Practical Guides to ACR MRI Accreditation

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Disclaimer
- Research collaboration with Siemens.
- Not officially endorsed by ACR. Only as reference

Outlines
- Overview of ACR MRI and Breast MR accreditation program
- Initial application and renewal
  - Planning
  - Clinical cases
  - Phantom scans
- Site visit

Why ACR Accreditation?
- Medicare and Insurance Reimbursement
  "All providers that bill for MRI under part B of the Medicare Physician Fee Schedule must be accredited in order to receive technical component reimbursement from Medicare"
- Opportunity to review and update protocols.
  - Use ACR criteria as minimal requirement
- Ensure adequate image quality.
  - Every exam should pass ACR

ACR Accreditation Program
- Personnel Qualifications
- Quality Assurance and Safety
  - Physician Peer review
  - Safety Policies
- Equipment QC
  - Acceptance testing and Annual Performance Evaluation
  - Weekly QA by MR Technologist
  - Preventive Maintenance
- Re-accreditation Every Three Years:
  - Last annual performance evaluation report
  - Attestation of weekly QA
  - Submit images from clinical exam and phantom scans

ACR MRI Clinical Modules
- Choice of Basic and Specialty exams
- Each scanner must apply for all modules routinely performed (Emergency use: < 10 / mo or 50 / yr)
ACR Breast MRI Accreditation

Preparation for ACR Accreditation

- Determine which module to include.
- Contact ACR to start the process.
- Schedule preventive maintenance.
- Acquire ACR phantom (plus phantom holder) or refill the ACR phantom.
- Choose the type of clinical cases carefully according to your patient population.
- Review your clinical protocols and make sure they meet ACR requirements (i.e. the resolution and scan time.)

Need good planning, communication and teamwork.

ACR Online Submission System

Clinical Scan Evaluation Categories

- Pulse Sequences and Image Contrast
- Spatial and Temporal Resolution
- Exam Identification: Missing Information
- Anatomic Coverage and Imaging Planes
- Artifacts
- Filming Technique (for hard copy film submissions only)

http://www.acr.org/accreditation/mri/mri_qc_forms/MRIAccredCIQG.aspx

Tips and Suggestions

- Check image quality and present your best case.
- Submit all the required series including the localizer with cross-reference, but only what’s required.
- Ask your radiologist to review the clinical images before ACR submission.

Finding the “Perfect” Cases

Readable, but too much noise
Clinical Case Datasheet

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Axial, sagittal or coronal dark fluid</th>
<th>Axial T2 FLAIR</th>
<th>Axial bright fluid</th>
<th>Axial or coronal dark fluid post contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence name/type</td>
<td>se</td>
<td>flair</td>
<td>tse fat sat</td>
<td>t1 irspgr</td>
</tr>
<tr>
<td>Sequence #</td>
<td>5</td>
<td>4</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Orientation</td>
<td>Axial</td>
<td>Axial</td>
<td>Axial</td>
<td>Axial</td>
</tr>
<tr>
<td>Slice Thickness (mm)</td>
<td>5.9</td>
<td>5.9</td>
<td>5.9</td>
<td>1.9</td>
</tr>
<tr>
<td>Gap (mm)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Flip (mm)</td>
<td>179.0</td>
<td>184.0</td>
<td>179.0</td>
<td>187.0</td>
</tr>
<tr>
<td>FOV (mm)</td>
<td>225.0</td>
<td>220.0</td>
<td>225.0</td>
<td>220.0</td>
</tr>
<tr>
<td>Ax (acquisition phase matrix)</td>
<td>256.0</td>
<td>122.0</td>
<td>220.0</td>
<td>220.0</td>
</tr>
<tr>
<td>Ax (reconstruction phase matrix)</td>
<td>160.0</td>
<td>180.0</td>
<td>179.0</td>
<td>187.0</td>
</tr>
<tr>
<td>Ax (display phase matrix)</td>
<td>128.0</td>
<td>198.0</td>
<td>197.0</td>
<td>187.0</td>
</tr>
<tr>
<td>Ax (display frequency matrix)</td>
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<td>198.0</td>
<td>197.0</td>
<td>187.0</td>
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<tr>
<td>Acquisitions</td>
<td>2.00</td>
<td>1.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>TR (ms)</td>
<td>7.6</td>
<td>100.0</td>
<td>112.0</td>
<td>3.7</td>
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<tr>
<td>Flip Angle</td>
<td>90</td>
<td>180</td>
<td>180</td>
<td>15</td>
</tr>
<tr>
<td>FOVp (mm)</td>
<td>179.0</td>
<td>184.0</td>
<td>179.0</td>
<td>187.0</td>
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<tr>
<td>FOVf (mm)</td>
<td>220.0</td>
<td>220.0</td>
<td>220.0</td>
<td>230.0</td>
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<tr>
<td>No. (acquisition phase matrix)</td>
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<td>188.0</td>
<td>179.0</td>
<td>187.0</td>
</tr>
<tr>
<td>No. (acquisition frequency matrix)</td>
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<td>320.0</td>
<td>220.0</td>
<td>230.0</td>
</tr>
<tr>
<td>No. (display phase matrix)</td>
<td>312.0</td>
<td>188.0</td>
<td>179.0</td>
<td>187.0</td>
</tr>
<tr>
<td>No. (display frequency matrix)</td>
<td>512.0</td>
<td>320.0</td>
<td>220.0</td>
<td>230.0</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Matrix Size</th>
</tr>
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<tbody>
<tr>
<td><strong>Acquisition matrix</strong>: frequency encoding and phase encoding used</td>
</tr>
<tr>
<td><strong>Reconstruction matrix</strong>: number of pixels in each dimension of the produced image</td>
</tr>
<tr>
<td><strong>Display matrix</strong>: number of pixels in each dimension of the final post-processed image</td>
</tr>
</tbody>
</table>

Find Parameters in DICOM Header

<table>
<thead>
<tr>
<th>(Group, Element)</th>
<th>Tag Name</th>
<th>VR</th>
<th>Length</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0018, 0024</td>
<td>Sequence Name</td>
<td>SH</td>
<td>6</td>
<td>*se2d2</td>
</tr>
<tr>
<td>0018, 1310</td>
<td>Acquisition Matrix</td>
<td>US</td>
<td>8</td>
<td>256/0/0/256</td>
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<tr>
<td>0018, 1312</td>
<td>In-plane Phase Encoding Direction</td>
<td>CS</td>
<td>4</td>
<td>COL</td>
</tr>
<tr>
<td>0018, 1314</td>
<td>Flip Angle</td>
<td>DS</td>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>0028, 0010</td>
<td>Rows</td>
<td>US</td>
<td>2</td>
<td>256</td>
</tr>
<tr>
<td>0028, 0011</td>
<td>Columns</td>
<td>US</td>
<td>2</td>
<td>256</td>
</tr>
</tbody>
</table>

View DICOM header in Synapse (Demo)
ACR Phantom Scan

1. ACR Sag Loc
2. ACR Ax T1
3. ACR Ax PD/T2
4. Site Brain Ax T1
5. Site Brain Ax T2

- Weekly Phantom Scans
- 11 slices of 5mm width 100% gap
- Total of 56 images; No DICOM viewer on CD

1. Knowing the ACR Phantom

- Wedges for slice position measurement (Sl2 & S11)
- Small holes for spatial resolution measurement (Slice 1)
- Ramps for slice thickness measurement (Slice 3)
- Grid for geometric accuracy (Slice 5)
- An uniform region (Slice 7)
- Shallow holes for low contrast detectability measurement (Slice 8-11)

ACR Large Phantom

2. Setup Phantom and Slices Properly

- Straight and in the center of the coil.
- Use a customized holder or the same support.
- Make sure the phantom would not rock.
- Line up slice #1 and #11 of ACR AX T1 to the cross of wedges on ACR Sag Loc.
- Copy slices to the rest of series

3. Using Correct Scan Protocols

- CSE sequence, TR/TE = 500ms/20ms (T1) or 2000ms/20ms/80ms (PD/T2)
- Acq. matrix = 256x256 and FOV = 250mm
- 11 slice of 5mm w. 100% gap

Other imaging options:
- Image intensity correction, especially if phase array coil is used.
- Normalizer or Pre-scan Norm (Siemens)
- SOI or PHIRE (Si)
- Raw data filter?

ACR Phantom Scan Data Form

<table>
<thead>
<tr>
<th>Study</th>
<th>Pulse Sequence</th>
<th>TR (ms)</th>
<th>TE (ms)</th>
<th>FOV (cm)</th>
<th>Num. of Slices</th>
<th>Slice Thickness (mm)</th>
<th>Slice Gap (mm)</th>
<th>NEX</th>
<th>Matrix</th>
<th>Routine Receive Band - Width (kHz)</th>
<th>Scan Time minutes (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ACR Sagital loc</td>
<td>Spin Echo</td>
<td>200.0</td>
<td>20.0</td>
<td>25.0</td>
<td>1</td>
<td>20</td>
<td>5X</td>
<td>1</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>2.</td>
<td>ACR Axial T1</td>
<td>Spin Echo</td>
<td>200.0</td>
<td>20.0</td>
<td>25.0</td>
<td>1</td>
<td>20</td>
<td>5X</td>
<td>1</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>3.</td>
<td>ACR Axial T2</td>
<td>Spin Echo</td>
<td>200.0</td>
<td>20.0</td>
<td>25.0</td>
<td>1</td>
<td>20</td>
<td>5X</td>
<td>1</td>
<td>256</td>
<td>256</td>
</tr>
<tr>
<td>4.</td>
<td>ACR Axial T2</td>
<td>Spin Echo</td>
<td>200.0</td>
<td>20.0</td>
<td>25.0</td>
<td>1</td>
<td>20</td>
<td>5X</td>
<td>1</td>
<td>256</td>
<td>256</td>
</tr>
</tbody>
</table>

10. Perform Your Site’s Axial T1-weighted Brain Scan
    Pulse: 400.00
    FOV: 22.00
    Slices: 25.0
    NEX: 5
    Matrix: 256
    Receive Band - Width: 130.0
    Scan Time: 3.24

11. Perform Your Site’s Axial T2-weighted Brain Scan
    Pulse: 400.00
    FOV: 22.00
    Slices: 25.0
    NEX: 5
    Matrix: 256
    Receive Band - Width: 130.0
    Scan Time: 3.24
What kind of images to expect

- ACR Sag Loc (1 image)
- ACR Ax T1 (11 images)
- Site T1 (11 images)
- ACR AX PD (11 images)
- ACR Ax T2 (11 images)
- Site T2 (11 images)

What’s wrong with this set?

ACR Sag Loc  ACR Ax T1  Site T1
ACR AX PD   ACR Ax T2  Site T2

Common Problems in ACR Phantom Scan

Previous ACR Submissions

www.mriprotocolex.com
(Demo)

Breast MR Accreditation Requirements

1 biopsy-proven positive case within last 6 mo.

A. Sequences:
- Scout/localizer
- T2-weighted/bright fluid or STIR
- Multi-phase T1-weighted series:
  1. Pre-contrast T1
  2. Early phase (first) post-contrast T1
  3. Delayed phase (last) post-contrast T1
     - Spatial resolution: better than 1.0mm x 1.0mm x 1.2mm
     - Temporal resolution: pre – delayed within 4 min.
Breast MR Accreditation Requirements

B. Positioning and Anatomic Coverage
- Coverage of the entire breast, from the axillary tail to the inframammary fold *
- Proper positioning of the breast within the coil
- Adequate breast tissue inside the coil
- Absence or minimization of skin folds
- Properly positioned nipple
- Appropriate FOV

C. Artifacts
- Motion/ghosting
- Non-uniform/heterogeneous fat suppression
- Aliasing/wrap artifacts
- Truncation/ringing artifacts (edge ringing)
- Non-uniform/heterogeneous signal within breasts
- Susceptibility
- Chemical shift
- Geometric distortion
- Filtering
- RF leak (zipper artifact)
- Misregistration of subtracted images

Artifacts in Breast MRI

Submit and relax ...

For the next 3 years!

Ready for Site Visit?

“Facilities will be surveyed with unannounced visits by representatives of the ACR or CMS at any time during the 3-year accreditation period.”

http://www.acr.org/Quality-Safety/Accreditation/MRI

Accreditation Document Binder

Tab 1: Site information
Tab 2: Personnel documentation for Physicians
Tab 3: Personnel documentation for Medical Physicists/MR Scientists
Tab 4: Personnel documentation for Technologists
Tab 5: Annual Physics Survey/Performance Evaluation Checklist, Tech QC Checklist, NRC/State Inspection Report Checklist (if applicable)
Tab 6: Policy and procedures review
Tab 7: Physician peer review program evaluation
Tab 8: Patient report evaluation
Tab 9: Image labeling evaluation
Tab 10: Resources
MR Specific Policies and Procedures

- MRI Safety
  - Policy on unforeseen ferrous objects in MR scan room
  - Policy on thermal burns and SAR
  - Policy on response of personnel during and after a quench
  - Policy on reporting of MR accidents to FDA via Medwatch Program *
  - Policy on hearing protection for patients/persons in MR scan room
  - Documentation of medical director/MR safety officer’s name and responsibilities

Screening
- Screening forms for patients or their representatives
- Policy on screening of visitors or other personnel in MR scan room *
- Policy that screens patient's renal status before contrast administration

Emergency Procedures – Zone II through IV
- Policy on crash cart/location/check
- Policy on how to handle emergencies/codes in Zone IV (Scanner room)

MR Education for personnel
- Policy on educating MR staff, non-MR staff and emergency personnel
- Policy on ongoing education

Image Labeling

Patient Demographics
- Patient name (first and last)
- Patient age or date of birth
- Patient identification number
- Date of examination

MRI
- Interslice gap (can be inferred from slice position), Slice thickness
- Field of view, Acquired matrix
- Size scale
- Laterality, left or right of midline section
- Label that indicates location of slice relative to other slices

MRI
- Plan Scan or scout for location of sagittal or axial slices
- Number that correlates with ‘plan scan’ or scout identifying the location of each slice

Breast MRI
- Facility name
- Laterality, left or right of midline section

Summary
- ACR MRI and Breast MRI accreditation process.
- Common problems in clinical case and phantom scan submissions.
- ACR Toolkit for site visit.

Questions?
http://www.indiana.edu/~mri