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.

Revised 2020 (Resolution 32)*

ACR–SPR–SSR PRACTICE PARAMETER FOR THE PERFORMANCE AND INTERPRETATION OF MAGNETIC RESONANCE IMAGING (MRI) OF THE SHOULDERTOPIC

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 practitioner in light of 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 the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document 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 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 sole purpose of this document is to assist practitioners in achieving this objective.

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 developed and written collaboratively by the American College of Radiology (ACR), the Society of Pediatric Radiology (SPR), and the Society of Skeletal Radiology (SSR).

Magnetic resonance imaging (MRI) is an established and proven imaging modality for the detection, evaluation, assessment, staging, and follow-up of disorders of the shoulder. Properly performed and interpreted, MRI contributes not only to diagnosis but also to treatment planning and prognostication. However, it should be performed only for a valid medical reason and after careful consideration of alternative diagnostic modalities. MRI of the shoulder may be performed without contrast, following intra-articular contrast injection (“direct” MR arthrography) to increase conspicuity of intra-articular abnormalities, or with intravenous (IV) contrast to identify hyperemic lesions or to create “indirect” arthographic images by enhancing synovial-lined structures and their contents.

An analysis of the strengths and potential risks of MRI and other diagnostic modalities should be weighed against their suitability for specific patients and particular clinical conditions. Computed tomography (CT) is used to evaluate the bone integrity of the glenoid fossa and humerus and the alignment and congruence of the glenohumeral joint [1]. When combined with arthrography, CT can also be used for evaluating the labrum, articular cartilage, and loose bodies [2]. Sonography can be used to evaluate the rotator cuff and biceps tendon and has the advantage of imaging during physiologic motion [3-7]. Radiographs are usually the first imaging test performed for most suspected abnormalities in the shoulder and will often suffice to diagnose or exclude an abnormality or to direct further imaging evaluation. Radionuclide bone scanning can screen the entire skeleton in addition to the shoulder for radiographically occult bone disease, such as metastases. Other nuclear medicine examinations have a role for specific clinical scenarios (eg, a labeled white blood cell study for suspected osteomyelitis). Conventional single-contrast or double-contrast arthrography can accurately depict most articular-surface and full-thickness tears of the rotator cuff [8,9]. Ultrasound and fluoroscopy can be used to guide arthrographic injection [10,11].

Although MRI is one of the most sensitive diagnostic tests for detecting anatomic abnormalities of the extremities, findings may be misleading if not closely correlated with other imaging studies, clinical history, clinical examination, and physiologic tests. Adherence to the following practice parameter will enhance the probability of accurately diagnosing such abnormalities.

II. INDICATIONS

A. Primary indications for MRI of the shoulder include, but are not limited to, diagnosis, exclusion, and grading of suspected:

1. Rotator cuff tendon abnormalities: massive, full-thickness, partial-thickness, and recurrent (postoperative) tears, tendinopathy, calcific tendinitis, and cuff tear arthropathy [12-22]
2. Disorders of the long head of the biceps brachii: full-thickness, partial-thickness, and recurrent (postoperative) tears, tendinopathy, calcific tendinitis, subluxation, and dislocation [10,11,20,23-25]
3. Conditions affecting the supraspinatus outlet: acromial shape, os acromiale, subacromial spurs, acromioclavicular joint disorders, coracoacromial ligament integrity, subacromial bursitis [15,26-29]
4. Labral abnormalities: tears, cysts, and degeneration, including superior labrum anterior posterior (SLAP) lesions, Bankart lesions and variants, and recurrent (postoperative) labral tears [2,20,30-44] Abnormalities of the rotator interval and biceps pulley [23,45,46]
5. Muscle disorders affecting the shoulder girdle: atrophy, hypertrophy, denervation, masses, and injuries [18,22,47-53]
6. Glenohumeral chondral and osteochondral abnormalities: osteochondral fractures and osteochondritis dissecans, articular cartilage degeneration, fissures, fractures, flaps, and separations\(^3\) [54-56] Intra-articular bodies\(^3\)

7. Synovial-based disorders: synovitis, bursitis, metaplasia, and neoplasia\(^2,3\) [57,58]

8. Marrow abnormalities: osteonecrosis, marrow replacement and edema syndromes, and osseous contusion and stress fractures\(^2\) [59]

9. Neoplasms, masses, and cysts of bone, joint, or soft tissue\(^2\) [29,39,60]

10. Infections of bone, joint, or soft tissue\(^2\) [61-63]

11. Congenital and developmental conditions, including dysplasia and normal variants\(^2\) [64-67]

12. Vascular conditions: entrapment, aneurysm, stenosis, and occlusion\(^2\) [68]

13. Neurologic conditions: entrapment, compression, masses, and peripheral neuritis\(^2\) [37,42,69]

14. Pathology in the shoulder following arthroplasty [70]

B. MRI of the shoulder may be indicated to further clarify and stage conditions diagnosed clinically and/or suggested by other imaging modalities including, but not limited to, the following:

1. Arthritides: inflammatory, infectious, neuropathic, degenerative, crystal-induced, posttraumatic\(^2\) [29,71,72]
2. Frozen shoulder (adhesive capsulitis)\(^3\) [45]
3. Primary and secondary bone and soft-tissue tumors\(^2\) [60]
4. Fractures and dislocations [26,73,74]

C. MRI of the shoulder may be useful to evaluate specific clinical scenarios including, but not limited to, the following:

1. Prolonged, refractory, or unexplained shoulder pain\(^2,3\)
2. Acute shoulder trauma [26,74]
3. Impingement syndromes: subacromial, subcoracoid, internal\(^3\) [15,27,28,75-78]
4. Glenohumeral instability [43,64,74,79-81]
5. Shoulder symptoms in the overhead motion athlete\(^3\) [82-84]
6. Mechanical shoulder symptoms: catching, locking, snapping, crepitus\(^3\)
7. Limited or painful range of motion
8. Swelling, enlargement, mass, or atrophy\(^2\) [39]
9. Patients for whom diagnostic or therapeutic arthroscopy is planned\(^3\)
10. Patients with recurrent, residual, or new symptoms following shoulder surgery\(^3\) [14,18,20,22,51,85,86]

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the ACR Practice Parameter for Performing and Interpreting Magnetic Resonance Imaging (MRI) [87].

The interpreting physician needs a thorough knowledge and understanding of the anatomy of the shoulder, including the numerous normal variations in the glenohumeral capsular and labral configurations and their corresponding MRI appearances.

IV. SPECIFICATIONS OF THE EXAMINATION

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

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). The provision of 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 – revised in 2016, Resolution 12-b)

The supervising physician must have adequate understanding of the indications, risks, and benefits of the examination as well as alternative imaging procedures. The physician must be familiar with the potential hazards associated with MRI, including potential adverse reactions to contrast media. The physician should be familiar with relevant prior ancillary studies. The physician performing MRI interpretation must have a clear understanding and knowledge of the relevant anatomy and pathophysiology.

The supervising physician must also understand the pulse sequences to be used and their effect on the appearance of the images, including the potential generation of image artifacts. Standard imaging protocols may be established and varied on a case-by-case basis when necessary. These protocols should be reviewed and updated periodically.

A. Patient Selection

The physician responsible for the examination should supervise patient selection and preparation and be available for consultation by direct communication. Patients must be screened and interviewed prior to the examination to exclude individuals who may have contraindications to MRI, in which the risks may outweigh the benefits.

Certain indications require administration of IV contrast media. IV contrast enhancement should be performed using appropriate injection protocols and in accordance with the institution’s policy on IV contrast utilization. (See the ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media [88].)

Patients suffering from anxiety or claustrophobia may require sedation or additional assistance. Administration of moderate sedation may be needed to achieve a successful examination. If moderate sedation is necessary, refer to the ACR–SIR Practice Parameter for Sedation/Analgesia [89].

B. Facility Requirements

Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications. The equipment and medications should be monitored for inventory and drug expiration dates on a regular basis. The equipment, medications, and other emergency support must also be appropriate for the range of ages and sizes in the patient population.

C. Examination Technique

Shoulder MRI can be performed using a variety of magnet designs (closed or open) and field strengths (low, medium, or high) [16,38,90-94]. Because the inherent signal-to-noise ratio (SNR) is reduced with lower field strength MR systems, imaging practice parameters may require modifications. With lower field strength systems, for example, the number of acquisitions can be increased at the expense of longer imaging times and increased risk of involuntary patient motion [90,92,95,96]. Alternatively, the voxel size can be increased (by a combination of larger field of view (FOV), thicker slices, and/or decreased matrix) at the expense of spatial resolution [92,93,96,97]. Fat-suppression techniques that rely on the difference between fat and water frequencies (chemical shifts) are unreliable at low field strength, and substituting short tau inversion recovery (STIR) images may be necessary [90,93]. Even when the imaging protocol is optimized for shoulder imaging on a low-field open system, subjective image quality will likely be inferior to that obtained with a high-field system [93,96]. Various investigators using different equipment and scanning protocols have reached contradictory conclusions regarding the diagnostic performance of low field strength MR scanners for shoulder disorders. Some studies have found that the accuracy for complete and partial rotator cuff tears and for labral abnormalities is not significantly different for open, low-field and closed, high-field systems, with careful attention to technique [91,93,94,98]. MR arthrography can further enhance the diagnostic yield for shoulder MRI performed on low field strength systems [90,96]. Other investigators
have found lower accuracy for evaluating disorders like SLAP tears, capsular abnormalities, and small rotator cuff tears with specific low-field systems compared with high-field ones [97-99].

Regardless of system design, a local coil is mandatory to maximize the SNR. Commercially available coils appropriate for shoulder imaging include single-loop contoured or flat-surface coils [100,101], paired coils in a Helmholtz configuration [36,102], circularly polarized flexible coils [97], solenoid coils [92], and phased array designs [31,41].

Patients are positioned supine with the affected arm at the side. For evaluation of the rotator cuff and anterior labrum, internal rotation of the arm should be avoided [81,101,103]. When MR arthrography is performed, repositioning the affected arm into the abduction external rotation (ABER) position may increase sensitivity for anterior inferior labral tears [2,32,104,105] and may increase accuracy for rotator cuff tears, especially partial-thickness undersurface tears [106-108]. Images with the patient’s arm in this position are obtained parallel to the humeral shaft prescribed from a coronal localizer image [32].

Shoulder MR examinations usually include images acquired in the transverse (axial), oblique sagittal, and oblique coronal planes. The oblique sagittal and oblique coronal planes are prescribed orthogonal to each other using either the glenoid fossa or the supraspinatus tendon as reference anatomic landmarks. Evaluation of the rotator cuff is performed using both oblique coronal and oblique sagittal images [109]. Prescribing the oblique sagittal images in the frontal plane so that they are perpendicular to the distal supraspinatus tendon may be useful for identifying subtle partial-thickness rotator cuff tears [110]. The oblique coronal and oblique sagittal images can be used to evaluate the labrum, biceps tendon, acromial anatomy, supraspinatus outlet, acromioclavicular joint, and rotator interval [23,27,46]. The transverse images best display the subscapularis tendon, the long head of the biceps tendon in the intertubercular groove, glenohumeral articulation, and the glenoid labrum [2,24,33,36]. Transverse images may aid in detecting anterior rotator cuff tears. The use of multiple imaging planes increases the accuracy of detecting subscapularis tendon tears [111]. Radial imaging can be used to evaluate the rotator cuff, especially the subscapularis tendon, long head biceps tendon, rotator interval, and glenoid labrum [112-114], but it is not widely used.

FOV should be tailored to the size of the patient and the structures being examined, but for the standard sequences, the FOV should be 16 cm or smaller on medium-field and high-field units. Larger FOVs and smaller imaging matrices may be necessary on lower field systems but will result in lower spatial resolution, limiting the sensitivity of the examination [93,96]. Occasionally, additional sequences with a larger FOV will be appropriate to more fully evaluate a specific suspected or detected abnormality, for example, scapulothoracic bursitis or pectoralis major tear in the anterior chest wall. Slice thickness in the oblique sagittal and oblique coronal planes of 4 mm or less is needed to demonstrate subtle tendon pathology, but thinner sections may be advantageous for detailed analysis of other structures, such as the labrum and articular cartilage. The size of an interslice gap, if used, would depend on hardware, software, time considerations, and need for anatomic coverage. Imaging with no gap has the advantage of imaging all of the anatomy in the covered field of view. The imaging matrix should balance intravoxel SNR with desired in-plane spatial resolution and reduction of truncation artifacts but should be at least 160 steps in the phase direction and 256 steps in the frequency direction for 2-D imaging, other than when imaging a large tumor. Some practices may use higher imaging matrices (up to 512 steps) to increase spatial resolution for diagnosing labral lesions, including SLAP tears [31,33].

Shoulder MRI can be performed with a wide variety of pulse sequences [115]. The choice of sequences can be tailored to optimize the examination for specific clinical questions and may vary because of local preferences. Conventional spin-echo, fast (turbo) spin-echo, and gradient-recalled sequences have all been used successfully for shoulder MRI. A typical imaging protocol will be composed of one or more of these pulse sequence types. The prescribed repetition time (TR), echo time (TE), and flip angle will depend on the field strength of the magnet and the relative contrast weighting desired.

Fluid-sensitive sequences, such as long-TR/moderate-to-long TE (proton-density weighted or T2-weighted) images with or without fat suppression or STIR images, are typically used for evaluating the rotator cuff, with either conventional spin-echo or fast (turbo) spin-echo technique [21,116-118]. T2*-weighted gradient-echo recalled
sequences can also be used for diagnosing rotator cuff abnormalities but probably with lower accuracy compared with conventional spin-echo or fast spin-echo sequences [119,120]. To show labral abnormalities, long-TR (proton-density weighted or T2-weighted) spin-echo or fast spin-echo images or T2*-weighted gradient-recalled images are typically performed [33,36,121], although gradient-echo imaging may be less accurate when used in isolation for anterior labrum abnormalities compared with conventional spin-echo or fast spin-echo imaging [101]. Lesions of the superior labrum such as SLAP tears can be visualized on fast spin-echo, long-TR images [31,41,114], or with MR arthrography [30,34]. T1-weighted sequences (short TR/short TE) have a role in characterizing marrow abnormalities [73], various stages of hemorrhage [122,123], and muscle pathology [22,47,48,51,52]. T1-weighted sequences have been used to characterize the degree of rotator cuff muscle atrophy in patients with tendon tears, which can be used to predict patient outcomes after surgery [124-128]. Additional imaging methods, such as spectroscopic MRI, T2-mapping, and 3-D Volume-interpolated Breathhold Examination (VIBE) with 2-point Dixon, have been used to provide a more quantitative measure of muscle atrophy [129-134]. 3-D T1-weighted fast field-echo and 3-D MR reconstruction using axial Dixon 3-D–T1-weighted–Fast low angle shot (FLASH) sequences as well as 3-D VIBE MR arthrography have proven accurate in quantifying glenoid bone loss when compared with CT and surgical measurements [135-138]. T2 relaxation maps of glenoid articular cartilage are possible and provide quantitative measures that reflect early structural change in articular cartilage.

MR arthrography using dilute gadolinium-containing contrast [79] may improve diagnostic accuracy in unstable shoulders [44]. Additionally, MR arthrography may improve diagnostic performance for some rotator cuff tendon tears, particularly partial-thickness tears, postoperative recurrent tears, and subscapularis tears [14,19,104,106,139-141]. Contrast opacification of the glenohumeral joint can also be accomplished indirectly by allowing IV-injected contrast to diffuse across the synovial membrane; MRI in this circumstance is performed after a short delay (during which time the patient may be asked to move or exercise the shoulder) following IV injection of a gadolinium-containing agent [106,142]. T1-weighted images either without (valuable to assess presence and degree of muscle fatty infiltration and/or volume loss) [2,79,139] or with fat suppression [30,32,140] are most frequently used when direct or indirect MR arthrography is performed with gadolinium-containing contrast. At least one fluid-sensitive sequence with fat suppression is still necessary when performing MR arthrography to detect pathology that does not communicate with the joint as well as to identify altered bone marrow signal intensity.

Suppressing the signal from fat may enhance the diagnostic yield of some pulse sequences [115]. Fat suppression can be performed using spectrally selective radiofrequency (RF) pulses, selective water excitation, a STIR sequence, or a phase-dependent method (eg, the Dixon method) [90,93,143,144]. The latter two techniques may be necessary on low-field systems [93,108]. Fat suppression is useful for identifying marrow abnormalities and may be a useful adjunct when performing MR arthrography [145]. The addition of fat suppression may increase diagnostic accuracy for rotator cuff tendon tears [117,143], especially partial-thickness tears [21]. Fat suppression is a useful adjunct to T1-weighted images when MR arthrography is performed using gadolinium-containing contrast [30,32,140]. Recent advances have demonstrated the ability to shorten MRI shoulder acquisition time without decreasing diagnostic yield, using the combination of high field strength systems and parallel imaging [146].

Additional imaging techniques have specific roles for certain shoulder disorders. Both shoulders are imaged together for evaluation of glenohumeral dysplasia related to brachial plexus birth injury allowing evaluation of associated rotator cuff muscle atrophy, glenohumeral alignment, and glenoid version [147]. Applying axial traction to the affected arm via a weight attached to the wrist may aid in the visualization of SLAP lesions [148]. The ABER position may help with the MR arthrographic diagnosis of instability lesions and partial-thickness, articular-surface rotator cuff tears [2,32,104-108]. Flexion-adduction and internal rotation of the shoulder can increase conspicuity of posterior labral tears if they are suspected and not seen on routine positioning [149].

Various techniques are used to minimize artifacts that can reduce imaging quality. Wraparound artifact should be reduced by phase oversampling [150]. Involuntary patient motion is best controlled by ensuring patient comfort combined with gentle immobilization when necessary [115]. Securing the affected arm against the thigh may further reduce motion artifacts [81]. When available, software that compensates for motion by the use of navigator echoes can be useful [151]. Flowing blood and other periodic motions produce ghosting artifacts, which can be reduced with presaturation pulses or gradient moment nulling [150,152]. Chemical shift artifact is more severe at higher field strengths and may necessitate an increase in the receiver bandwidth [16,95,150]. Susceptibility artifacts, which
originate from heterogeneity of the local field, are also more severe at higher field strengths and when using gradient-recalled pulse sequences. In clinical practice, patients with known metallic implants should be scheduled for MRI using 1.5T rather than 3T units. Avoiding gradient-echo imaging and reducing the voxel size will help reduce the magnitude of susceptibility artifacts [150,151]. Other techniques to reduce susceptibility artifact include the avoidance of spectral fat suppression and the use of a STIR sequence as well as the use of a fast spin-echo (FSE) technique rather than spin-echo (SE) imaging and increasing bandwidth [153,154]. Newer techniques include the use of view angle tilting (VAT) to correct the in-plane distortions, slice encoding for metal artifact correction (SEMAC), and multiacquisition variable-resonance image combination (MAVRIC), which correct both the in-plane and through-slice distortions [155]. Vacuum phenomena in the shoulder joint can also result in artifact generation, especially when gradient-recalled pulse sequences are used [156]. Lastly, magic angle artifact can produce increased signal intensity within the supraspinatus tendon as it curves over the humeral head, mimicking intratendinous pathology particularly on short-TE images [157,158]. This pitfall is best avoided by confirming abnormal signal intensity in the tendon on long-TR images and correlating apparent signal intensity abnormalities with changes in tendon thickness.

It is the responsibility of the supervising physician to determine whether additional pulse sequences or imaging techniques would confer added benefit for the diagnosis and management of the patient. Examinations that use techniques not approved by the Food and Drug Administration (FDA), such as the intra-articular injection of gadolinium chelates (direct MR arthrography) [159], can be considered when they are judged to be medically appropriate.

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [160].

At a minimum, the report should address the condition of the rotator cuff muscles and tendons, supraspinatus outlet (as defined in Section II. A. 3), biceps tendon, and labrum. In selected cases, a description of findings in the major ligaments and capsule, articular cartilage, bone marrow, synovium, and cortical bone would be appropriate. An effort should be made to adopt a standardized lexicon of terms, and the report should use precise anatomic descriptions of identified abnormalities whenever possible [161].

Specific policies and procedures related to MRI safety should be in place with documentation that is updated annually and compiled under the supervision and direction of the supervising MRI physician. Guidelines should be provided that deal with potential hazards associated with the MRI examination of the patient as well as to others in the immediate area [162-164]. Screening forms must also be provided to detect those patients who may be at risk for adverse events associated with the MRI examination [162-165].

See the ACR Practice Parameter for Performing and Interpreting Magnetic Resonance Imaging (MRI) [87], the ACR Guidance Document on MR Safe Practices 2020 [166], and the ACR Manual on Contrast Media [167].

Peer-reviewed literature pertaining to MR safety should be reviewed on a regular basis [163,164].

VI. EQUIPMENT SPECIFICATIONS

The MRI equipment specifications and performance must meet all state and federal requirements. The requirements include, but are not limited to, specifications of maximum static magnetic strength, maximum rate of change of the magnetic field strength (dB/dt), maximum RF power deposition (specific absorption rate), and maximum acoustic noise levels.

Equipment monitoring should be in accordance with the ACR-AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance Imaging (MRI) Equipment [89].
VII. 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 ACR Position Statement on Quality Control and 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).

ACKNOWLEDGEMENTS

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 (https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards) by the Committee on Body Imaging (Musculoskeletal) of the ACR Commission on Body Imaging and by the Committee on Practice Parameters – Pediatric Radiology of the ACR Commission on Pediatric Radiology in collaboration with the SPR and the SSR.

Collaborative Committee
Members represent their societies in the initial and final revision of this practice parameter.

ACR
Christine B. Chung, MD, Chair
Laura W. Bancroft, MD, FACR
Timothy J. Carmody, MD, FACR
Soterios Gyftopoulos, MD

SPR
Siddharth Jadhav, MD
Jie C. Nguyen, MD, MS

SSR
Padmaja Jonnalagadda, MD
Tony Wong, MD

Committee on Body Imaging (Musculoskeletal)
(ACR Committee responsible for sponsoring the draft through the process)

Catherine C. Roberts, MD, Chair
Jeffrey M. Brody, MD, FACR
Bethany U. Casagrande, DO
Elaine S. Gould, MD, FACR
Mary K. Jesse, MD
Kenneth S. Lee, MD

Suzanne S. Long, MD
Kambiz Motamedi, MD
Carlos A. Rivera, BSc
Aleksandr Rozenberg, MD
Naveen Subhas, MD

Committee on Practice Parameters – Pediatric Radiology
(ACR Committee responsible for sponsoring the draft through the process)

Beverley Newman, MB, BCh, BSc, FACR, Chair
Terry L. Levin, MD, FACR, Vice Chair
John B. Amadio, MD, FACR
Tara M. Catanzano, MB, BCh
Harris L. Cohen, MD, FACR
Kassa Darge, MD, PhD
Dorothy L. Gilbertson-Dahdal, MD
Lauren P. Golding, MD
Safwan S. Halabi, MD

Jason Higgins, DO
Jane Sun Kim, MD
Jessica Kurian, MD
Matthew P. Lungren, MD, MPH
Helen R. Nadel, MD
Erica Poletto, MD
Richard B. Towbin, MD, FACR
Andrew T. Trout, MD
Esben S. Vogelius, MD

Lincoln L. Berland, MD, FACR, Chair, Commission on Body Imaging
Richard A. Barth, MD, FACR, Chair, Commission on Pediatric Radiology
Jacqueline A. Bello, MD, FACR, Chair, Commission on Quality and Safety
Mary S. Newell, MD, FACR, Chair, Committee on Practice Parameters and Technical Standards
Comments Reconciliation Committee
Daniel Ortiz, MD– Chair
Adam Specht, MD, FACR– Vice Chair
Laura W. Bancroft, MD, FACR
Richard A. Barth, MD, FACR
Jacqueline Anne Bello, MD
Lincoln L. Berland, MD, FACR
Timothy J. Carmody, MD, FACR
Christine B. Chung, MD
Richard Duszak, Jr., MD
Soterios Gyftopoulos, MD
Siddharth Jadhav, MD
Padmaja Jonnalagadda, MD
Amy L. Kotsenas, MD
Paul A. Larson, MD, FACR
Robert W. Morris, MD
Mary S. Newell, MD
Beverley Newman, MB, BCh, BSc, FACR
Jie Chen Nguyen, MD, MS
Catherine C. Roberts, MD
Michael I. Rothman, MD, FACR
G. Scott Stacy, MD
Tony Wong, MD

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.

Development Chronology for this Practice Parameter
2005 (Resolution 10)
Amended 2006 (Resolution 35)
Revised 2010 (Resolution 17)
Amended 2014 (Resolution 39)
Revised 2015 (Resolution 7)
Revised 2020 (Resolution 32)