ACR Update: MRI Accreditation Programs

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Outline

1. Provide a brief overview of the current ACR MRI Accreditation Program (MRAP)
2. Provide a brief overview of the current Breast MRI Accreditation Program (BMRAP)
3. Describe updates to program instructions and documentation
4. Present planned changes to both programs
ACR MRI Accreditation Program

MRAP Overview
- Six modules: Head, Spine, MSK, Body, MRA, Cardiac
- Allows accreditation of whole body, dedicated MSK and certain specialty MRI systems.
- Large ACR MRI phantom
- Small ACR MRI Phantom added for use in small bore orthopedic MRI systems

ACR MRI Program

MRAP Overview
Accreditation submissions:
1. Physicist/MRI Scientist’s Annual Equipment Evaluation report
   - System tests including all RF coils
   - Technologist QC Program review
   - MR Safety Assessment
2. Clinical images depending on module selection
3. Phantom images – large or small phantom depending on module and system design
ACR Breast MRI Program

BMRAP Overview

Separate program established in 2010

Accreditation submissions:
1. Physicist/MRI Scientist’s Annual Equipment Evaluation report
   - System tests including all RF coils, breast coil
   - Technologist QC Program review
   - MR Safety Assessment
2. Clinical case (bilateral) BI-RADS category 6: known, enhancing, biopsy-proven malignancy

Breast MR Imaging Systems

Dedicated breast MRI systems:

Whole body MRI systems:
~ detachable table-top breast coils
~ dedicated tables with integrated breast coils

www.sentinellemedical.com/products.html

www.invivocorp.com/coils/

www.auroramri.com

www.sentinellemedical.com/products.html
Breast MRI Technical Requirements

1.5 or 3T MRI systems
- Dedicated breast MRI system or whole body MRI system with breast imaging capability
- Dedicated breast coil capable of simultaneous bilateral imaging
- Table top coils or detachable breast table with integrated imaging and biopsy coils
- Modern breast coils are phased array to improve speed and SNR

MR Annual Equipment Evaluation Summary Form

Available under Gather Data section, required to include in the Physicist/MRI Scientist’s annual report:

- Equipment Evaluation Summary of all tests
- Evaluation of Site’s Technologist QC Program
- MR Safety Program Assessment
# ACR MRI Programs: Statistics as of May 1, 2018

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*Active: Includes accredited units/facilities and those in the accreditation or renewal process
2015 ACR MRI Quality Control Manual

- Update of 2004 QC Manual
- Interslice RF interference test removed
- Magnetic field homogeneity assessment: alternative methods described
- MRI safety program assessment: new checklist
- Other changes and additions to improve clarity

Radiologist’s section
Technologist’s section
Medical Physicist’s section

Quality control program and medical physicist involvement essentially the same for both programs MRAP and BMRAP
MR Accreditation Program
Testing Instructions

Combines the instructions necessary for the clinical exams, phantom testing and general submission.
- Includes content of former *Clinical Image Quality Guide*
- Includes content of former *Large and Small Phantom Testing Instructions*


MR Accreditation Program
Large Phantom Test Guidance

Provides information about the large phantom tests
- Purpose of each test
- How the measurements are made
- Clarified action criteria for images submitted for accreditation:
  - *Recommended values “should be within...”*
  - *Failure limits “will fail if outside these limits...”*
- Causes of failure and corrective actions

MR Accreditation Program
Small Phantom Test Guidance

Provides information about the small phantom tests

- Purpose of each test
- How the measurements are made
- Clarified action criteria for images submitted for accreditation:
  - Recommended values “should be within...”
  - Failure limits “will fail if outside these limits...”
- Causes of failure and corrective actions

Action Criteria: Geometric accuracy

ACR large phantom

- All measured lengths in ACR T1 images should be within ± 2 mm
- Images submitted for accreditation will fail if any length differs more than ± 3 mm
**Action Criteria: Geometric accuracy**

**ACR small phantom**
- All measured lengths in ACR T1 images must be within ± 2 mm to pass accreditation

**Action Criteria: Spatial Resolution**

**ACR Large Phantom**
- Must resolve 1.0 mm or better on both the ACR T1 and T2 series
- If the ACR T1 or T2 series fail, the site can pass if both the Site T1 and Site T2 series pass
### Action Criteria: Spatial Resolution

**ACR Small Phantom**
- Must resolve 0.8 mm or better on both the ACR T1 and T2 series
- If the ACR T1 or T2 series fail, the site can pass if both the Site T1 and Site T2 series pass

 phantom image


### Action Criteria: Slice Thickness

**ACR Large Phantom**
- Should be within 5.0 ± 0.7 mm on ACR T1 and T2 series. Images submitted for accreditation will fail if greater than 5.0 ± 1.0 mm
- If either of the ACR series fail, the site can pass if both the Site T1 and Site T2 series pass

 phantom image

Action Criteria: Slice Thickness

ACR Small Phantom

- Should be within $5.0 \pm 0.7$ mm on ACR T1 and T2 series. Images submitted for accreditation will fail if greater than $5.0 \pm 1.0$ mm.
- If either of the ACR series fail, the site can pass if both the Site T1 and Site T2 series pass.

ACR Large and Small Phantoms

- Magnitude of each bar length difference should be $\leq 5.0$ mm.
- Must be $\leq 7.0$ mm to pass accreditation.
- Bar length differences $> 4.0$ mm can affect slice thickness and LCD scores.
Action Criteria: Percent Image Uniformity

ACR Large Phantom
- For systems less than 3T: ACR T1 and T2 series PIU should be $\geq 87.5\%$ and will fail if $< 85\%$.
- PIU for 3T systems should be $\geq 82.0\%$ and will fail if $< 80\%$.

ACR Small Phantom
- ACR T1 and T2 series PIU must be $\geq 85\%$
Action Criteria: Percent Signal Ghosting

ACR Large Phantom

- Percent signal ghosting (ghosting ratio) of the ACR T1 series should be $\leq 0.025$ (2.5%)
- Images submitted for accreditation will fail if $> 0.030$ (3.0%)

Action Criteria: Percent Signal Ghosting

ACR Small Phantom

- Percent signal ghosting (ghosting ratio) of the ACR T1 series must be $> 0.030$ (3.0%) for images submitted for accreditation
**Action Criteria: Low Contrast Detectability**

**ACR large phantom**
- For systems less than 3T: ACR T1 and T2 series total LCD score should be $\geq 9$ spokes but must be at least 7 to pass.
- For 3T systems the total LCD score for both series must be at least 37 to pass.
- If either of the ACR series fail, the site can pass if both the Site T1 and Site T2 series pass.

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**Phantom Test Guidance for Use of the Large MRI Phantom, www.acr.org, April 17, 2018.**

**Action Criteria: Low Contrast Detectability**

**ACR small phantom**
- ACR T1 and T2 series total LCD score must be at least 9 spokes
- If either of the ACR series fail, the site can pass if both the Site T1 and Site T2 series pass.

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**Phantom Test Guidance for Use of the Small MRI Phantom, www.acr.org, April 17, 2018.**
2015 ACR MRI Quality Control Manual

Includes recommended slice # for weekly QC and typical low-contrast scores by field strength.

Table 1. Recommended slice of the ACR large MRI phantom to use for weekly low-contrast detection QC and typical number of spokes visible in the recommended slice and on all slices as a function of magnetic field strength.

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<th>Field Strength</th>
<th>Recommended weekly QC slice #</th>
<th>Typical number of spokes visible in recommended QC slice</th>
<th>Total number of spokes on all slices</th>
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Documentation updates

FAQs: updated more frequently than other program documentation

https://www.acraccreditation.org/Modalities/MRI
https://www.acraccreditation.org/Modalities/Breast-MRI
New FAQs

Change in practice: Increased use of software to perform automated phantom QC measurements. Automated SNR measurements are less subjective and less sensitive to slice positioning than LCD scoring.

New FAQs

LCD correlates with SNR

Automated SNR measurement method used by one facility
New FAQs

FAQ: Is it acceptable to measure SNR for daily/weekly QC instead of recording an LCD score?

Answer: Yes, SNR is an acceptable alternative to LCD scoring for daily/weekly phantom QC. However, LCD scores must be included in the Annual System Performance Evaluation.

https://www.acraccreditation.org/How-To/MRI-Accreditation-FAQ

Planned Program Changes

1. ACR Large and Small MRI Phantom re-design
   - Geometric accuracy section: the grid insert is designed to guide the phantom diameter measurements in order to assess geometric accuracy.
   - Manufacturer running out of material
   - Insert re-design made of acrylic with equally spaced holes to guide measurements
Large MRI Phantom:
geometric accuracy
insert

190 mm diameter
9 equally-spaced holes
2.0 mm hole diameter
50.0 mm spacing

Small MRI Phantom:
geometric accuracy
insert

100 mm diameter
9 equally-spaced holes
2.0 mm hole diameter
25.0 mm spacing
Planned Program Changes

2. Re-design of the resolution pattern
   - Currently the ACR Large phantom includes 1.1, 1.0 and 0.9 mm hole patterns.
   - Addition of 0.8 mm pattern
   - Resolution Pass/Fail limits will not change.

3. Development of a Medium MRI Phantom
   - Large ACR phantom is too large to fit into many modern phased array brain coils.
   - Medium phantom diameter = 165 mm
   - Phantom will also include the re-designed geometric accuracy and resolution inserts.
   - Pass/Fail limits to be determined.
   - Status: Request for Intent recently submitted to potential phantom manufacturers
Planned Program Changes

4. Incorporate Breast MR Accreditation into the MRAP program
   - Breast MRI will become a 7th Module in the MRI Accreditation Program
   - Details to be developed over the next 1-2 years

Medium MRI Phantom: geometric accuracy insert

165 mm diameter
9 equally-spaced holes
2.0 mm hole diameter
40.0 mm spacing
Summary

- ACR has revised guidance documents for the MRI and Breast MRI Accreditation Programs.
- 2015 ACR MRI QC Manual was updated to improve instructions.
- Large and small phantom test documents now clarify phantom measurement recommendations and pass/fail limits for accreditation submission.
- Coming changes to the ACR MRI programs include changes to existing phantoms, development of a medium phantom that fits into modern phased array head coils, and incorporation of Breast MRI as a new module in the MRI program.

Thank You!