MRI-Guided Breast Biopsy

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MRI of the Breast

- MRI is an important tool for the detection of breast cancer and assessment of silicone implant integrity
- The use of MRI with contrast agents for the detection of breast cancer was first reported in 1986

Heywang 1986

2

Current Indications for Breast MRI

- Axillary metastasis of unknown origin
- High risk patients (screening MRI)
- Extent of disease (with new diagnosis)
- Aid to pre-surgical treatment planning
- Treatment response/follow-up
- History of chest radiation

3

Current Indications for Breast MRI

- Differentiating postoperative changes from recurrence
- Reduced mammographic sensitivity
- Problem solving for selective inconclusive clinical or mammographic/ultrasound findings
- Guidance for biopsy

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Breast MRI Technique

- MRI creates images of the breast by measuring changes in the movement of protons in fat and water with the application of changing magnetic fields
- By utilizing the differences in tissue relaxation characteristics, an image is acquired by processing the signal changes that occur following application of pulses of energy

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Chernoff 2020

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MRI for Breast Cancer Detection

- Requires administration of the contrast agent gadolinium
- The use of contrast is based on the concept of tumor angiogenesis or neovascularity

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Breast MRI Technique

Tumor-associated blood vessels have increased permeability, which leads to prompt uptake and release of gadolinium within the first 1-2 minutes after administration, leading to a pattern of rapid enhancement and washout on MRI.

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MR Breast Lexicon

- Focus/foci (tiny spot <5mm) no other descriptor
- Mass (3D space-occupying lesion)
  - Shape (round, oval, lobulated, irregular)
  - Margin (smooth, irregular, spiculated)
  - Mass enhancement (homogeneous, heterogeneous, rim, non-enhancing septations, enhancing septations

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MR Breast Lexicon

- Non-mass enhancement
  - Focal, linear, ductal, segmental, regional, multiple regions, diffuse
  - Homogeneous, heterogeneous, stippled/punctate, clumped NMLE
- Symmetric or asymmetric
- Other: nipple retraction, edema, lymphadenopathy, pectoralis muscle or chest wall invasion, skin thickening/invasion
- Kinetic curves

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MRI of the Breast

Evaluates:
- Morphology
- Kinetics/Angiogenesis

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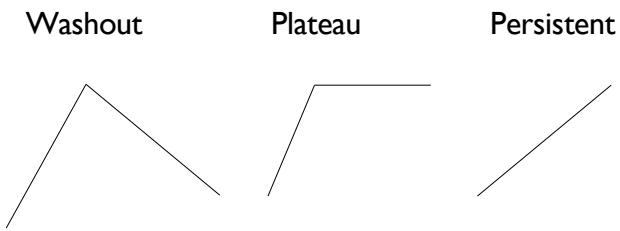
Kinetic Curves



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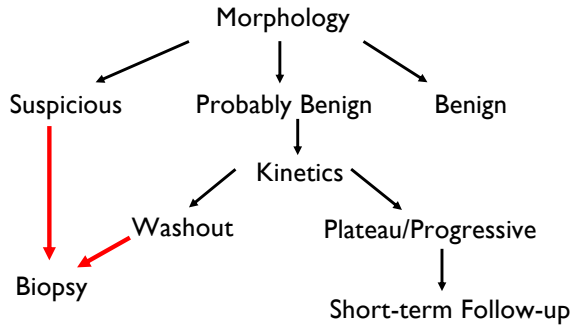
MRI Findings Flow Chart



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Breast MRI

- Correlate with mammogram/ultrasound (US)
- Second look mammogram/US after MRI imaging/finding
- May be able to convert biopsy to US guidance

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MRI Breast Biopsy – the "Why"

- Performed if lesion cannot be identified by other modalities
- 14g core can be done
- Vacuum assisted core is gold standard
- Dedicated coil for biopsy
- Varies from standard bilateral coil used
- Typically, far fewer coils
- Unilateral imaging only

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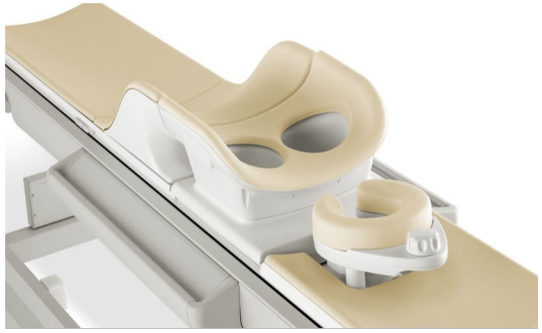
"Our" Standard Coil – 16 Channel



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Courtesy Philips

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"Our" Biopsy Coil – 7 Channel

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Courtesy Philips

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Pitfalls

- Some systems are limited to lateral approach only
- Breast size
- Posterior lesions
- IMF lesions
- High axillary lesions

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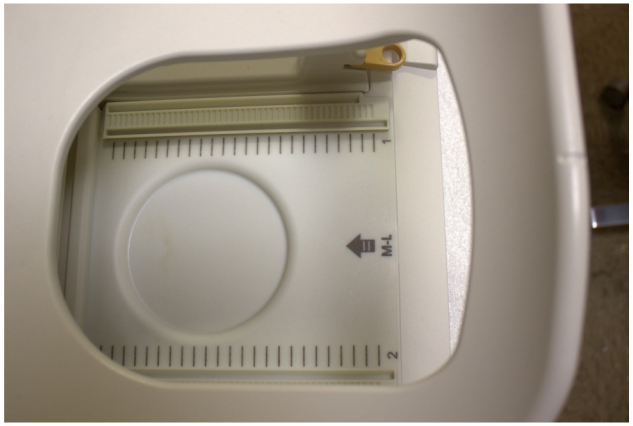

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Patient JMF

- Hx prior Stage IIA IDCA 2005
- Triple neg
- Stage
- BRCA1+
- Treated with BCS, chemo & XRT
- Annual MRI added to surveillance

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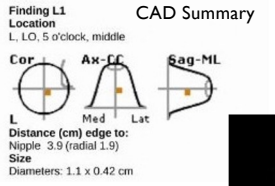
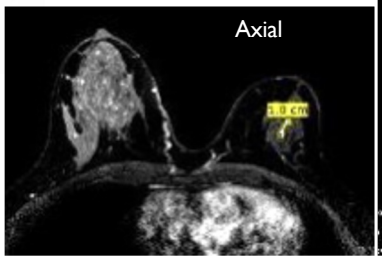
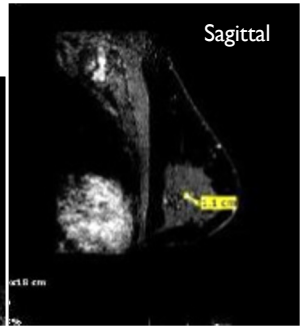
"The Why"



CAD Summary





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MRI Breast Biopsy – The "How"

- Position patient in biopsy cradle
- Skin is cleaned *before* patient is positioned in the biopsy coil
- It will be cleaned a 2nd time, before giving anesthetic

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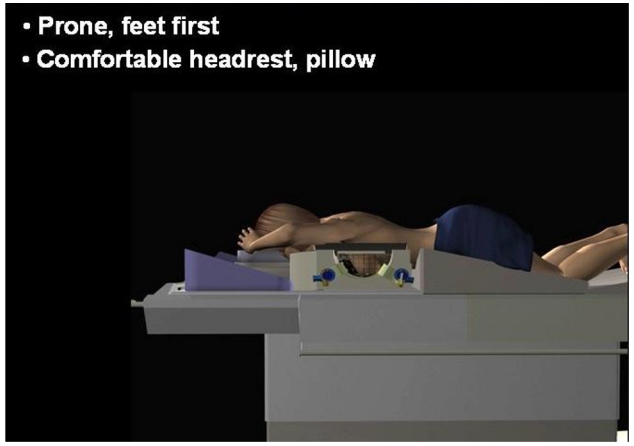

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MRI Breast Biopsy Position

- Breast is supported in the biopsy cradle/coil by 2 plates
- Grid on aspect/side of breast accessed for biopsy stabilizes breast
- Opposite side of breast supported by solid plate

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Grid and Solid Compression Plates

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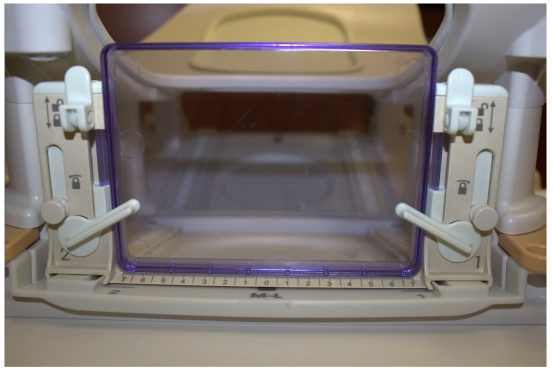
Solid Plate "Unlocked"



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Solid Plate "Locked"

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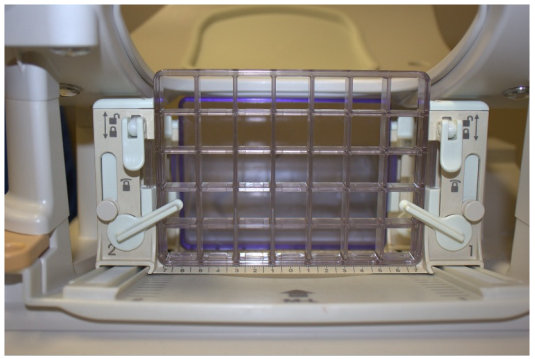
Grid Support Plate "Unlocked"



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Introducer Kit and Tissue Marker "Clip"

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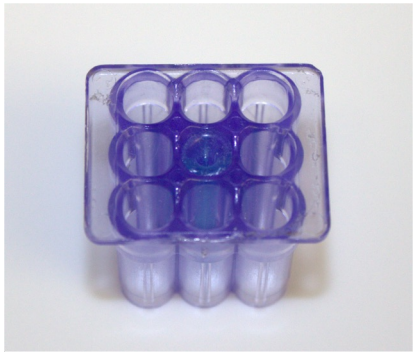
Fiducial



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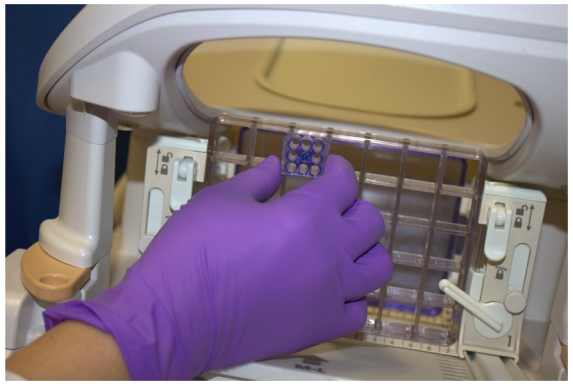
Fiducial Placed in Grid



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MRI Breast Biopsy – The "How"

- Perform "scout" scan for parameters
- Give GAD injection
- Perform dynamic imaging
- "Send" images to CAD program
- Localize skin fiducial & lesion for targeting data, using CAD program

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MRI CAD Program

- Provides lesion identification, analysis and kinetics from screening or work-up study
- Used with biopsy procedures for targeting lesion or ROI to be sampled

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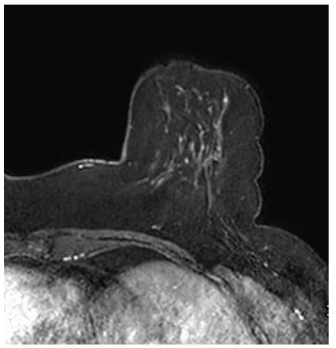
Patient Positioned in BX Coil/Cradle



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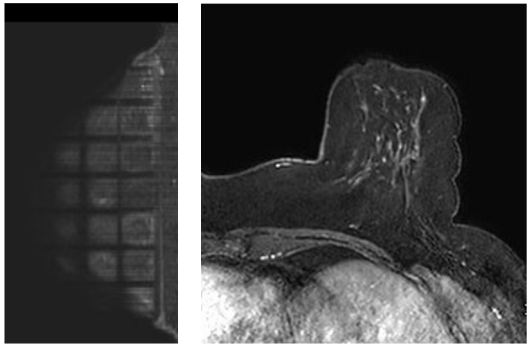
Patient Positioned in BX Coil/Cradle



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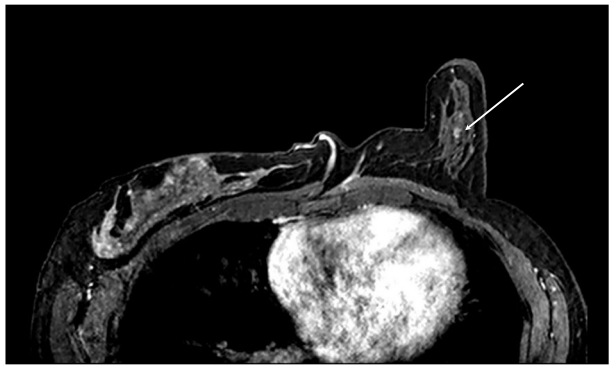
First Post-contrast Image



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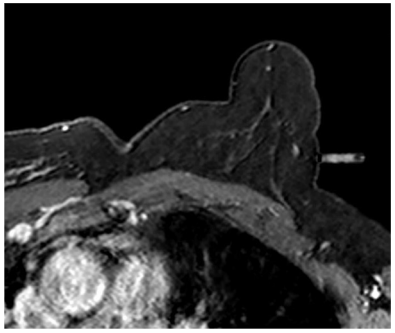
Skin Fiducial



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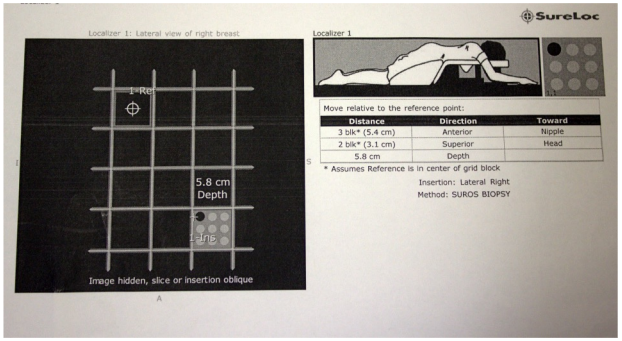
CAD Targeting Data



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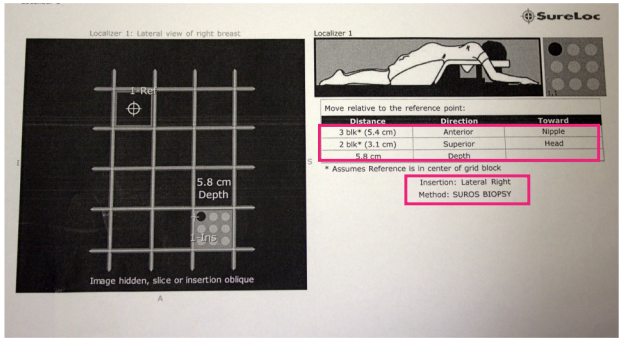
CAD Targeting Data



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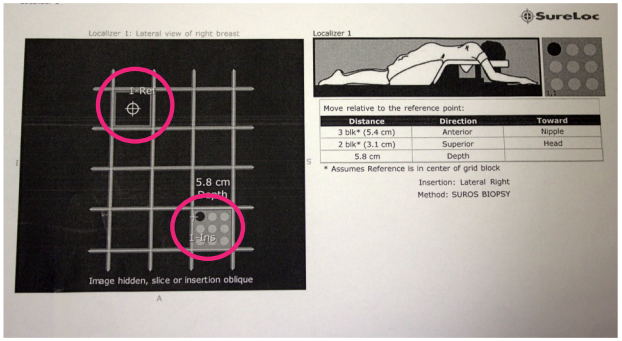

MRI Breast Biopsy – The "How"

- Patient's skin is cleaned again, through the grid section identified by targeting
- Universal time outperformed
- Patient given superficial and deep lidocaine
- Skin nick made with scalpel blade
- Plastic introducer stylet and trocar placed in breast (with depth set on hub)

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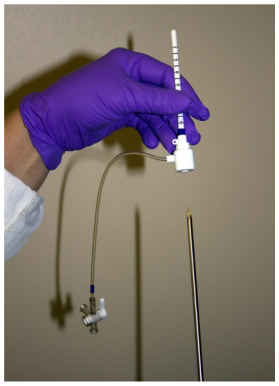
Inserting Trocar Through Introducer



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Depth Set Based on Targeting Data

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Depth Stop Hub on Introducer

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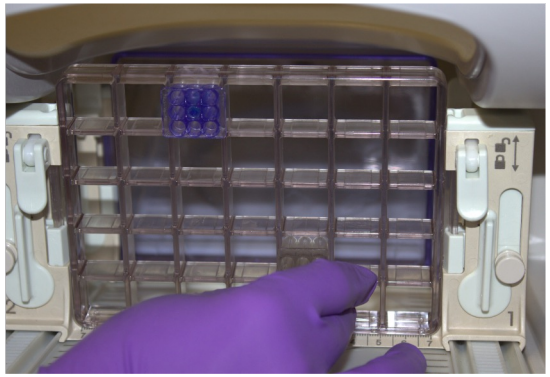
Placement of Needle Guide



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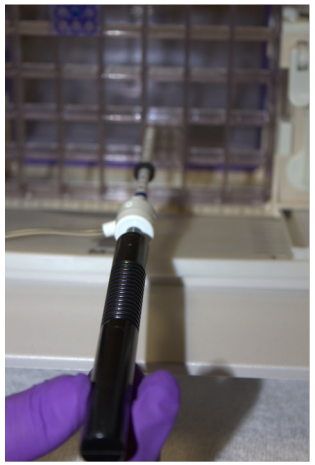

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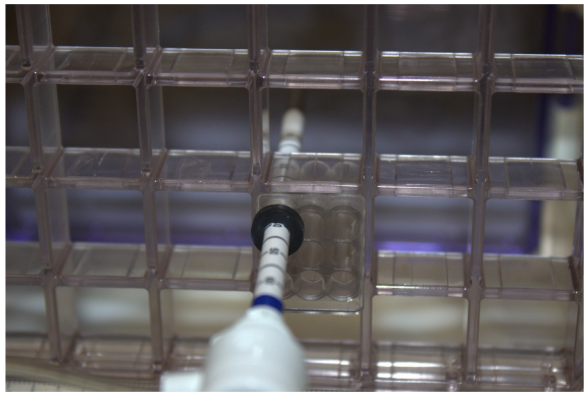
Needle Guide Used to Support Introducer and Trocar



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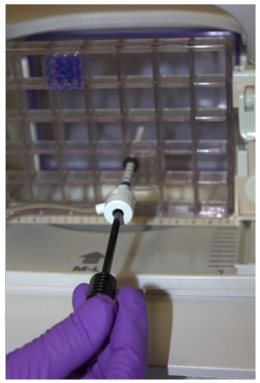
Obturator Placed Through Needle Guide



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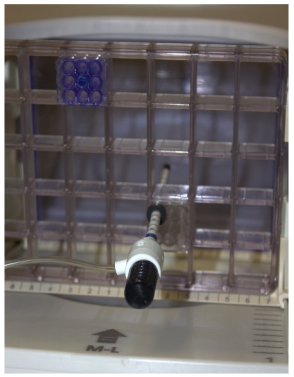
Final Position Flush Against Needle Guide



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MRI Breast Biopsy – The "How"

- Plastic obturator replaces trocar
- Needle confirmation scan done
- To ascertain that needle/obturator tip is at desired location relative to target area
- If accuracy confirmed, proceed with tissue sampling

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Needle Confirmation Scan

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MRI Breast Biopsy – The "How"

- Confirmation scan is reviewed for accuracy and need for any adjustments
- Plastic obturator is removed
- Tissue sampling can begin
- VAC assisted probe inserted through needle guide to targeted lesion

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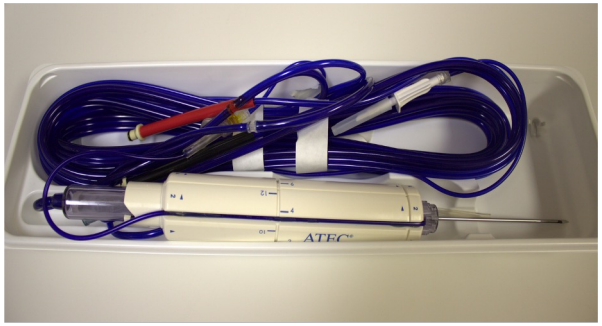
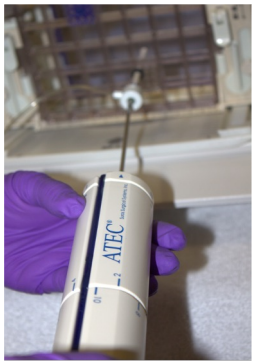
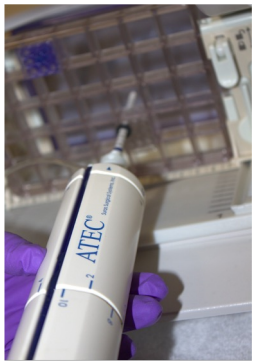
Biopsy Probe



Probe Replaces Obturator

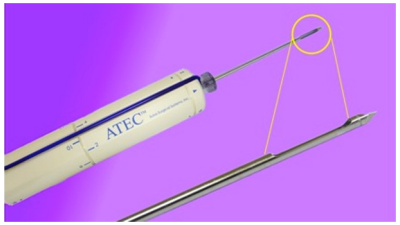




Biopsy Samples Taken

- Probe rotated around clockface
- Quadrant or hemisphere or "clock" identified by relative position of ROI/lesion to probe
- Vacuum assisted sampling
- Lavage after sampling

9 g Vacuum Assisted System



Stays outside of room-
Console NOT MRI compatible

Tissue Samples Retrieved

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MRI Breast Biopsy – The "How"

- Marker clip placement
- Inserted through introducer, similar to stereotactic biopsy
- Post-clip placement scan may be done if desired

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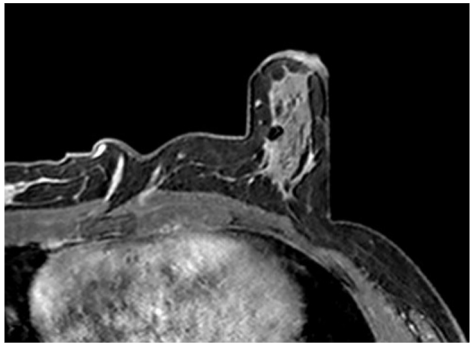
Post-clip Scan



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MRI Breast Biopsy – The "How"

After hemostasis is achieved, wound dressing placed and post-biopsy mammogram done for clip placement evaluation.

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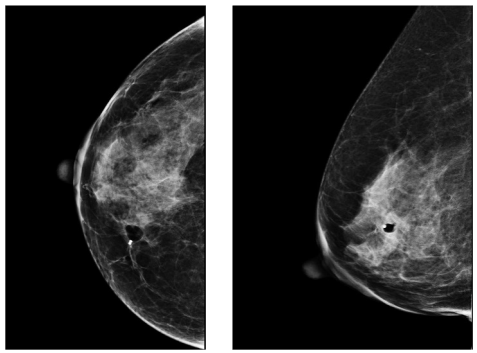
Post-biopsy Mammogram



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Pathology Results

- DCIS intermediate grade
- Concordant with Imaging findings
- Patient elected bilateral mastectomy
- SLNB negative
- Patient went on to 2-stage reconstruction

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MRI Breast Biopsy – The "How"

- Position patient (after cleaning skin)
- Perform "scout" scan for imaging parameters
- Give GAD injection
- Perform dynamic imaging
- Localize skin fiducial and lesion for targeting data with CAD program
- Clean skin a second time
- Universal time-out pause

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MRI Breast Biopsy – The "How"

- Administer superficial & deep lido
- Make skin nick
- Insert needle guide into grid
- Insert introducer and advance trocar to target
- Replace trocar with obturator
- Perform needle confirmation scan

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MRI Breast Biopsy – The "How"

- Remove obturator and perform tissue sampling
- Place marker clip
- Do post biopsy mammogram
- Follow-up as directed by pathology results

Summary

- MRI is an important tool for the detection of breast cancer and assessment of silicone implant integrity
- Images are analyzed for morphology and initial/delayed contrast enhancement
- Sensitivity is high, but specificity is lower
- Provides biopsy guidance for MRI-only imaging findings

References

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