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 parameters 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 parameters and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice parameter 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 and approval. The practice parameters 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 parameter and technical standard by those entities not providing these services is not authorized.

Amended 2014 (Resolution 39)*

ACR–AIUM–SPR–SRU PRACTICE PARAMETER FOR THE PERFORMANCE OF AN ULTRASOUND EXAMINATION OF THE NEONATAL SPINE

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. 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 physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the practice parameters, 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 practice parameters when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the practice parameters. However, a practitioner who employs an approach substantially different from these practice parameters 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 practice parameters 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 practice parameters is to assist practitioners in achieving this objective.

1 Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, ___ N.W.2d ___ (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

The clinical aspects contained in specific sections of this practice parameter (Introduction, Indications, Specifications of the Examination, and Equipment Specifications) were developed collaboratively by the American College of Radiology (ACR) the American Institute of Ultrasound in Medicine (AIUM), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU). Recommendations for physician requirements, written request for examination, procedure documentation, and quality control vary between the four organizations and are addressed by each separately.

This practice parameter has been developed to assist practitioners performing a sonographic examination of the neonatal and infant spine. In some cases, an additional or specialized examination may be necessary. While it is not possible to detect every abnormality, following this practice parameter will maximize the detection of abnormalities of the infant spine. Sonographic examination of the pediatric spinal canal is accomplished by scanning through the normally incompletely ossified posterior elements. Therefore, it is most successful in the newborn period and in early infancy. In infants above 6 months of age, the examination can be very limited, although the level of termination of the cord may be identified.

In experienced hands, ultrasound of the infant spine has been demonstrated to be an accurate and cost-effective examination that is comparable to MRI for evaluating congenital or acquired abnormalities in the neonate and young infant.

II. INDICATIONS/CONTRAINDICATIONS

A. Indications

The indications for ultrasonography of the neonatal spinal canal and its contents include, but are not limited to [1-8]:

1. Lumbosacral stigmata known to be associated with spinal dysraphism, including but not limited to:
   a. Midline or paramedian masses.
   b. Skin discolorations.
   c. Skin tags.
   d. Hair tufts.
   e. Hemangiomas.
   f. Pinpoint midline dimples.
   g. Paramedian deep dimples.

2. The spectrum of caudal regression syndrome, including patients with sacral agenesis and patients with anal atresia or stenosis.

3. Evaluation of suspected defects such as cord tethering, diastematomyelia, hydromyelia, syringomyelia.

4. Detection of sequelae of injury, such as:
   a. Hematoma following spinal tap or birth injury.
   b. Sequelae of prior instrumentation, infection or hemorrhage.
   c. Post-traumatic leakage of cerebrospinal fluid (CSF).

5. Visualization of fluid with characteristics of blood products within the spinal canal in patients with intracranial hemorrhage.


7. Postoperative assessment for cord retethering [10].
Infants with simple, low-lying sacrococcygeal dimples typically have normal spinal contents, for them the examination has a low diagnostic yield [3,7]. On the other hand, atypical dimples, such as those larger than 5 mm, located greater than 2.5 cm above the anus, or seen in combination with other lesions, are at higher risk of occult spinal dysraphism [3]. A sacral dimple or congenital sinus that is leaking CSF will need further assessment with MRI, and sonography is therefore not a mandatory first examination in this circumstance.

B. Contraindications

1. Preoperative examination in patients with open spinal dysraphism.
2. Examination of the contents of a closed neural tube defect if the skin overlying the defect is thin or no longer intact.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

Each organization will address this section in its document. ACR language is as follows:

See the ACR–SPR–SRU Practice Parameter for Performing and Interpreting Diagnostic Ultrasound Examinations.

IV. WRITTEN REQUEST FOR THE EXAMINATION

Each organization will address this section in its document. ACR language is as follows:

The written or electronic request for a neonatal and infant spine ultrasound examination 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. (ACR Resolution 35, adopted in 2006)

V. SPECIFICATIONS OF THE EXAMINATION

The examination should be performed with the infant lying in the prone position, although the study can also be done with the patient lying on his or her side when necessary. A small bolster, such as a rolled blanket, may be placed under the lower abdomen/pelvis to help position the patient. The knees may be flexed to the abdomen to allow adequate spacing of the spinous processes and visualization of the spinal canal contents. An infant who has recently been fed will generally lie quietly during the examination. If feeding is not possible, a pacifier dipped in glucose solution will often be helpful in keeping an infant still for an optimal examination. It is important to note that infants, particularly if not full term, have difficulty maintaining normal body temperature. Therefore, the examination should be performed in a warm room, and the coupling agent should be warmed.

The cord should be assessed in the longitudinal and transverse planes, with right and left labeled on transverse images. The examination may be limited to the lumbosacral region in specific cases, such as in patients being evaluated for a sacrococcygeal dimple, or in those patients being scanned to look for the presence of hematoma after an unsuccessful or traumatic spinal tap. The entire spinal canal, from the craniocephal junction to the coccyx, may be included in appropriately selected cases.
The normal cord morphology and the level of termination of the conus should be assessed and documented. In order to do this, the vertebral body levels need to be accurately identified and numbered. Once the vertebral bodies are clearly numbered, the level of termination of the conus can be determined. In normal patients, the conus should lie at or above the L2 to L3 disc space [8,11-14]. In fetuses and extremely preterm infants the normal conus medullaris may be caudal to the superior endplate of L3 [14]. In a preterm infant with a conus that terminates at the L3 midvertebral body, a follow up sonogram after age correction of 40 weeks gestation but before age correction of 6 months is warranted [8]. The level of termination of the conus and its configuration should be documented, as well as any deviations from normal.

The vertebral level can be determined in a number of ways [15-16]. These include:

- After assessment of the normal lumbosacral curvature to locate the last lumbar vertebra or L5, the vertebral level of the conus is determined by counting the cephalad. This method tends to be more reproducible than the other methods described below, which rely on counting the number of rib-bearing vertebrae or the number of ossified sacral and coccygeal segments and can lead to less reliable results.
- The first coccygeal segment has variable ossification at birth but, if ossified, can be distinguished by its more rounded shape compared with the square or rectangular shape of the sacral bodies. Counting cephalad from S1 again can help determine the vertebral level of the conus.
- The last rib-bearing vertebra can be presumed to be T12 and the sequential lumbar level can be thus determined.
- When the level of the conus cannot be definitively assessed as normal or abnormal, correlation with previous plain films, if available, is helpful. A radiopaque marker can be placed on the skin at the level of the conus under sonographic guidance, followed by and correlated with a spine radiograph.

The level of termination of the cord is important in assessment of tethering. Cord position within the spinal canal and motion of cord and nerve roots are also helpful parameters in assessment for cord tethering. The normal position of the cord within the spinal canal, and deviation from normal, such as apposition to the dorsal aspect of the spinal canal as seen in tethering, should be documented. Cine evaluation can be helpful both in demonstrating anatomy and in showing movement of the distal cord and nerve roots in conjunction with cardiac-related pulsations of the spinal CSF. M-mode can also be very helpful in documenting motion of the cord and nerve roots. The normal nerve roots pulsate freely with cardiac and respiratory motion, layer dependently with variable patient positioning, and are not adherent to each other. Cine can also document changes that occur with head flexion and extension. A stand-off pad or a thick layer of coupling gel may be used, if needed, to follow a tract from the skin surface.

The integrity of the cord should be documented. Areas of abnormal fluid accumulation, such as hydromyelia or syringomyelia, anterior, lateral or posterior meningoceles or pseudomeningoceles, or arachnoid cysts, should be documented and their level identified. Transverse images are essential to identify and document diastematomyelia, with off-center scanning to avoid the potential pitfall of a reverberation artifact creating a lateral duplication, or ghost image [17-18].

The subarachnoid space should be evaluated for a normal anechoic appearance, interrupted by normal hyperechoic linear nerve roots and dentate ligaments. The subarachnoid space, dura, and epidural space should be evaluated, and abnormalities such as hematoma, lipoma, or other masses should be documented.

In addition to the termination of the conus, the termination of the thecal sac, typically located at S2, should be documented. The normal filum measures less than 2 mm in thickness. If the filum is abnormally hyperechoic or appears thickened, it should be measured and documented. The nerve roots of the cauda equina should be delineated within the thecal sac. In cases of failed lumbar puncture, additional imaging with the child supported in a seated position, bending forward, may be useful to allow gravity to distend the lower thecal sac with CSF.

Upright positioning can be used for image guidance of lumbar puncture or to demonstrate meningoceles or pseudomeningoceles in some patients. Anterior meningoceles or presacral masses should also be scanned from an anterior position.
The vertebral bodies and posterior elements should be evaluated for deformities. Dysraphic defects with open posterior elements should be documented on transverse views.

VI. DOCUMENTATION

Each organization will address this section in its document. ACR language is as follows:

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Comparison with prior relevant imaging studies may prove helpful. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by size measurements and/or vertebral level when applicable. The initials of the operator should be accessible on the images or electronically on PACS. Images should be labeled with the patient identification, facility identification, examination date, and image orientation. An official interpretation (final report) of the ultrasound examination should be included in the patient’s medical record. Retention of the ultrasound examination images should be based on clinical need and the relevant legal and local health care facility requirements.

Reporting and communication efforts should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings.

VII. EQUIPMENT SPECIFICATIONS

Ultrasound of the infant spine should be performed with real-time scanners using high-frequency linear array transducers, typically 7 MHz to 10 MHz or higher in neonates [19]. When possible, panoramic views of the entire spinal canal are very helpful in providing an overview of the anatomy and termination of the cord and thecal sac. Images of the craniocervical junction may need to be performed with a small vector or tightly curved array transducer.

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

Each organization will address this section in its document. ACR language is as follows:

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 QC & Improvement, Safety, Infection Control, and Patient Education on the ACR website (http://www.acr.org/guidelines).

Equipment performance monitoring should be in accordance with the ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Real Time Ultrasound Equipment.

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This practice parameter was revised according to the process described under the heading The Process for Developing ACR Practice Parameters and Technical Standards on the ACR website (http://www.acr.org/guidelines) by the Committees on Practice Parameters of the ACR Commissions on Pediatric Radiology and Ultrasound in collaboration with the AIUM, the SPR, and the SRU.

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REFERENCES


*Practice parameters and technical standards are published annually with an effective date of October 1 in the year in which amended, revised or approved by the ACR Council. For practice parameters and technical standards published before 1999, the effective date was January 1 following the year in which the practice parameter or technical standard was amended, revised, or approved by the ACR Council.*

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