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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.

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ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF MAGNETIC RESONANCE IMAGING (MRI) OF THE SOFT-TISSUE COMPONENTS OF THE PELVIS

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 of 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

Magnetic resonance imaging (MRI) of the pelvis is a proven and useful tool for the evaluation, assessment of severity, and follow-up of diseases of the male and female pelvic organs. It should be performed only for a valid medical reason.

MRI of the pelvis is the imaging modality of choice for many clinical situations involving pelvic pathology. This technique has superb soft-tissue contrast, particularly of the gynecologic organs, and has the advantage of providing multiplanar and 3D depiction of anatomy and pathology. Additional benefits include absence of ionizing radiation and exposure to iodinated contrast material. Due to the time and patient positioning required for MR imaging, the patient should be able to lie flat and cooperate for at least 20 minutes. Careful attention to patient comfort prior to beginning the MR examination will result in improved diagnostic quality.

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the [ACR Practice Guideline for Performing and Interpreting Magnetic Resonance Imaging \(MRI\)](#).

III. INDICATIONS

Indications for MRI of the pelvis include, but are not limited to:

1. Detection and staging of gynecologic malignancies, including those originating in the vulva, cervix, uterus, ovaries, and fallopian tubes [1-3].
2. Evaluation of pelvic pain or mass, including detection of adenomyosis, ovarian cysts, torsion, tubo-ovarian abscesses and benign solid masses, obstructed fallopian tubes, endometriomas, and fibroids [4-7].
3. Identification of congenital anomalies of the male and female pelvic viscera [8,9].
4. Determination of number, location, and type (solid or hemorrhagic) of fibroids prior to myomectomy, hysterectomy, or uterine artery embolization [10].
5. Assessment of pelvic floor defects associated with urinary or fecal incontinence [11,12].
6. Detection and staging of malignancies of the bowel, prostate, bladder, penis, testis, and scrotum [13-17].
7. Assessment for recurrence of tumors of the bowel, bladder, prostate, or gynecologic organs following surgical resection or exenteration [18].
8. Evaluation of complications following pelvic surgery, including abscess, urinoma, lymphocele, radiation enteritis, and fistula formation [8,19].
9. Determination of arterial and venous anatomy and patency [20].
10. Identification and staging of soft-tissue origin sarcomas.
11. Identification of the source of lower abdominal pain in pregnant women, including appendicitis and ovarian and uterine masses [21].
12. Assessment of fetal and placental abnormalities [22].
13. Identification of inflammatory bowel disease and its complications, particularly perianal fistulas [23].
14. Planning and guidance for minimally invasive surgery and brachytherapy.

IV. SAFETY GUIDELINES AND POSSIBLE CONTRAINDICATIONS

See the [ACR Practice Guideline for Performing and Interpreting Magnetic Resonance Imaging \(MRI\)](#), the

ACR Guidance Document for Safe MR Practices, and the [ACR Manual on Contrast Media](#) [24,25].

Peer-reviewed literature pertaining to MR safety should be reviewed on a regular basis [26,27].

V. SPECIFICATIONS OF THE EXAMINATION

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

The written or electronic request for MRI of the soft-tissue components of the pelvis 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)

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 in person or by phone for consultation. Patients must be screened and interviewed prior to the

examination to exclude individuals who may be at risk by exposure to the MR environment.

Certain indications require administration of intravenous (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 Practice Guideline for the Use of Intravascular Contrast Media](#).)

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 Guideline for Sedation/Analgesia](#).

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

1. Suggested coils and pulse sequences for use in evaluating benign disease of the uterus, including fibroids, adenomyosis, and Mullerian anomalies.

Whenever possible a multicoil array should be used to allow for smaller fields of view and higher spatial resolution. Fasting for 6 hours prior to the examination will diminish bowel peristalsis and improve quality. Alternatively, glucagon could be administered subcutaneously or intramuscularly to diminish artifacts from bowel peristalsis unless contraindicated. A coronal scout image should be obtained demonstrating the presence of the kidneys. The majority of information is obtained using T2-weighted images. Fast spin echo, turbo spin echo, or their equivalents are recommended in the sagittal, coronal, and axial planes to clearly demonstrate the anatomy of the uterus and ovaries. Ultrafast T2-weighted pulse sequences such as single shot fast spin echo or half-acquisition turbo spin echo can be substituted, yielding a significant time savings with some diminished spatial resolution. A relatively small field of view (20 to 24 cm) extending from hip to hip with slices 3 to 5 mm in thickness will

suffice. Following this an axial rapidly obtained T1-weighted image with fat suppression and during suspended respiration should be obtained to determine the presence of blood. Intravenous contrast agents are not usually needed. The exception would be for identifying degenerated fibroids prior to uterine artery embolization.

2. Suggested coils and pulse sequences for use in evaluating inflammatory and malignant disease of the male and female pelvis (including prostate cancer, bladder cancer, anal and rectal cancers, and gynecologic cancers), for characterizing adnexal masses, for identifying complications of inflammatory bowel disease, and for suspicion of malignant recurrent disease.

As for benign uterine disease, a multicoil array should be used and patient fasting encouraged to diminish bowel peristalsis. Alternatively, glucagon could be administered subcutaneously or intramuscularly to diminish artifacts from bowel peristalsis unless contraindicated. Once again, T2-weighted pulse sequences in the axial, coronal, and sagittal planes will yield the majority of information. Because contrast enhancement is often critical for detecting peritoneal disease, rapid T1-weighted gradient echo images should be obtained prerapid and postrapid administration of a gadolinium chelate (0.1 mmol/kg) to highlight sites of disease. Images obtained during the arterial and venous phase of enhancement may be useful in determining the vascular supply and enhancement pattern of a pelvic mass. A 3D sequence, particularly on high field strength magnets (>1.0 T), yields superb thin section contrast enhanced images. In the case of advanced disease, MR imaging of the abdomen should be considered to search for distant metastases. Additional pulse sequences may be used as required for diagnosis. In particular, endocoils have been used to stage prostate cancer.

3. Suggested coils and pulse sequences for use in diagnosing appendicitis or defining origins of a pelvic mass in the pregnant patients.

A multicoil array should be used with the patient fasting as tolerated to diminish fetal motion and bowel peristalsis. Diagnostic information can almost always be obtained using T2-weighted images. The patient may be imaged in the supine or left lateral decubitus position. Using a large-field-of-view (38 to 44 cm), a T2-weighted single shot fast spin echo, half acquisition turbo spin echo or an equivalent pulse sequence is used

to obtain images in the sagittal, axial and coronal plane. Axial T1-weighted images with fat suppression are obtained through the pelvis to identify placental hematoma or hemorrhagic adnexal mass. Intravenous contrast agent is not recommended. MRI of the pelvis is recommended for pregnant women in the second and third trimester. For pregnant women in the first trimester, MRI of the pelvis is only recommended if clinically necessary and then only as an adjunct to initial evaluation with ultrasound. (See the [ACR Practice Guideline for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#).)

VI. DOCUMENTATION

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

VII. 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 radiofrequency power deposition (specific absorption rate), and maximum acoustic noise levels.

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 QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR web page (<http://www.acr.org/guidelines>).

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 MRI examination of the patient as well as to others in the immediate area [26-34]. Screening forms must also be provided to detect those patients who may be at risk for adverse events associated with the MRI examination [26,30].

Equipment performance monitoring should be in accordance with the [ACR Technical Standard for](#)

[Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance Imaging \(MRI\) Equipment](#).

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REFERENCES

1. Frei KA, Kinkel K, Bonel HM, Lu Y, Zaloudek C, Hricak H. Prediction of deep myometrial invasion in patients with endometrial cancer: clinical utility of contrast-enhanced MR imaging—a meta-analysis and Bayesian analysis. *Radiology* 2000; 216:444-449.
2. Funt SA, Hricak H. Ovarian malignancies. *Top Magn Reson Imaging* 2003; 14:329-337.
3. Yu KK, Hricak H, Subak LL, Zaloudek CJ, Powell CB. Preoperative staging of cervical carcinoma: phased array coil fast spin-echo versus body coil spin-echo T2-weighted MR imaging. *AJR Am J Roentgenol* 1998; 171:707-711.
4. Ascher SM, Imaoka I, Lage JM. Tamoxifen-induced uterine abnormalities: the role of imaging. *Radiology* 2000; 214:29-38.

5. Ascher SM, Jha RC, Reinhold C. Benign myometrial conditions: leiomyomas and adenomyosis. *Top Magn Reson Imaging* 2003; 14:281-304.
6. Atri M, Reinhold C, Mehio AR, Chapman WB, Bret PM. Adenomyosis: US features with histologic correlation in an in-vitro study. *Radiology* 2000; 215:783-790.
7. Sala EJ, Atri M. Magnetic resonance imaging of benign adnexal disease. *Top Magn Reson Imaging* 2003; 14:305-327.
8. Petrillo A, Catalano O, Delrio P, et al. Post-treatment fistulas in patients with rectal cancer: MRI with rectal superparamagnetic contrast agent. *Abdom Imaging* 2007; 32:328-331.
9. Troiano RN, McCarthy SM. Mullerian duct anomalies: imaging and clinical issues. *Radiology* 2004; 233:19-34.
10. deSouza NM, Williams AD. Uterine arterial embolization for leiomyomas: perfusion and volume changes at MR imaging and relation to clinical outcome. *Radiology* 2002; 222:367-374.
11. Fielding JR. Practical MR imaging of female pelvic floor weakness. *Radiographics* 2002; 22:295-304.
12. Fielding JR. MR imaging of the female pelvis. *Radiol Clin North Am* 2003; 41:179-192.
13. Barentsz JO, Berger-Hartog O, Witjes JA, et al. Evaluation of chemotherapy in advanced urinary bladder cancer with fast dynamic contrast-enhanced MR imaging. *Radiology* 1998; 207:791-797.
14. Barentsz JO, Engelbrecht MR, Witjes JA, de la Rosette JJ, van der Graaf M. MR imaging of the male pelvis. *Eur Radiol* 1999; 9:1722-1736.
15. Cornud F, Flam T, Chauveinc L, et al. Extraprostatic spread of clinically localized prostate cancer: factors predictive of pT3 tumor and of positive endorectal MR imaging examination results. *Radiology* 2002; 224:203-210.
16. D'Amico AV, Schnall M, Whittington R, et al. Endorectal coil magnetic resonance imaging identifies locally advanced prostate cancer in select patients with clinically localized disease. *Urology* 1998; 51:449-454.
17. Mattei A, Fuechsel FG, Bhatta Dhar N, et al. The template of the primary lymphatic landing sites of the prostate should be revisited: results of a multimodality mapping study. *Eur Urol* 2008; 53:118-125.
18. Kinkel K, Tardivon AA, Soyer P, et al. Dynamic contrast-enhanced subtraction versus T2-weighted spin-echo MR imaging in the follow-up of colorectal neoplasm: a prospective study of 41 patients. *Radiology* 1996; 200:453-458.
19. Blomlie V, Rofstad EK, Trope C, Lien HH. Critical soft tissues of the female pelvis: serial MR imaging before, during, and after radiation therapy. *Radiology* 1997; 203:391-397.
20. Twickler DM, Setiawan AT, Evans RS, et al. Imaging of puerperal septic thrombophlebitis: prospective comparison of MR imaging, CT, and sonography. *AJR Am J Roentgenol* 1997; 169:1039-1043.
21. Pedrosa I, Levine D, Eyvazzadeh AD, Siewert B, Ngo L, Rofsky NM. MR imaging evaluation of acute appendicitis in pregnancy. *Radiology* 2006; 238:891-899.
22. Levine D, Barnes PD, Edelman RR. Obstetric MR imaging. *Radiology* 1999; 211:609-617.
23. Essary B, Kim J, Anupindi S, Katz JA, Nimkin K. Pelvic MRI in children with Crohn disease and suspected perianal involvement. *Pediatr Radiol* 2007; 37:201-208.
24. American College of Radiology. Manual on Contrast Media. http://www.acr.org/SecondaryMainMenuCategories/quality_safety/contrast_manual.aspx. Accessed September 11, 2009.
25. Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document for safe MR practices: 2007. *AJR Am J Roentgenol* 2007; 188:1447-1474.
26. Sawyer-Glover AM, Shellock FG. Pre-MRI procedure screening: recommendations and safety considerations for biomedical implants and devices. *J Magn Reson Imaging* 2000; 12:92-106.
27. Shellock FG, Tkach JA, Ruggieri PM, Masaryk TJ, Rasmussen PA. Aneurysm clips: evaluation of magnetic field interactions and translational attraction by use of "long-bore" and "short-bore" 3.0-T MR imaging systems. *AJNR Am J Neuroradiol* 2003; 24:463-471.
28. Medical magnetic resonance (MR) procedures: protection of patients. *Health Phys* 2004; 87:197-216.
29. Rezaei AR, Finelli D, Nyenhuis JA, et al. Neurostimulation systems for deep brain stimulation: in vitro evaluation of magnetic resonance imaging-related heating at 1.5 tesla. *J Magn Reson Imaging* 2002; 15:241-250.
30. Shellock FG. *Magnetic Resonance Procedures: Health Effects and Safety*. Boca Raton, Fla.: CRC Press; 2001.
31. Shellock FG. Magnetic resonance safety update 2002: implants and devices. *J Magn Reson Imaging* 2002; 16:485-496.
32. Shellock FG. Biomedical implants and devices: assessment of magnetic field interactions with a 3.0-Tesla MR system. *J Magn Reson Imaging* 2002; 16:721-732.
33. Shellock FG. *Reference Manual for Magnetic Resonance Safety, Implants, and Devices*. 2005 edition ed. Los Angeles, CA: Biomedical Research Publishing Group; 2005.
34. Shellock FG, Crues JV. MR procedures: biologic effects, safety, and patient care. *Radiology* 2004; 232:635-652.

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