Breast MRI and MRI-guided Breast Biopsy

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Clinical Indications for Contrast-enhanced Breast MRI:
• Search for primary breast cancer in women with a positive axillary node
• Staging of tumor extent in women with a known breast cancer – MRI most accurate
• Search for multifocal, multicentric or bilateral breast cancer in women with a known breast cancer

Clinical Indications for Contrast-enhanced Breast MRI:
• Search for residual tumor shortly after surgery in patients with + margins
• Evaluation for tumor recurrence after surgery and/or radiation
• Monitoring tumor size and extent in neoadjuvant chemotherapy
• Screening of high-risk women

Technical Requirements
For Good Cancer Detection:
• High-field breast MRI (1.5T or >)
• Gadolinium-DTPA injection
• Dedicated bilateral breast coil
• Good fat suppression techniques
• High-resolution 3D gradient echo pulse sequence

Technical Requirements
For Good Cancer Detection:
• High-resolution 3D gradient echo pulse sequence
  – Bilateral coverage
  – In-plane resolution < 1 mm
  – Slice thicknesses < 3 mm
• Dynamic imaging with adequate temporal resolution (1-2 minutes)

Why Gd-chelates Are Essential for Cancer Detection

T1W-Gradient-echo Pre-Gd-chelate
T1W –Gradient-echo 2 minute Post Gd
Why Gd-chelates Are Essential for Cancer Detection

Sagittal Maximum Intensity Projection (MIP)

Why Use a Dedicated Breast Coil?
Same STIR Pulse Sequence at 1.5T

SNR = 190
SNR = 27

4-Channel Breast Coil
Body Coil as Receiver

Why Use Fat-saturation in Contrast Series?

Residual Signal Due to Motion Between Pre- and Post-Contrast Images Mimics Enhancement

1st Post-Contrast
Subtracted Image
Examples of Bad and Good Image Quality

Old (BAD) Scanning Protocol
- T2-FSE or TSE
- Pre-Gd
- Larger FOV than Necessary
- Low Matrix for Bilateral Axial Scan
- Motion Artifacts Obscure Lateral Breast Tissue

Old (BAD) Scanning Protocol
- Post-Gd

New Protocol
- 1st Subtracted
- Motion Artifacts Obscure Lateral Breast Tissue
- Receiver Coil Has Better SNR
- Breast Positioning Is Better
10 Ways to Tell That a Site Isn’t Doing Good Breast MRI

- Field strength < 1.5 T
- Images acquired unilaterally only
- No fat saturation in CE images
- Inadequate Gd-DTPA uptake
- In-plane resolution > 1 mm in CE images
- Slice thickness > 3 mm in CE images
- No dynamic information obtained
- Images interpreted from film
- BIRADS for breast MRI not used
- Few or no vessels seen on 3D MIPs

Looking at 3D MIPs in the Acquired Projection Plane is a Good Way to Assess Overall Image Quality
Excellent Sagittal MIP from Same 3D Dataset

Good Sag MIP

Low SNR Sag MIP

Poor Sag MIP

PrePre--GdGd PostPost--GdGd

50 seconds post-injection

PostPost--GdGd Subtracted from PreSubtracted from Pre--GdGd

Pre-Gd Post-Gd 50 seconds post-injection

Post-Gd Subtracted from Pre-Gd
3D 50 s Post-Gd Subtracted

Maximum Intensity Projection (MIP) of Subtracted Images
Isotropic Imaging Permits Projection in Any Plane

MRI-GUIDED BREAST BIOPSY
- Appropriate for suspicious lesions found on MRI & not seen on mammography or US
- Equipment Needed:
  - A dedicated breast coil
  - A biopsy guidance system compatible with the breast coil and tissue sampling device
  - A MR-compatible tissue sampling device:
    - 14 gauge cutting needle
    - 8-11 gauge vacuum-assisted sampling device: Suros, Mammatome, etc.

InVivo 4-channel Bilateral Breast Coil

GE 8 Channel Breast Coil
MR-GUIDED BIOPSY

Grid Biopsy Guidance Devices

Reusable

Disposable

Guidance for Biopsy - Pillar/Post

Biopsy Needles

Front View

14g Cutting 11g VA 10g VA 8g VA

Biopsy Needles

Side View

14-gauge Cutting Needle

14g Cutting 11g VA 10g VA 8g VA
14 Gauge spring-loaded biopsy gun

Suros 9G MR-compatible Biopsy System

Suros - ATEC now Hologic

Suros 9G MR-compatible Biopsy System

Suros 9G Biopsy Samples
MR-guided Vacuum-assisted Biopsy Setup

Breast Biopsy Sample Weights

<table>
<thead>
<tr>
<th>Device</th>
<th>Sample Weight</th>
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<tbody>
<tr>
<td>14 g Cutting Needle</td>
<td>18 mg</td>
</tr>
<tr>
<td>14 g Mamotome</td>
<td>37 mg</td>
</tr>
<tr>
<td>12 g Suros ATEC</td>
<td>49 mg</td>
</tr>
<tr>
<td>11 g Mamotome</td>
<td>95 mg</td>
</tr>
<tr>
<td>9 g Suros ATEC</td>
<td>118 mg</td>
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<tr>
<td>8 Mamotome</td>
<td>300 mg</td>
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Core Biopsy Sample Sizes

<table>
<thead>
<tr>
<th>Device</th>
<th>Sample Weight</th>
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<tbody>
<tr>
<td>14 G Core Needle</td>
<td>12-17 mg</td>
</tr>
<tr>
<td>14 G Mamotome</td>
<td>35-40 mg</td>
</tr>
<tr>
<td>11 G Mamotome</td>
<td>83-110 mg</td>
</tr>
<tr>
<td>8 G Mamotome</td>
<td>250-310 mg</td>
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MR-GUIDED BIOPSY

MR-guided Breast Biopsy

Pre-Contrast | Post-Contrast

External Marker | Targeted Lesion
MR-guided Breast Biopsy

Grid at Skin of Lateral Breast       Targeted Lesion

Suros 9G Vacuum Biopsy System

Suros 9G Biopsy Needle and Inserter

Grid After Needle Placement        Targeted Lesion

Suros 9G Biopsy Needle and Localizer

Stylus Track

MR-guided Breast Biopsy

Suros 9G Biopsy Needle and Inserter

Targeted Lesion Before Tissue Sampling

MR-guided Breast Biopsy

Targeted Lesion After Tissue Sampling

Suros 9G Biopsy Needle and Localizer
Conclusions

- Breast MRI has an important role in the search for and evaluation of breast cancer
- MRI-guided breast biopsy is appropriate for suspicious enhancing lesions seen on MRI and not seen on mammography or breast US
Conclusions

• MRI-guided breast biopsy usually gets sufficient samples, but can underestimate disease

• It is harder to confirm correct sampling with MRI-guided breast biopsy than with x-ray or US guidance