Facilities should have and adhere to policies and procedures that require ionizing radiation examination protocols (radiography, fluoroscopy, interventional radiology, CT) to vary according to diagnostic requirements and patient body habitus to optimize the relationship between appropriate radiation dose and adequate image quality. Automated dose reduction technologies

available on imaging equipment should be used, except when inappropriate for a specific exam. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org). These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

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 appearing under the heading *Position Statement on Quality Control & Improvement, Safety, Infection Control*, *and Patient Education* on the ACR website (https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement).

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