МРТ МОЛОЧНЫХ ЖЕЛЕЗ: ИНТЕРПРЕТАЦИЯ И БИОПСИЯ

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BREAST MRI INTERPRETATION AND BIOPSY: A SHORT COURSE

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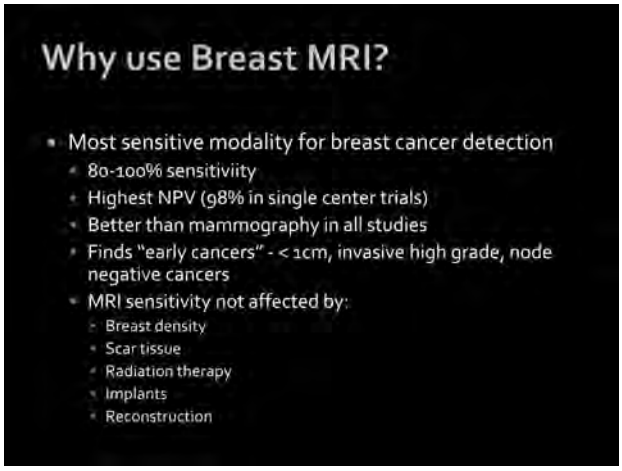
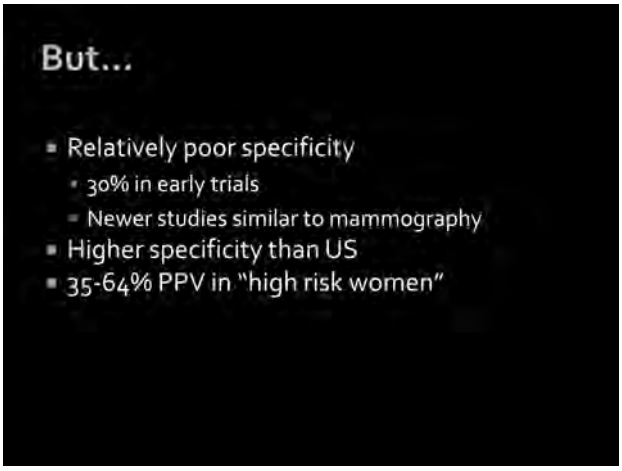
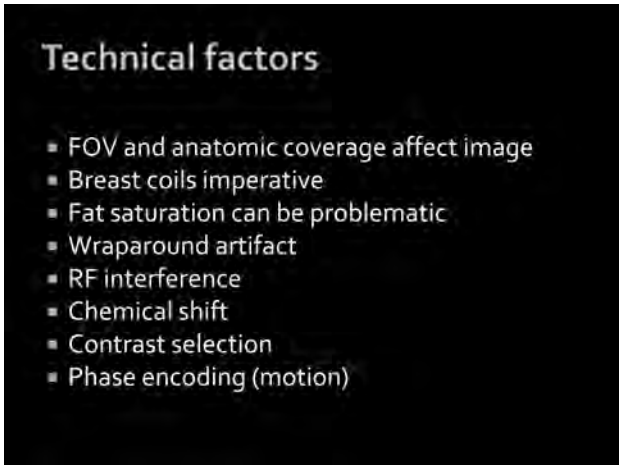
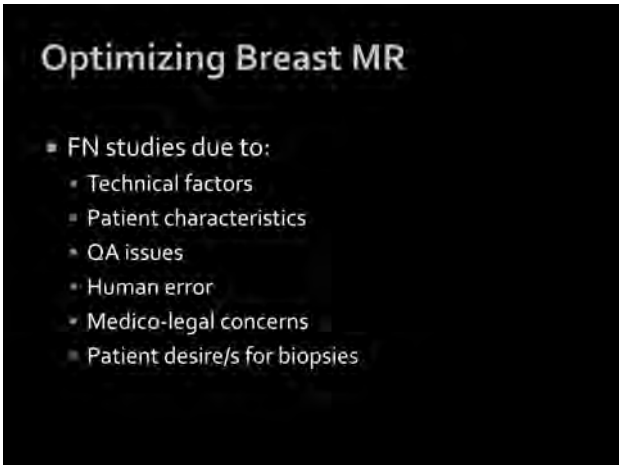
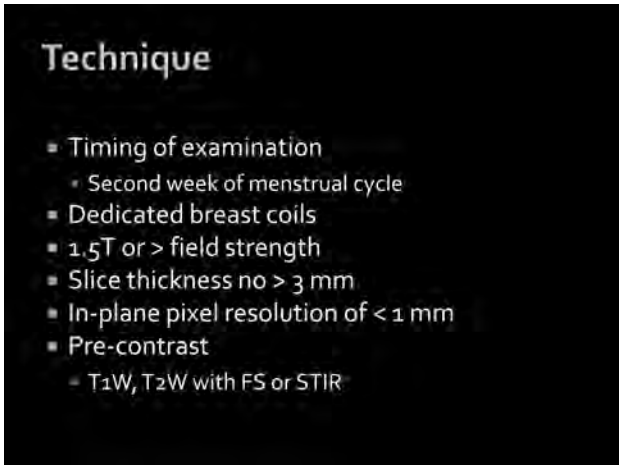
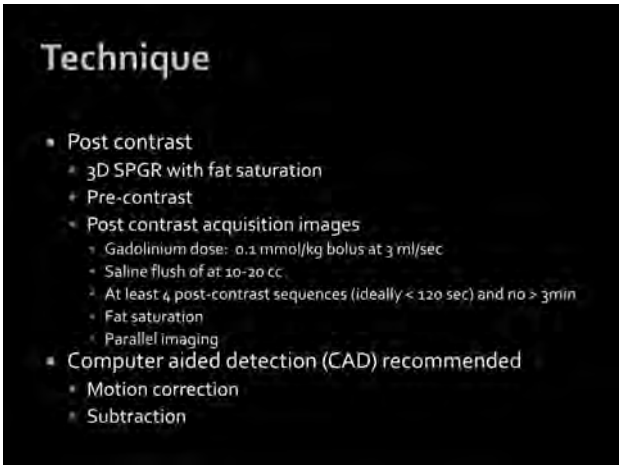












Preparation for interpretation

- Comparison mammograms within 6 months of MRI examination
- All other ancillary breast imaging studies
  - Prior Breast MRI study, Breast ultrasound, etc.
- Pertinent history
  - History sheet to be filled out by site
  - "Breast cancer" doesn't cut it

My interpretation sequence

- Is the exam OK?
  - Is there contrast? Enough "passes?"
- T1-weighted
- T2-weighted or STIR
- Pre-contrast
- Post-contrast
- Key factors:
  - Morphology
  - Kinetics
- CAD

Assessment - 1

- What is background parenchymal enhancement (BPE)?
  - None, minimal, mild, moderate, marked
- Is there focal enhancement?
  - Discrete and stands out? Is there a lesion?
- What is the lesion type?
  - Focus/foci, mass, non-mass-like enhancement (NMLE)

Assessment - 2

- What is the lesion/s morphology?
  - Mass – shape, margin, internal enhancement
  - NMLE – distribution, internal enhancement, symmetry
- Kinetic curve??
  - Early: slow, medium, rapid
  - Delayed: persistent, plateau, washout

Assessment - 3

- Associated findings?
- BIRADS Assessment and Recommendation?

T1-weighted sequence

- Lymph nodes
  - Fatty hilum
- "Bright" lesions before contrast administration
  - Proteinaceous material in cyst or ducts

T1 W example

- Lymph node
- Proteinaceous cyst

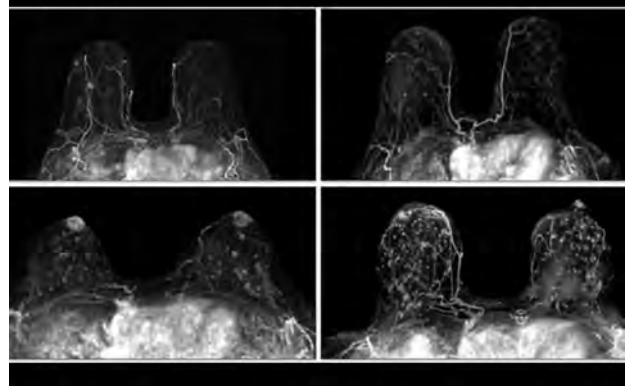
STIR (or equivalent) sequence

- Bright lesions
  - Cysts
- High SI lesions without enhancement
  - Proteinaceous material
- High SI lesions with enhancement
  - Fibroadenoma
  - Lymph nodes

Background parenchymal enhancement (BPE)

- None
- Minimal
- Mild
- Moderate
- Marked

BPE



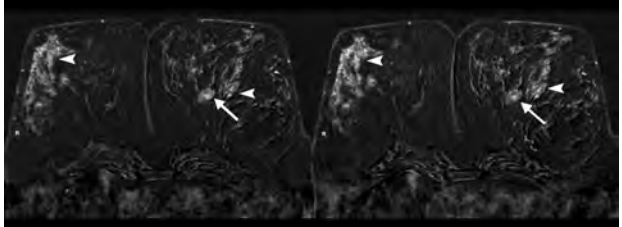
General concepts

- Morphology on early image acquisition
- Morphology trumps kinetics
- Morphology mimics findings on traditional mammographic imaging

Morphology

Best seen on the early enhancement images

Morphology

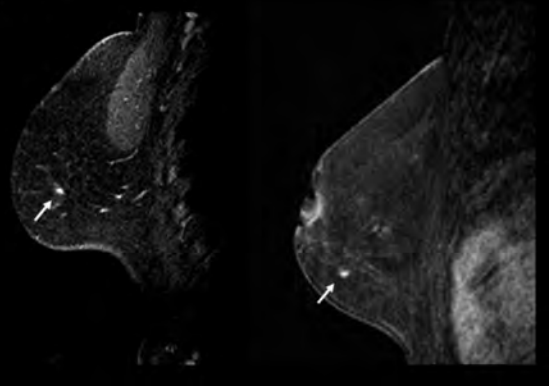


Lesion less identifiable as BPE increases

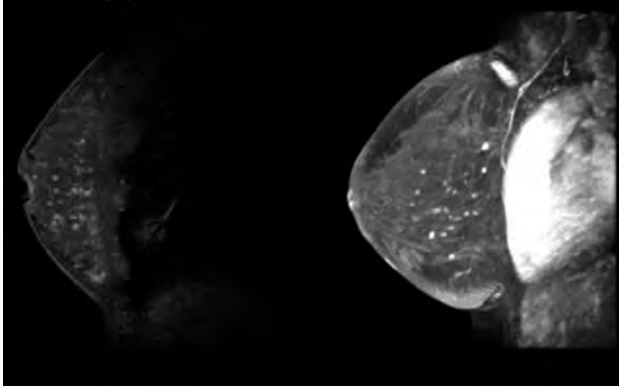
Lesion Characterization MR BI-RADS Lexicon

- Focus
  - Enhancing area < 5 mm
  - No further characterization
  - "Size does matter!"
    - Lieberman AJR 2006
    - 666 consecutive "foci"
    - Only 1/37 foci (3%) malignancy
  - Does not mean that focus is benign!
  - Multiple enhancing foci = "stippled"

Foci



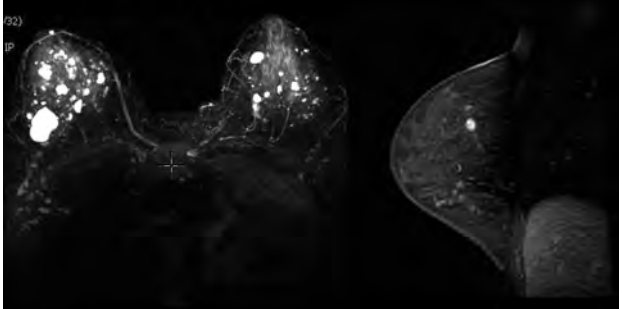
"Stippled"



Lesion Characterization MR BI-RADS Lexicon

- Mass
  - Space-occupying lesion
  - Three dimensional
  - Usually a visible correlate on pre-contrast T1W and T2W images
  - Comparable to use of term in mammography
- Shape (Round, Oval, Lobulated, Irregular)
- Margin (Smooth, Irregular, Spiculated)

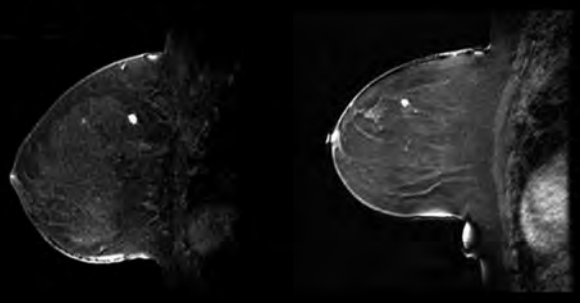
Round masses



Multiple simple cysts

Circumscribed carcinoma

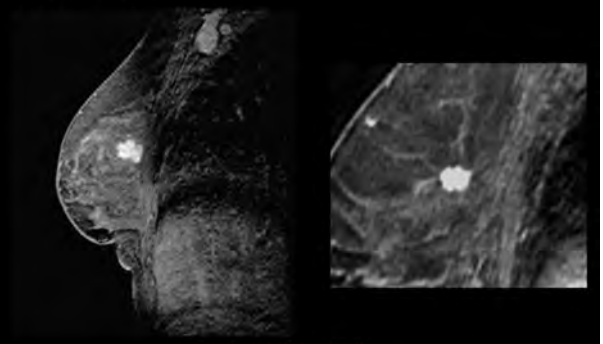
Oval masses



Lymph node

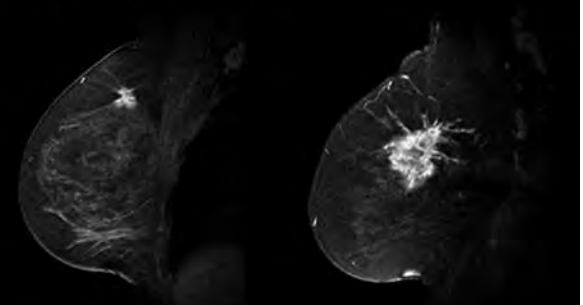
Smooth carcinoma

Lobular mass



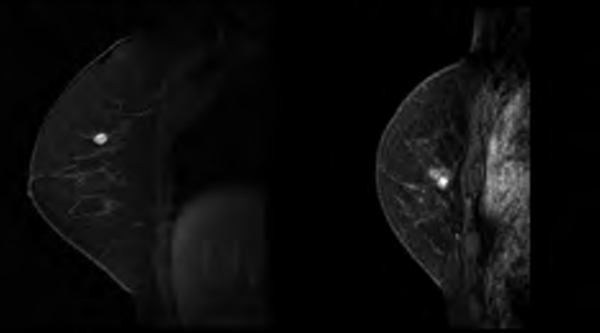
Two circumscribed cancers

Irregular masses



Invasive duct carcinomas

Looks can be deceiving



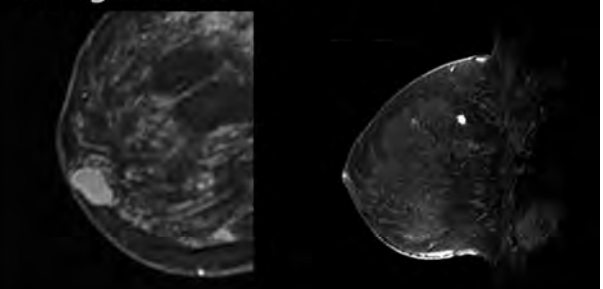
Fibroadenoma

Also a fibroadenoma

Lesion Characterization MR BI-RADS Lexicon

- Internal enhancement descriptors
  - Homogeneous (confluent and uniform)
    - Often benign disease
  - Heterogeneous (non-uniform with areas of variable signal intensity
    - Suggestive of cancer

Homogeneous enhancement Benign lesion



Fibroadenoma

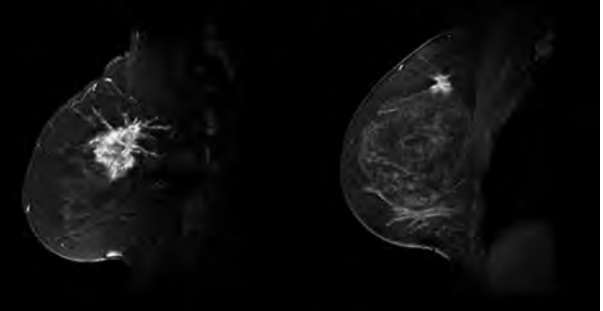
Lymph node

Homogeneous enhancement Malignant lesion

Invasive cancer

Smooth rounded carcinoma

Heterogeneous enhancement

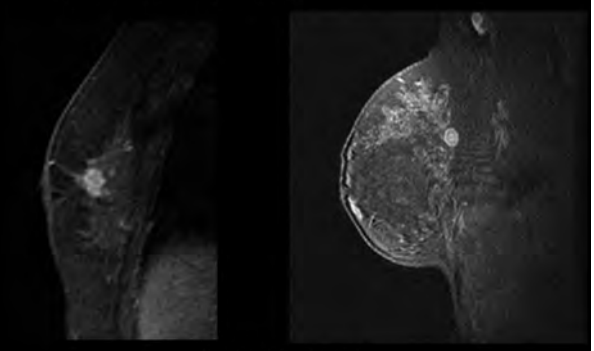


Invasive duct carcinomas

Lesion Characterization MR BI-RADS Lexicon

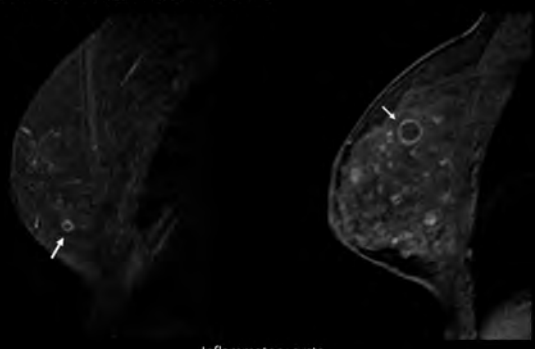
- Rim enhancement
  - Most commonly is malignancy
  - Differential Dx:
    - Carcinoma
    - Inflammatory cyst
    - Fat necrosis
- Dark internal septations
  - Dark non-enhancing lines within mass
  - > 95% benign (often FA)
- Enhancing internal septations
- Central enhancement

Rim enhancement



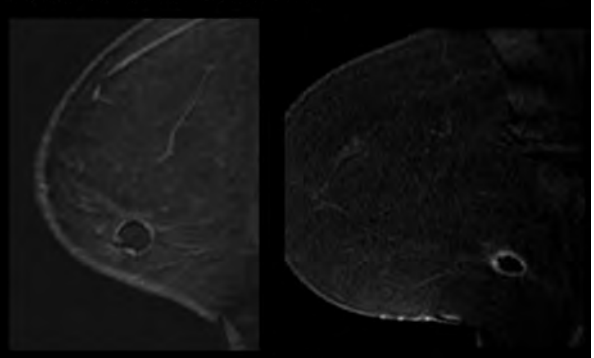
Invasive duct carcinoma

Rim enhancement



Inflammatory cysts

Rim enhancement

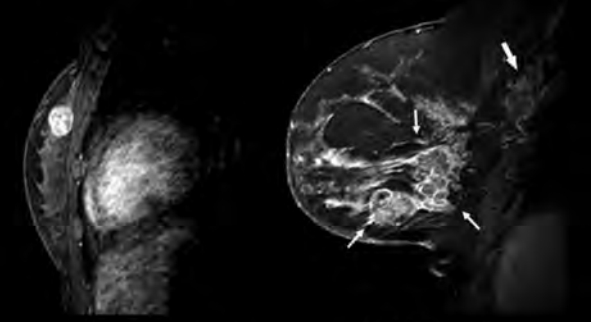


Fat necrosis

Dark non-enhancing septations

Fibroadenoma

Enhancing internal septations

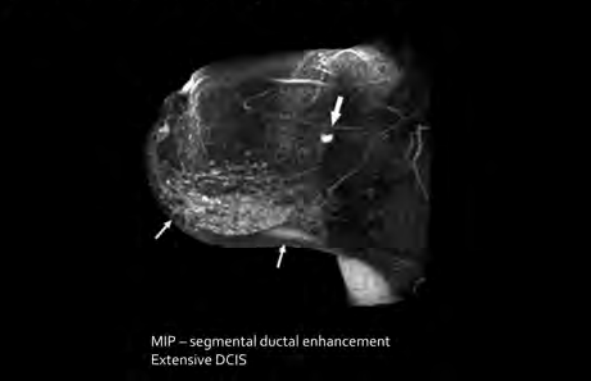


Invasive duct carcinoma IDC with axillary mets

Central enhancement

Invasive duct carcinoma

Enhancement patterns



MIP – segmental ductal enhancement
Extensive DCIS

Non-mass enhancement

- Enhancement of an area, not a mass
- No space occupying effect
- Small or large volume
- Internal enhancement results in pattern discrete from normal parenchyma
- Has interspersed spots of normal glandular tissue or fat between enhancing areas
- Enhancement in area which is normal on pre-contrast images
- No correlate on FS or non-FS T2W images

Non-mass enhancement

- Distribution
  - Focal (< 25% of quadrant, confined area with interspersed fat and/or glandular tissue
  - Linear (in a line and not a duct)
  - Ductal (linear pointing toward nipple)
  - Clumped (aggregate of enhancing massesor foci-confluent in cobblestone pattern)
  - Segmental (triangular region or cone-apex toward nipple)
  - Regional (geographic > 25% of quadrant-not conforming to ductal distribution)
  - Multiple regions
  - Diffuse

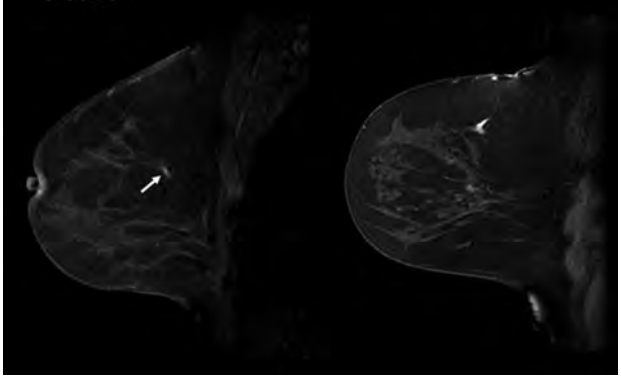
Lesion Characterization MR BI-RADS Lexicon

- Internal enhancement pattern
  - Homogeneous
  - Heterogeneous
  - Stippled/punctate
  - Clumped
  - Reticular/dendritic

Non-mass enhancement

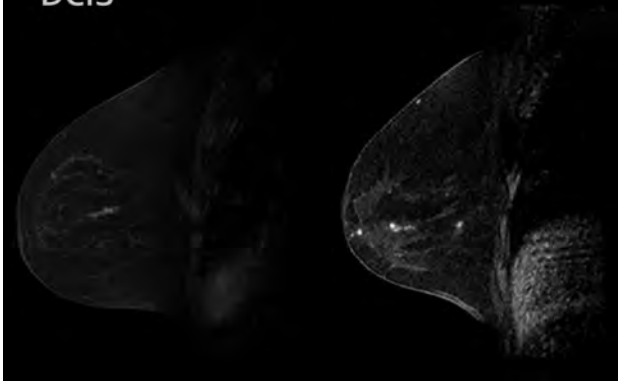
- Symmetric (both breasts) or Asymmetric
- Differential diagnosis overall
  - DCIS
  - Diffuse lobular cancer
  - Mastopathic changes (focal adenosis)
  - Hormonal stimulation
  - Inflammatory changes

Linear non-mass enhancement Scars

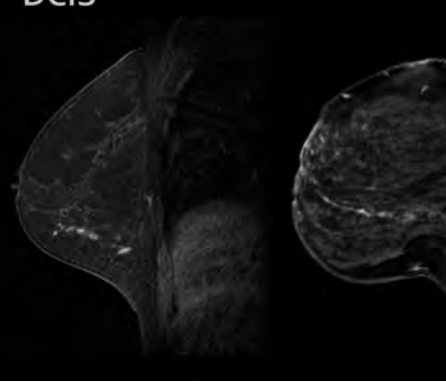


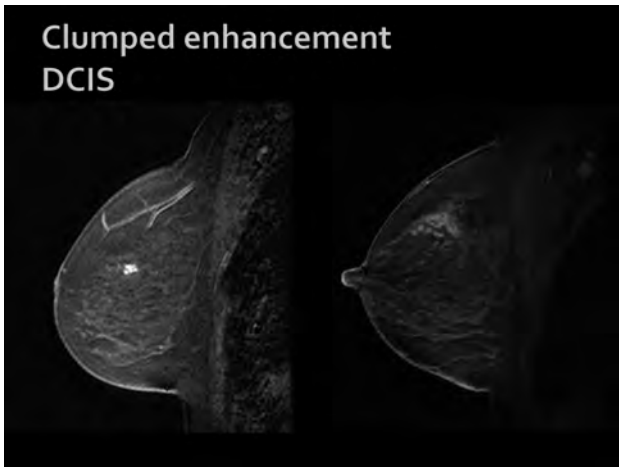
Linear non-mass enhancement DCIS

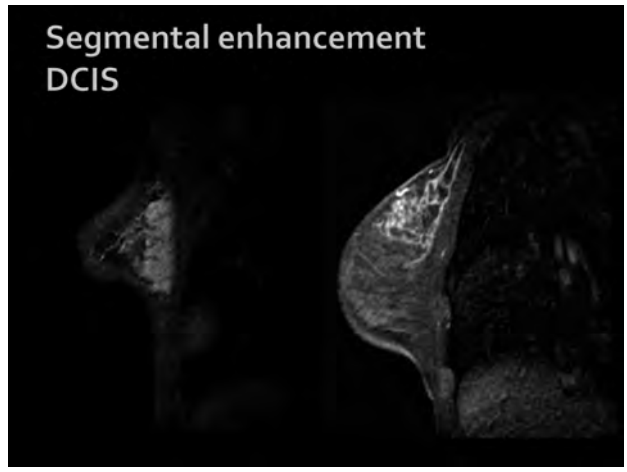
Linear non-mass enhancement DCIS

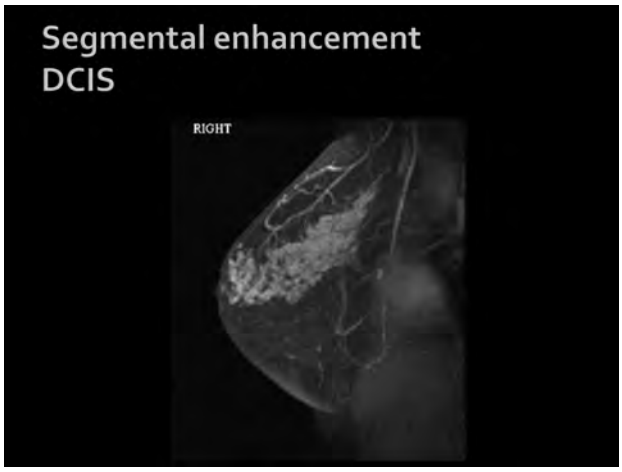


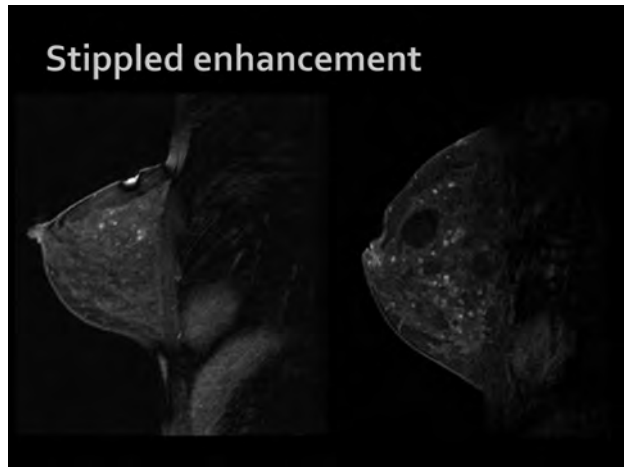
Ductal enhancement DCIS

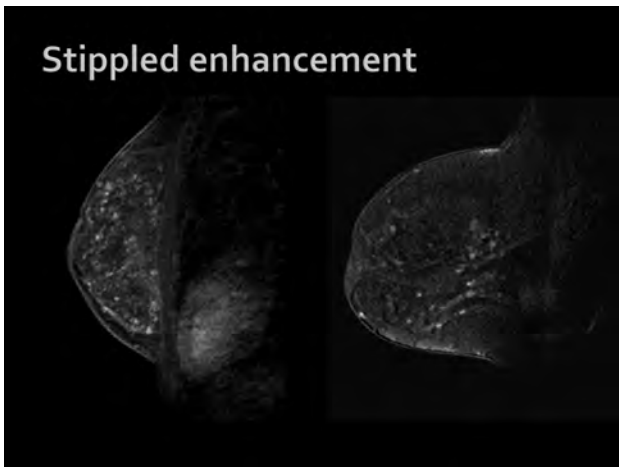


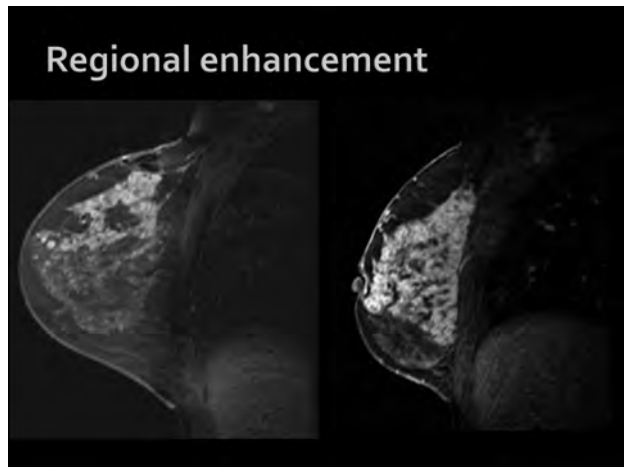

Clumped enhancement
DCIS

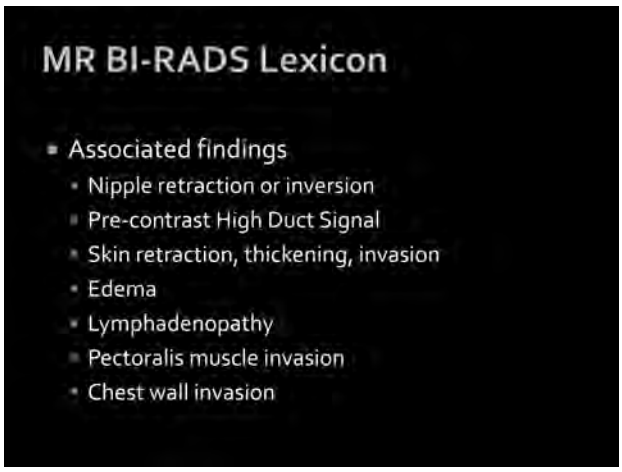

Segmental enhancement
DCIS

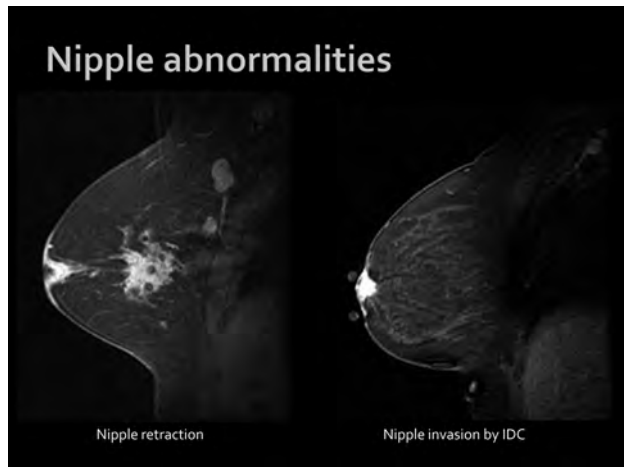

Segmental enhancement
DCIS
RIGHT


Stippled enhancement

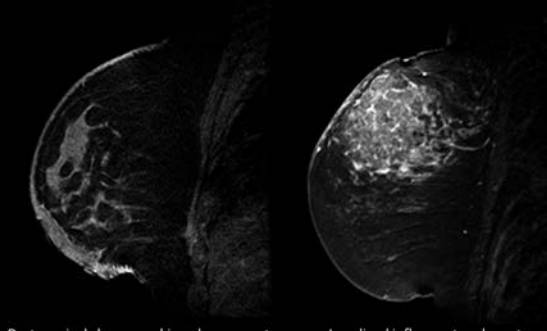

Stippled enhancement


Regional enhancement


MR BI-RADS Lexicon
Associated findings
Nipple retraction or inversion
Pre-contrast High Duct Signal
Skin retraction, thickening, invasion
Edema
Lymphadenopathy
Pectoralis muscle invasion
Chest wall invasion


Nipple abnormalities
Nipple retraction
Nipple invasion by IDC

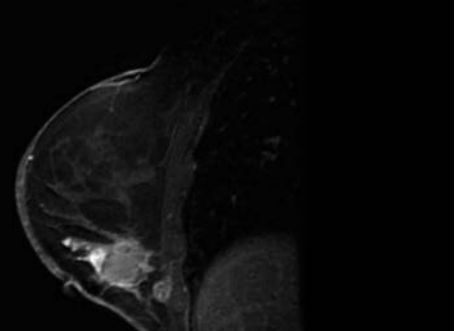
Skin abnormalities



Post surgical changes –skin enhancement

Localized inflammatory breast ca

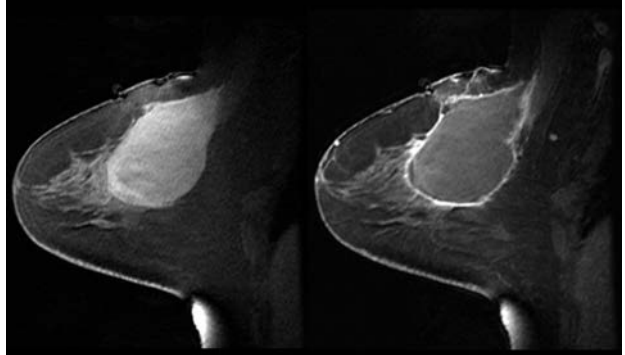
Chest wall invasion



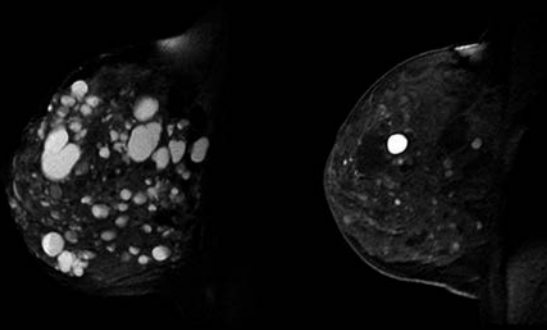
MR BI-RADS Lexicon

- Associated findings
  - Hematoma/Blood
  - Abnormal Signal Void
  - Cyst
- Location
  - Right or left
  - Quadrant, subareolar, central axillary tail
- Depth
  - Distance from nipple, skin or chest wall (in cm)

Post-operative hematoma



Cysts



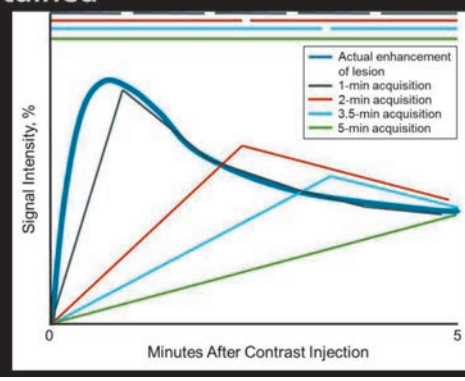
Value of T2-weighted images

- Always correlate lesion on post-contrast with T2W images
- Lesion of high SI on T2W images more likely to be benign
- High SI on T2W lesions:
  - Simple or proteinaceous cysts
  - Lymph nodes
  - FA (myxomatous)
- Sometimes mucinous or necrotic carcinomas may be high SI on T2W images

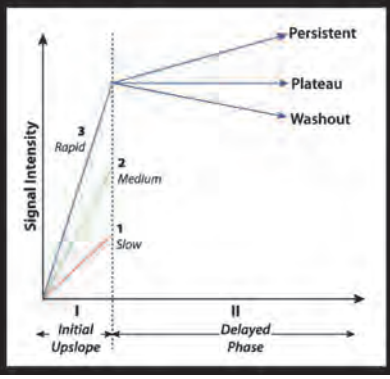
MR BI-RADS Lexicon

- Kinetics
  - Signal intensity Time Curve Description
    - Initial phase
      - Slow, medium or rapid
    - Delayed phase
      - Persistant, plateau or washout

Importance of when acquisition obtained



Kinetic curves



Finding at MRI Directed US/Mammo evaluation

- MRI-Initiated
  - Second look US/Mammo
  - Can biopsy ~ 50% under US
- Lesion may be difficult to correlate
  - MRI performed prone
  - US done supine
  - Mammogram performed upright
- To correlate:
  - Lesion must be of identical size, morphology and position to be sure!
- If ANY doubt, perform MR-guided biopsy

Interventional MRI Significance of US correlate

- Second look sono fails to show correlate in 77% of patients
- US correlate found in 23% (21/93)
  - With correlate = 43% + for cancer
  - Without correlate = 14% + for cancer
- Need to biopsy whether correlate found or not

LaTrenta, RADIOL 2003; 227: 856-61

US correlation

- 111 consecutive women with known/suspected invasive cancer
- MR suspicious finding in 25 women
  - 40% malignant
  - 17/25 (68%) idenfied on "second look" US
  - Two lesions seen on mammography "retrospectively"

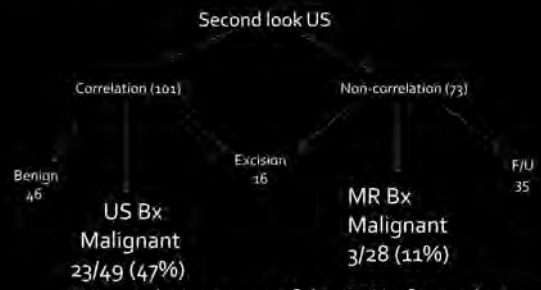
Berg, et al. Radiology 2004; 233: 830-849

Second look US for MR-detected lesions **

- 174 enhancing lesions first detected on MRI
  - 134 consecutive cases
  - Mean age 49.2 yo
  - Two year period
- Findings:
  - 137 masses mean size of 10.2mm
  - 32 foci < 5mm
  - 5 non-mass mean size of 20.6mm

**Abe, Schmidt, Sennett, Newstead RSNA presentation 2005

Results



US correlation successful in 60% of mass lesions
Non-mass lesions not well correlated

MRI Guided Biopsy Equipment

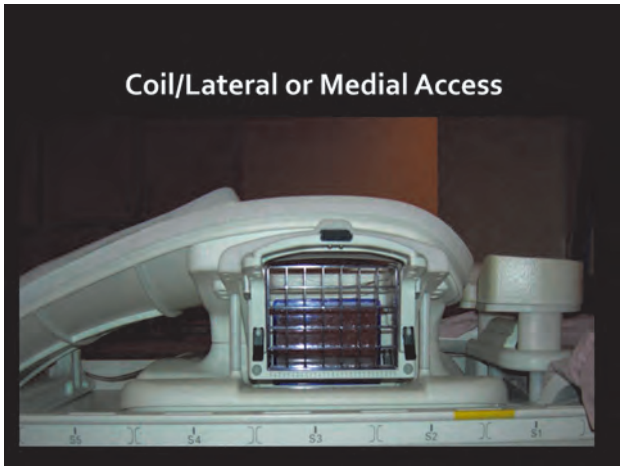
- Tray
- Biopsy devise
- Flashlight
- Trained staff

Equipment

- Introducer stylet
- Introducer sheath
- Needle guide
- Localiz

MRI Vacuum Biopsy Device

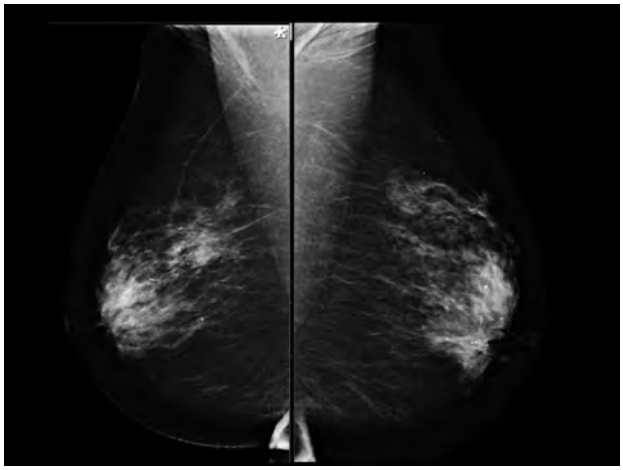
- 9 Gauge vacuum-assisted biopsy device by Suros Surgical Systems
- Fast - Takes a tissue sample every 4.5 seconds
- Do not need to fire a gun
- All disposable hand-pieces w/ MRI safe materials
- Underestimation

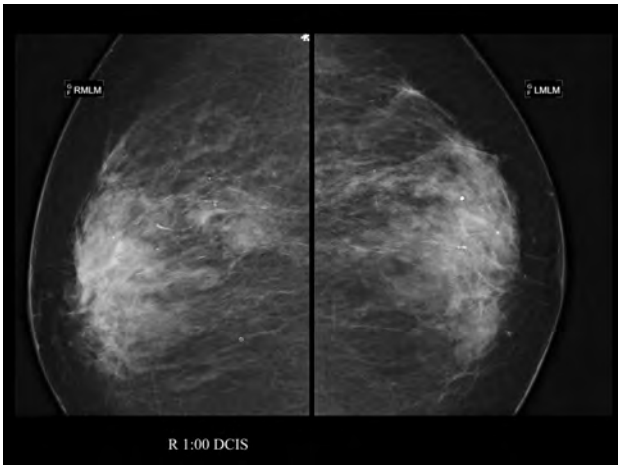


Case:

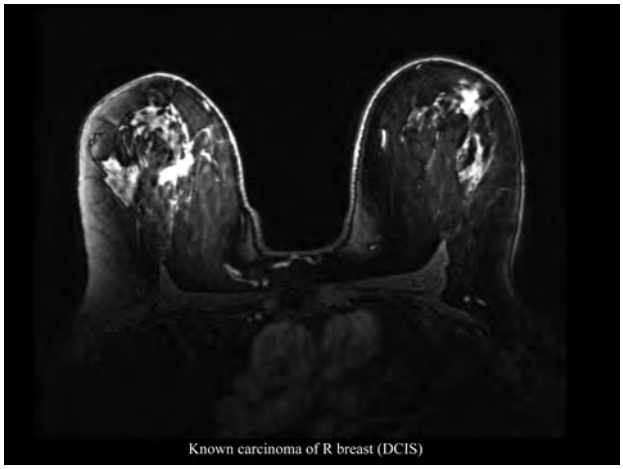
84 year old patient presents for MRI extent of disease for newly diagnosed Right DCIS

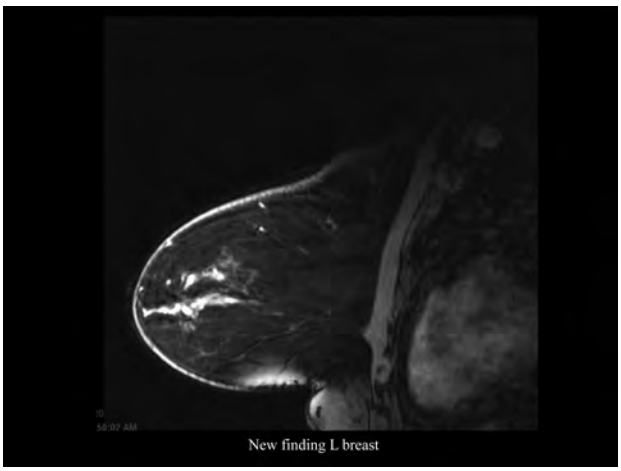
- Right breast-6.6 cm linear enhancement of known DCIS
- Left breast-2 cm UIQ linear enhancement with a suspicious kinetic curve-MRI guided biopsy recommended





R 1:00 DCIS

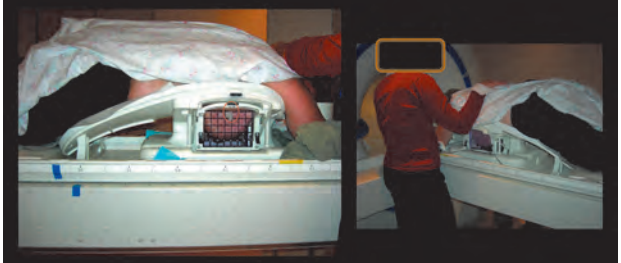

Known carcinoma of R breast (DCIS)


New finding L breast

MRI Guided Biopsy

- Patient prone with affected breast in dedicated biopsy compression device
- Compress breast in coil with enough compression to "extrude" or "pooch" tissue through grid – don't do too tight or will impede contrast flow and uptake
- Place a fiducial marker (VIT. E) either over expected lesion site or just adjacent to it

MRI Biopsy Positioning



After Axial Localizing Sequence

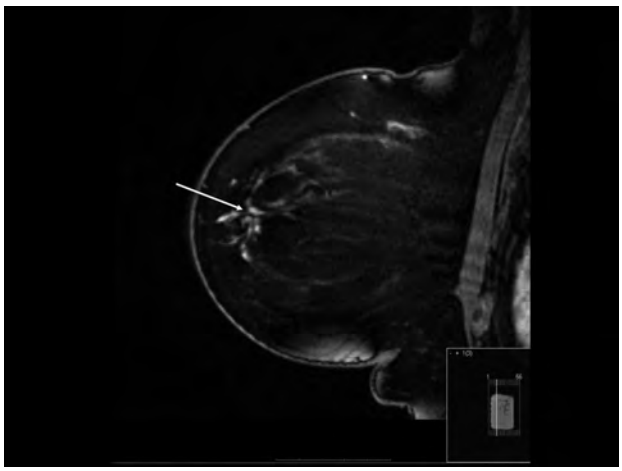
- Image patient with pre-contrast sagittal images to include the lateral grid

MRI Guided Biopsy

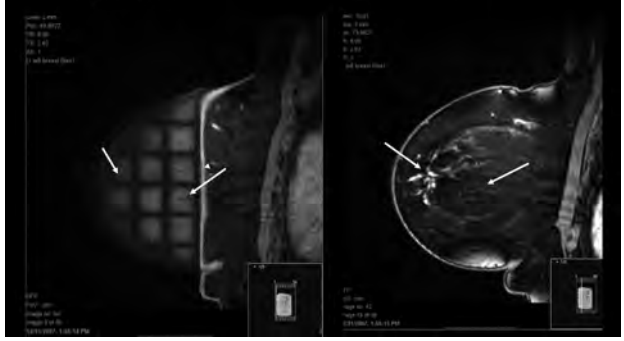
- Remove patient from bore of magnet
- Inject contrast (Gadolinium) 0.1 mmol/L per Kg of body weight rapidly through an indwelling IV catheter
- Acquire sagittal images immediately post contrast injection

Post-contrast enhancement

1.Scroll through case to find fiducial marker/grid/skin (record Slice #)
2. Find enhancing lesion (record slice #)
3. Subtract the two and this calculation is your depth

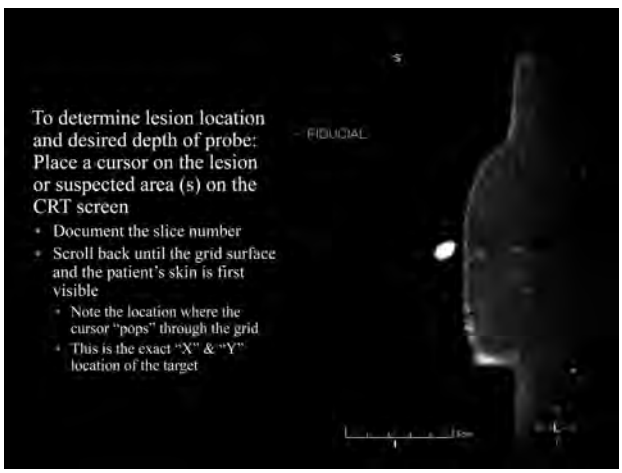


Use fiducial marker and enhancing lesion for location
Use slice numbers of skin and enhancing lesion to get depth

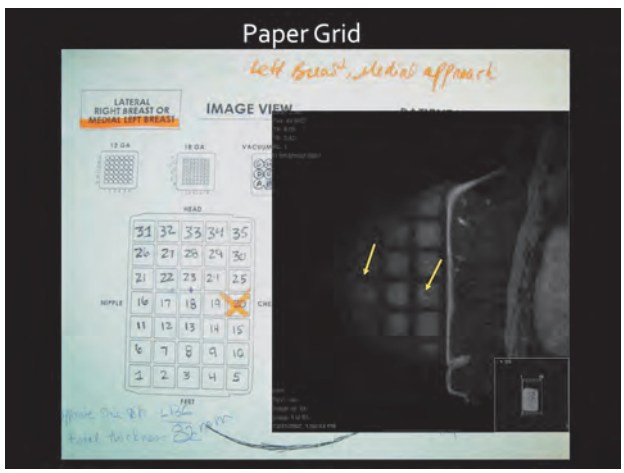


To determine lesion location and desired depth of probe:
Place a cursor on the lesion or suspected area (s) on the CRT screen

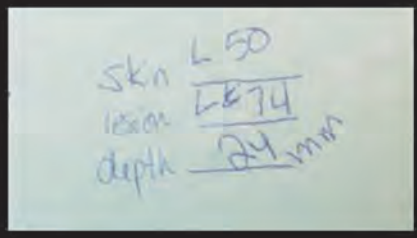
- Document the slice number
- Scroll back until the grid surface and the patient's skin is first visible
  - Note the location where the cursor "pops" through the grid
  - This is the exact "X" & "Y" location of the target

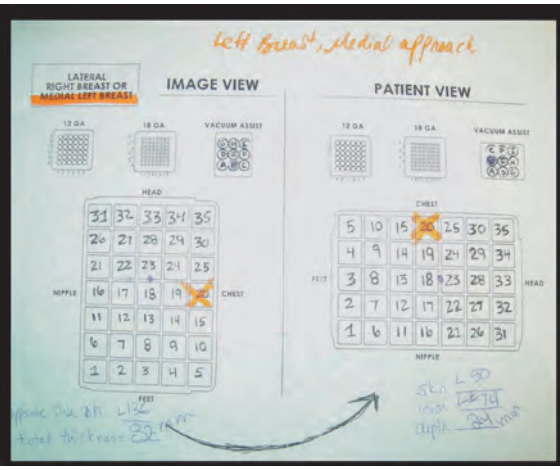


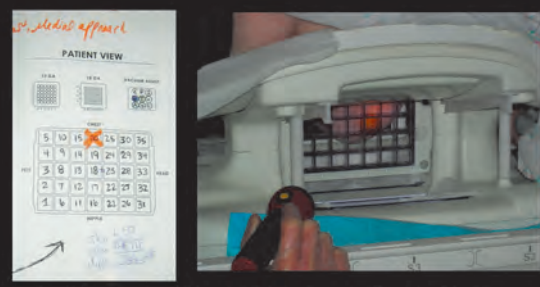
Paper Grid



- Document this slice number
- Subtract the two slice numbers from each other







- Mark the cursor position on the paper chart grid in relation to the fiducial
- Bring the patient out of the magnet bore and prepare for biopsy
- Prepare the breast with betadine by cleansing the skin in the desired grid block that the target area will be accessed

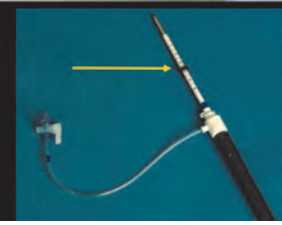
Anesthetize the patient's skin

Generally using Lidocaine without Epinephrine for skin wheel

Lidocaine with diluted epinephrine to and beyond the target lesion

Insert the needle guide into the compression grid at the target area in the appropriate "cube" Insert the needle guide into the compression grid at the target area in the appropriate "cube"

Use the black rubber "depth stop" to mark the depth of the lesion on the Introducer sheath at the pre-determined "Z" axis value



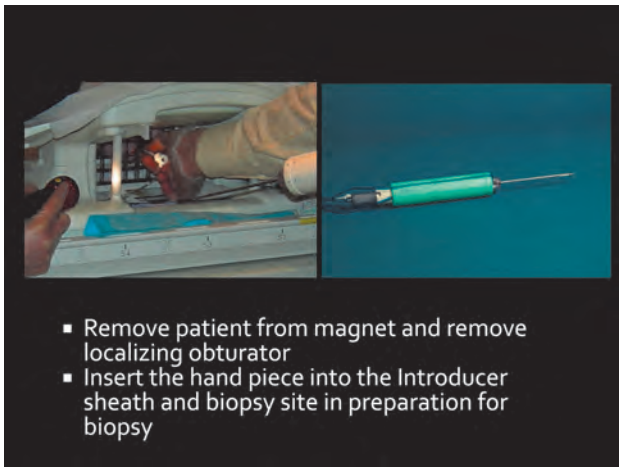
- Insert Introducer stylet into the Introducer sheath
  - Hub the two together
- The sharp stylet eliminates the need for a scalpel in the MRI suite
- Insert the Introducer sheath with the Introducer stylet in a rotating fashion to the depth stop
- Remove the stylet from the Introducer sheath while leaving the sheath in place
- Insert the Localizing Obturator into the sheath
- Move the patient back into the magnet and image to confirm target accuracy

Obturator artifact:

Sagittal: ~3mm round black dot

Axial: Long black line

Use as guide to assure accuracy of localization of target



- Remove patient from magnet and remove localizing obturator
- Insert the hand piece into the Introducer sheath and biopsy site in preparation for biopsy

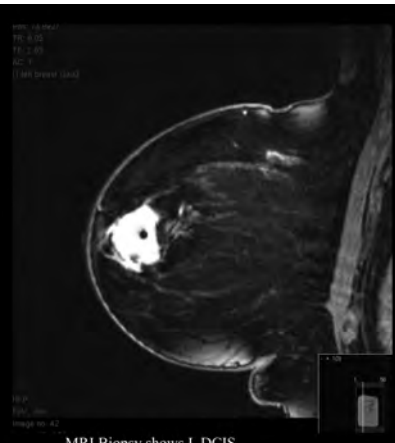
Only bring foot pedal into magnet room!

- Press foot on pedal and samples are taken one every 4.5 seconds
- If patient is uncomfortable, hook-up lidocaine syringe to the Schroeder "Y" valve

MRI Biopsy

Lavage before retrieving specimens

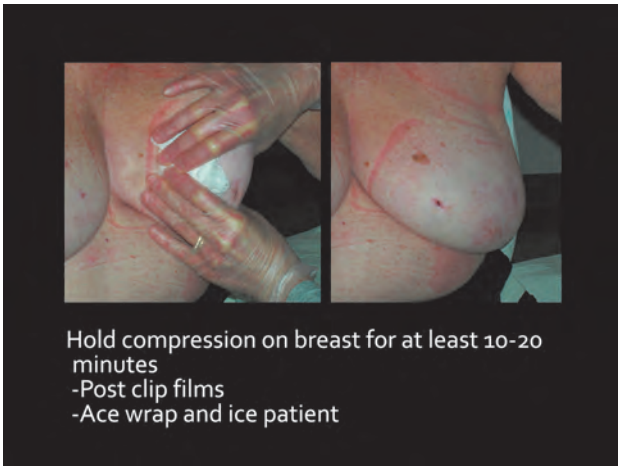
- Once the samples have been taken, remove the hand-piece
- Leave introducer sheath in place
- Re-insert the localizing obturator
- Re-image the patient with sagittal T1W images to confirm acquisition of the suspected target area

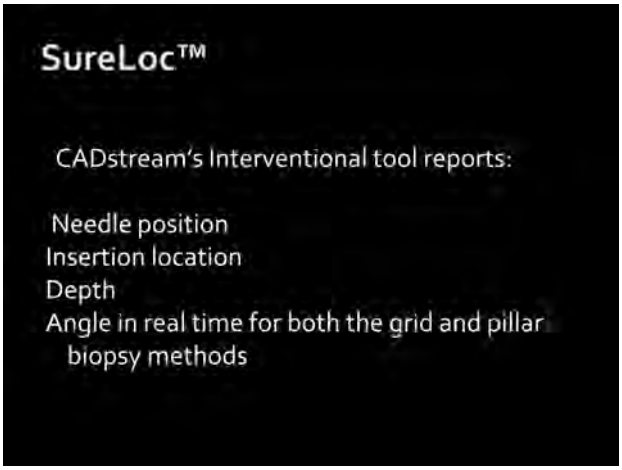


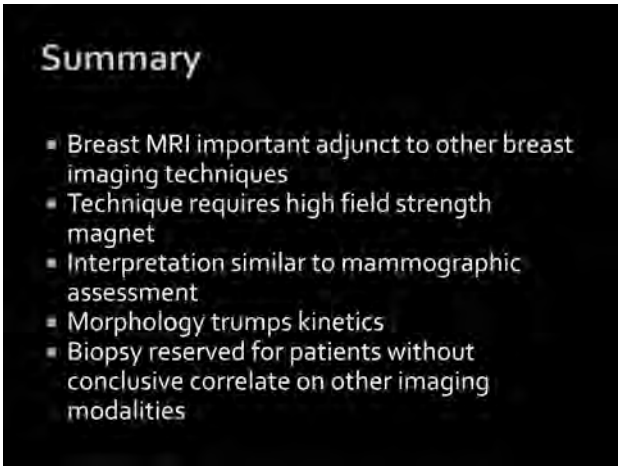
MRI Biopsy shows L DCIS

- The technologist will collect the specimens and put them in formalin

- Remove patient from MRI bore
- Place a biopsy site marker in the target cavity area to later identify the biopsy site
- Re-image patient with all introducers out of the breast with T1W images to visualize clip
  - Clip will give ~6mm of artifacts







Профессор Трофимова, огромное спасибо за Ваше гостеприимство и участие в нашей встрече в Санкт-Петербурге. Мы наслаждались мероприятием и очень много почерпнули благодаря Вашим идеям и доброй воле.

Мы с нетерпением ждем встречи с Вами снова на будущих совещаниях, например RSNA!

Спасибо, с наилучшими пожеланиями на будущее!

Томми Поп