How To Interpret Breast MRI

Kathryn Zamora, MD, MPH
University of Alabama Birmingham

Rebecca Leddy, MD
Medical University of South Carolina

Indications for MRI

- Screening
  - High-risk
  - Intermediate risk (may be considered)
  - Occult contralateral breast malignancy in the setting of newly diagnosed breast cancer (3-5%)
  - Breast augmentation
- Extent of Disease
  - Multifocality and multicentricity
  - Invasion of deep fascia
  - Lumpectomy with positive margins
  - Neoadjuvant therapy
- Additional evaluation of clinical or imaging findings
  - Recurrence of breast cancer
    - Including patients with reconstruction
  - Metastasis of Unknown primary
  - Lesions characterization

Organized and Systematic Approach

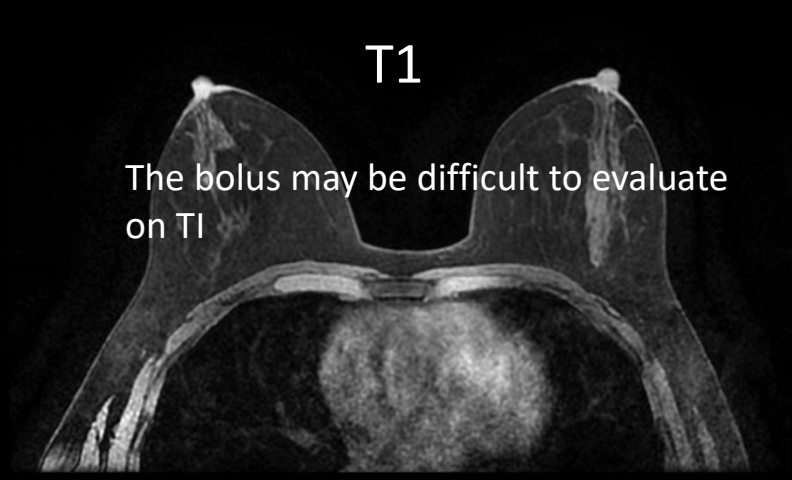
- Prior to interpretation review the following
  - Clinical History
  - MRI Technique
  - Previous Exams

Quality Control Evaluation

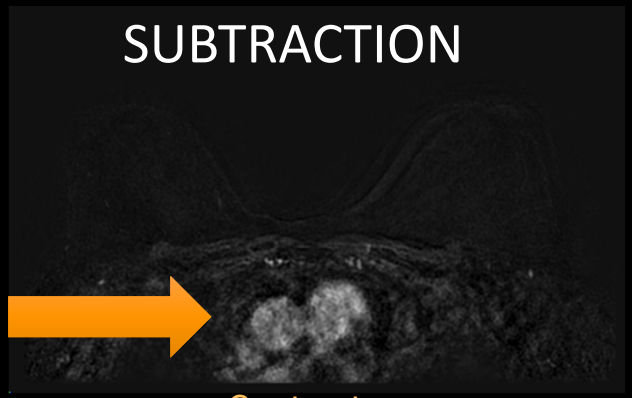
- Adequate Enhancement
- Poor positioning
- Field of View
- Motion
- Inadequate fat suppression

Look for Contrast Bolus

Contrast bolus is easily identified in the heart.

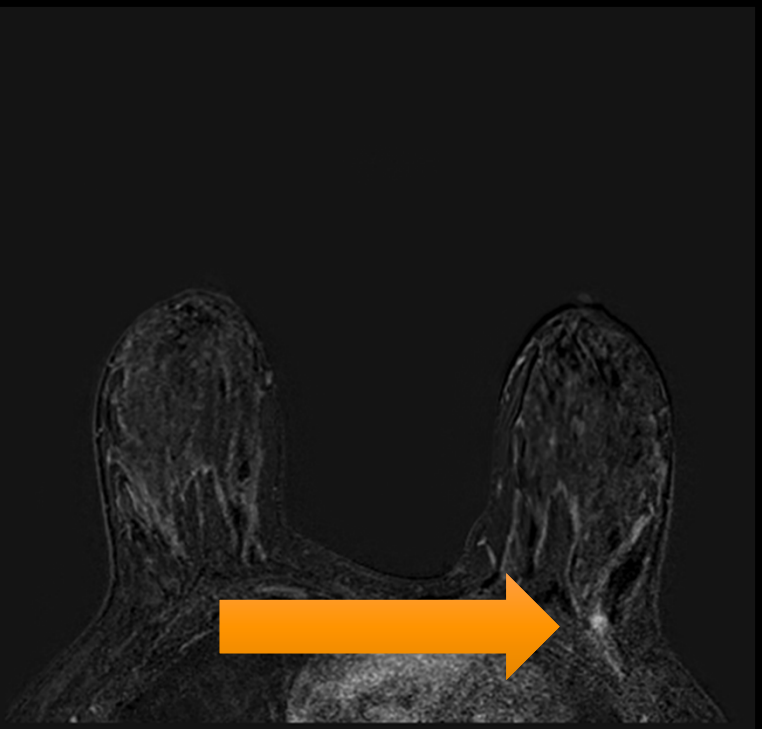


No Contrast

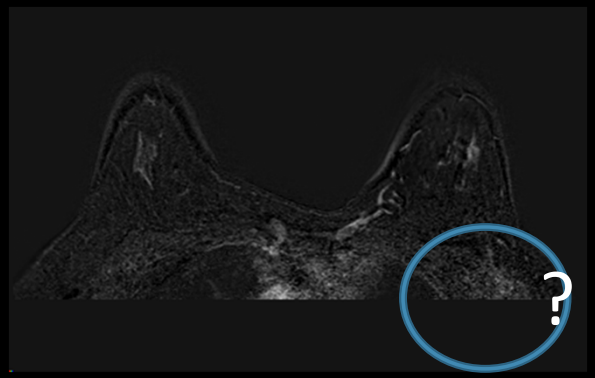


Contrast

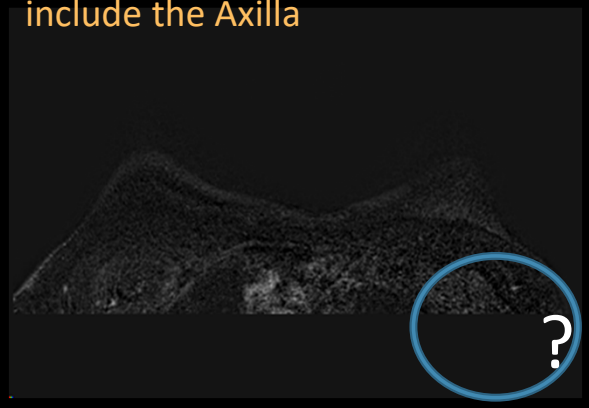
Evaluate the Field of View



Left upper outer quadrant IDC



More superior images do not include the Axilla

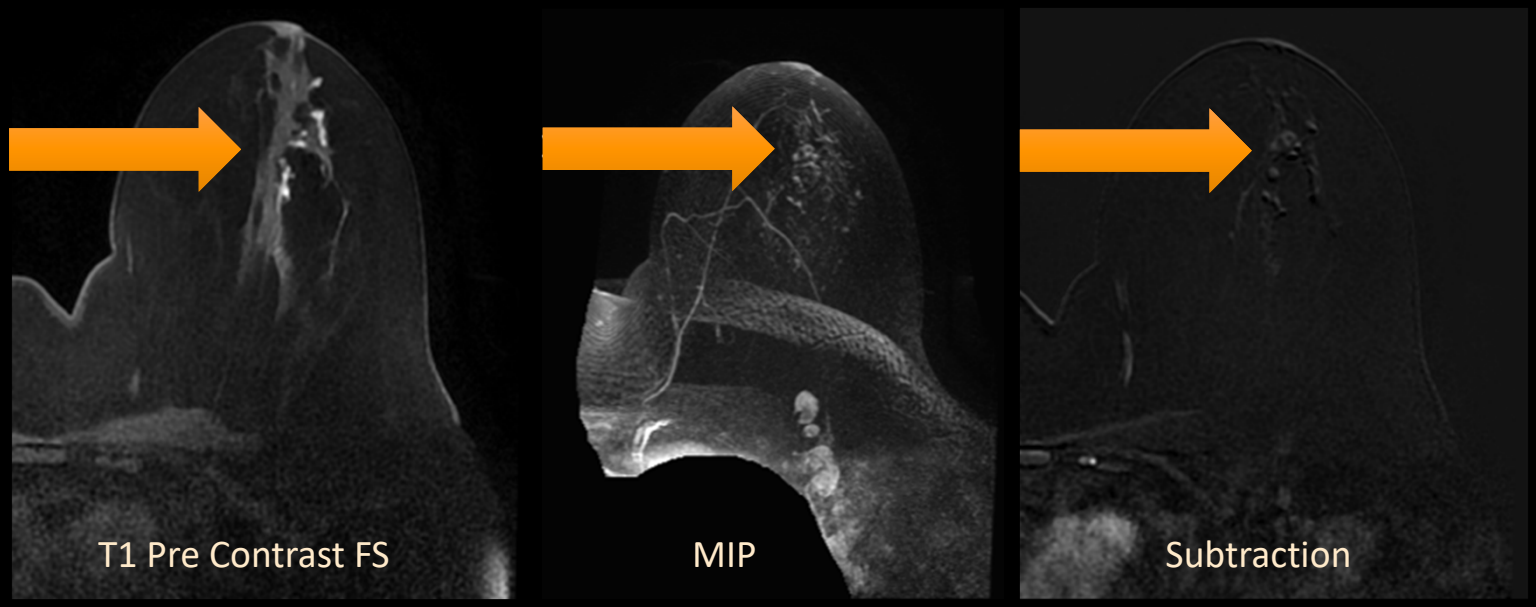


FOV is too small

Ultrasound demonstrates an abnormal level 1 axillary lymph node not imaged on the MRI

Asses for Motion

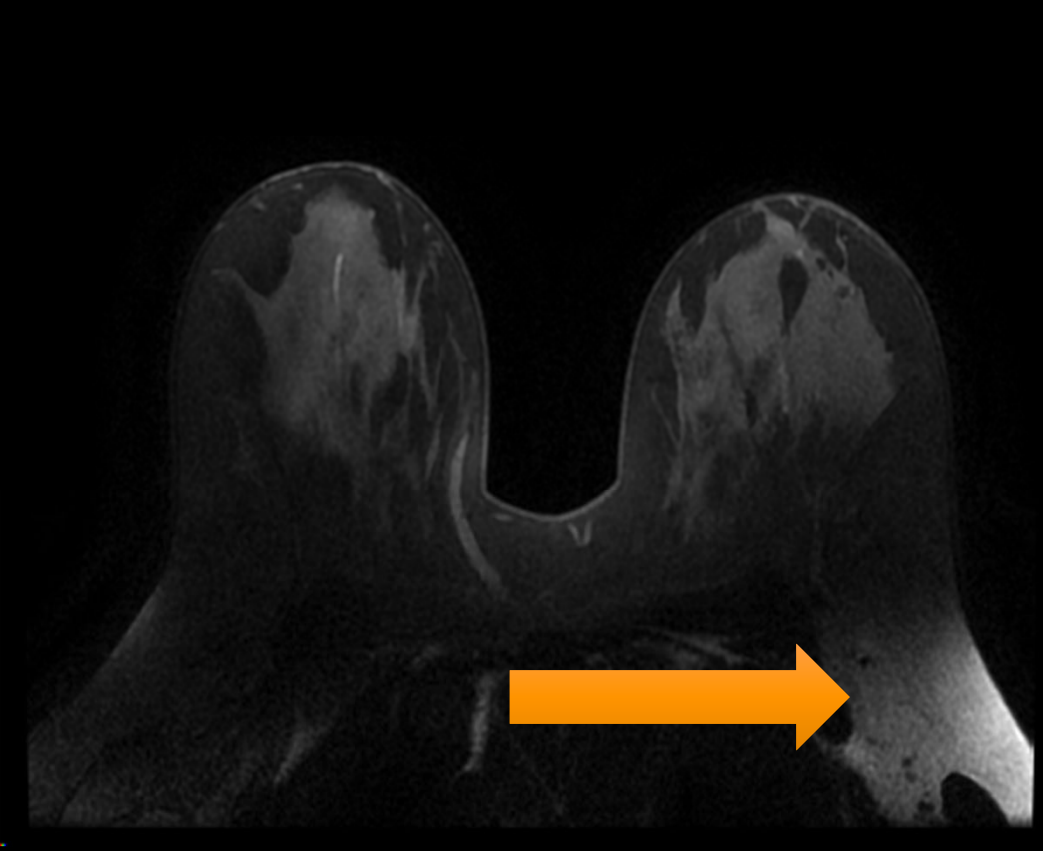
Motion may limit evaluation of subtle non mass enhancement and may cause mis-registration artifact on subtraction images.

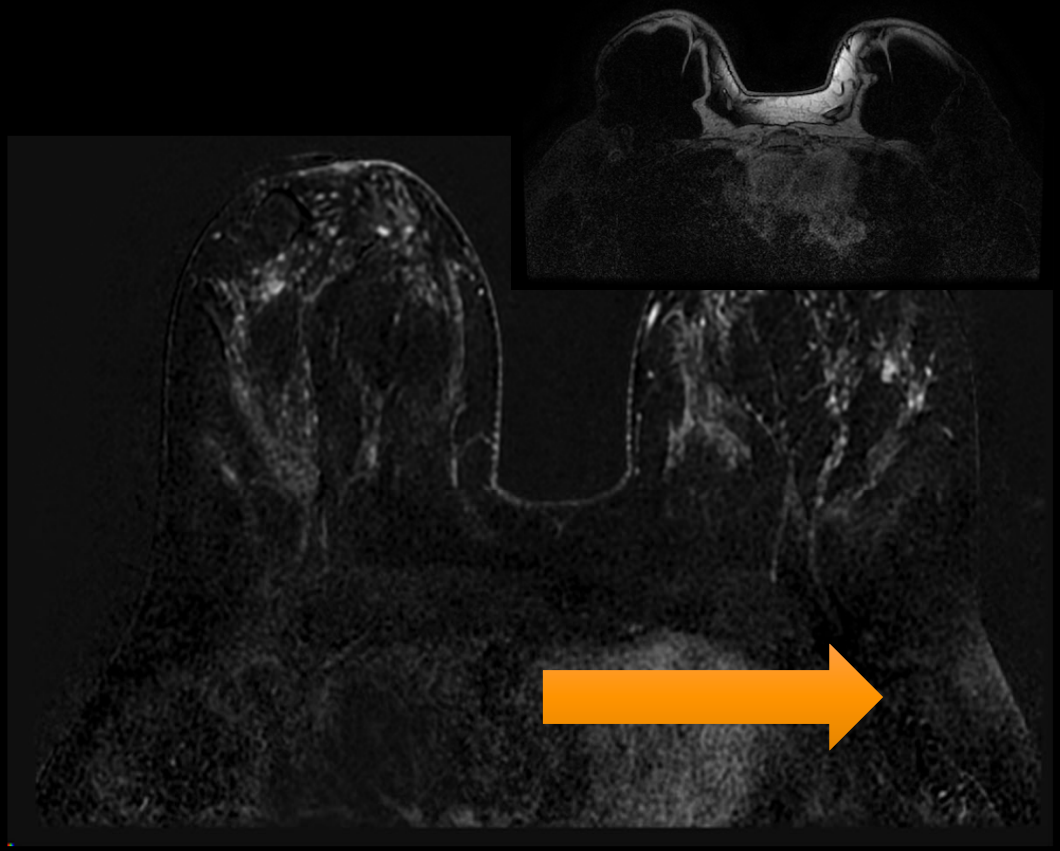


Mis-registration artifact from T1 hyperintense material in the ducts may appear as non mass enhancement on the MIP and subtraction images.

Use T1 pre and post to confirm if enhancement is real

Evaluate for Adequate Fat Saturation





Inadequate Fat Sat limits evaluation of the region.

Evaluate Background Parenchymal Enhancement (BPE)

- NOT related to breast density
- Evaluate Maximum Intensity Projection (MIP) and 1st post contrast sequence

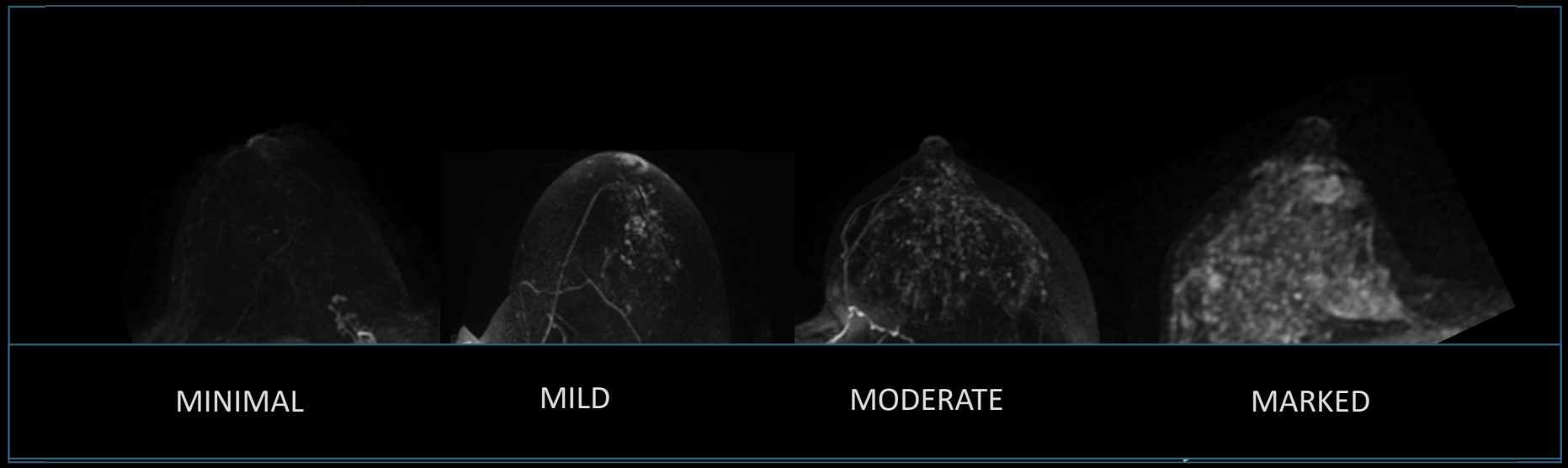


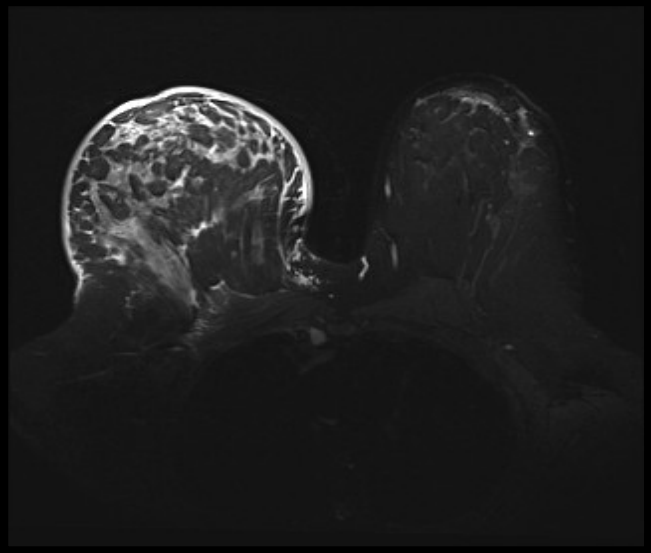
Image Interpretation

Sequences:

- T2 weight imaging
- T1 non fat sat images
- Post Contrast
  - Maximum Intensity Projection (MIP)
  - Source images (not subtracted)
  - Subtracted
    - axial and sagittal
- Kinetics
- Correlate with mammogram and ultrasounds

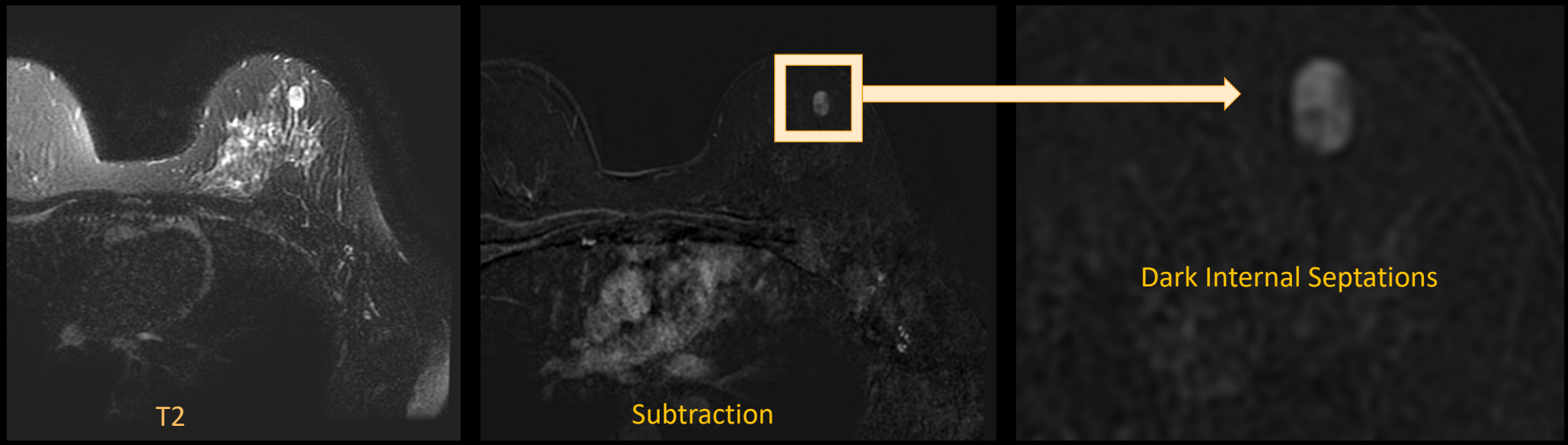
T2 weighted sequences

- T2 hyperintense lesions have a higher likelihood of being benign
  - **(Exception: mucinous carcinoma)**
- Edema
- Skin changes
- Fluid collections
- Lymph nodes
- Fibroadenomas (sometimes)
- Fibrocystic change
- Cysts
- Duct ectasia



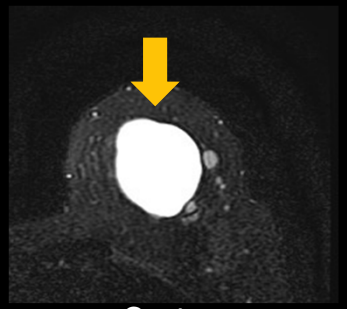
Inflammatory Breast Cancer -
Breast Edema and Skin Thickening

T2 Hyperintense mass

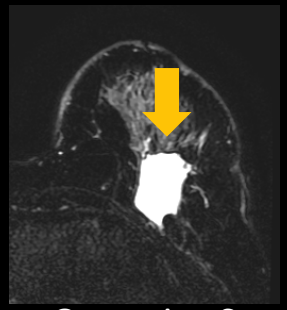


Fibroadenoma

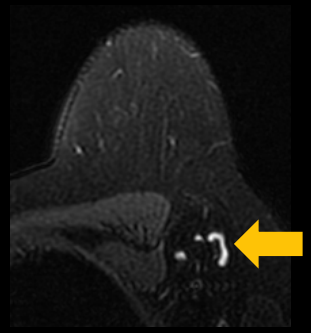
T2 Hyperintense Lesions



Cyst



Post Operative Seroma



Lymph Node

CAUTION

T2

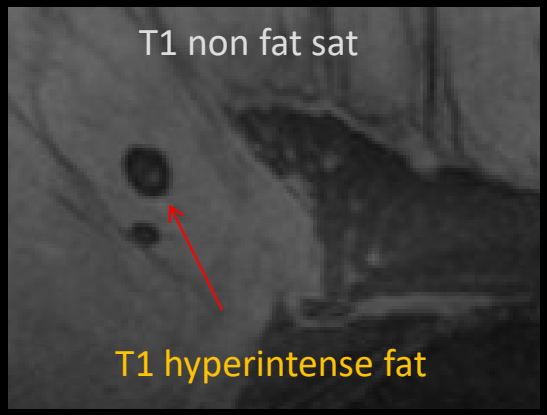
T1 Postcontrast

Mucinous Carcinoma

may be T2 hyperintense

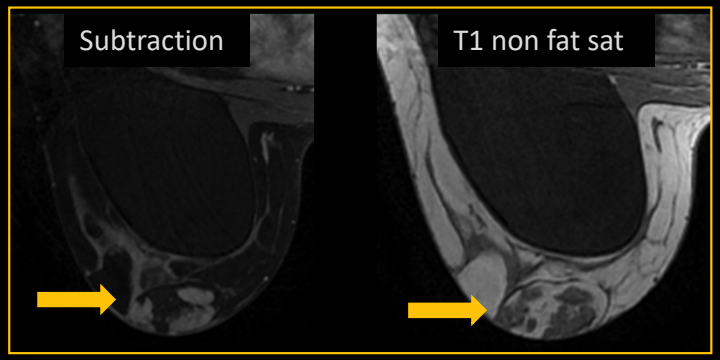
T1 Non Fat Sat

- Asses for fat
  - Fat containing masses
  - Fat necrosis
  - Lymph nodes
- Evaluate margin and mass effect
- Demonstrate susceptibility artifact (blood, clips)

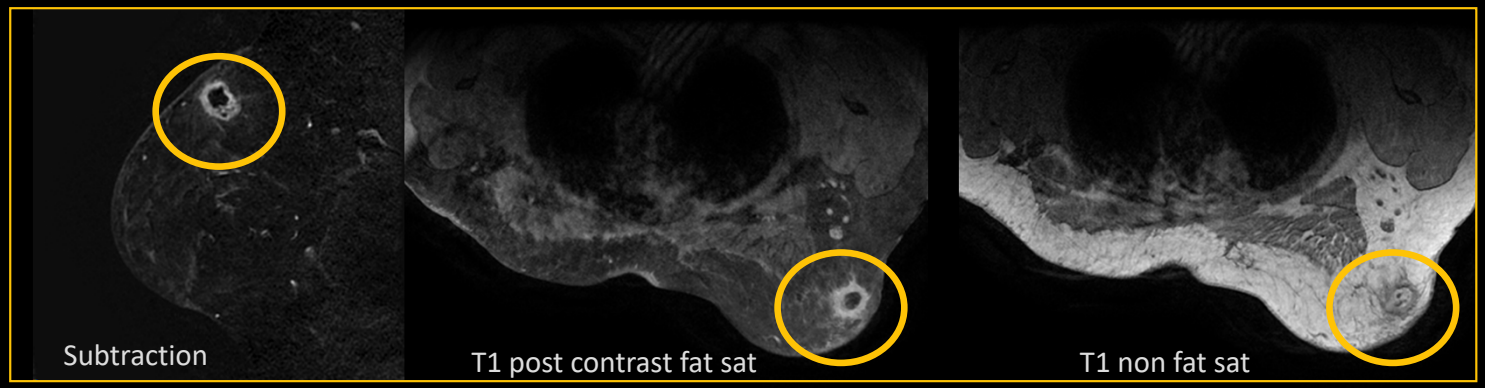


Benign lymph node

T1 Non Fat Sat



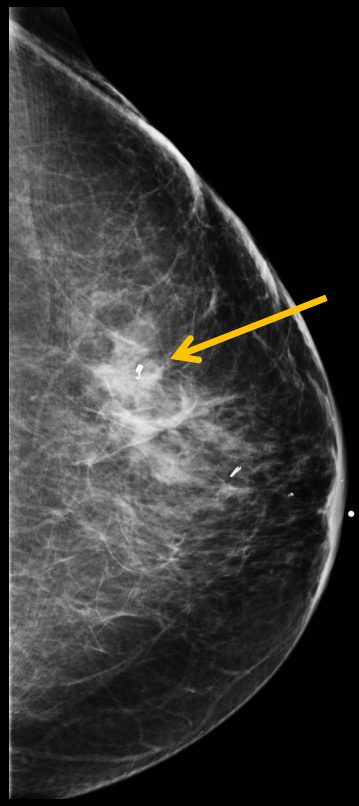
Hamartoma



Fat Necrosis

Susceptibility Artifact

T1 non fat sat



Post Contrast Imaging

- Review peak subtraction images
  - Identify areas of enhancement
  - Determine if it is real (exclude artifact)
    - Interrogate pre and post imaging
  - Location (quadrant, clock)
  - Characterize the type of enhancement
  - Associated features: Involvement skin, nipple, chest wall

Characterize Types of Enhancement
MRI BIRADS Terminology: Types of enhancement
(Mass versus Non-mass enhancement)

Masses	Shape	Oval
		Round
		Irregular
	Margin	Circumscribed
		Not circumscribed - Irregular - Spiculated
	Internal enhancement characteristics	Homogeneous
		Heterogeneous
		Rim enhancement
		Dark internal septations

Non-mass enhancement (NME)	Distribution	Focal
		Linear
		Segmental
		Regional
		Multiple regions
		Diffuse
	Internal enhancement patterns	Homogeneous
		Heterogeneous
		Clumped
		Clustered ring

Non-mass enhancement

MIP

Subtraction

- Distribution
  - SEGMENTAL
- Internal Enhancement pattern
  - CLUMPED

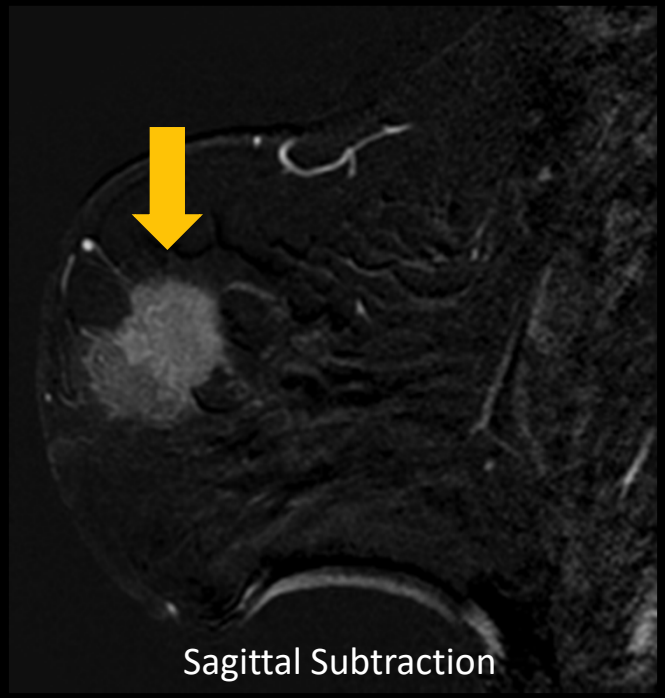
Non-mass enhancement

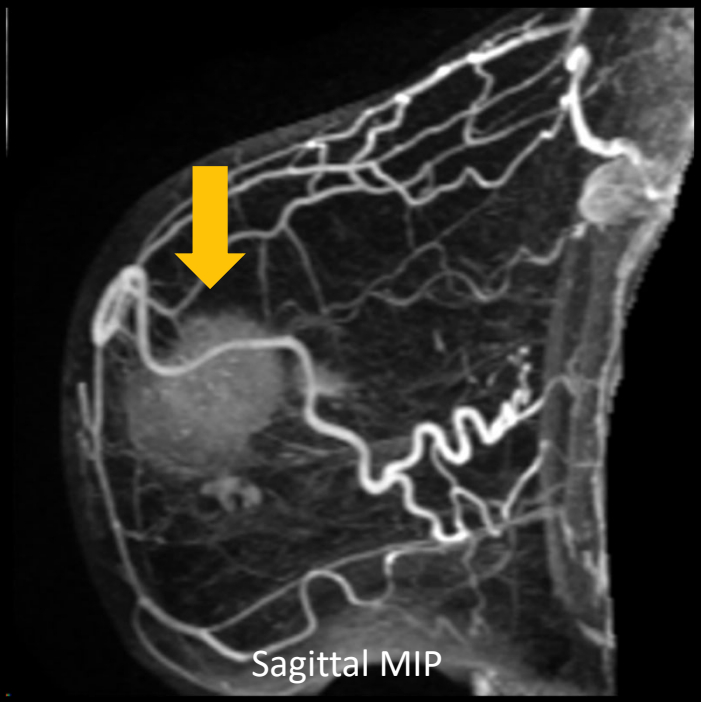

Sagittal Subtraction


Axial Subtraction

- Distribution
  - FOCAL
- Internal Enhancement pattern
  - CLUSTERED RING

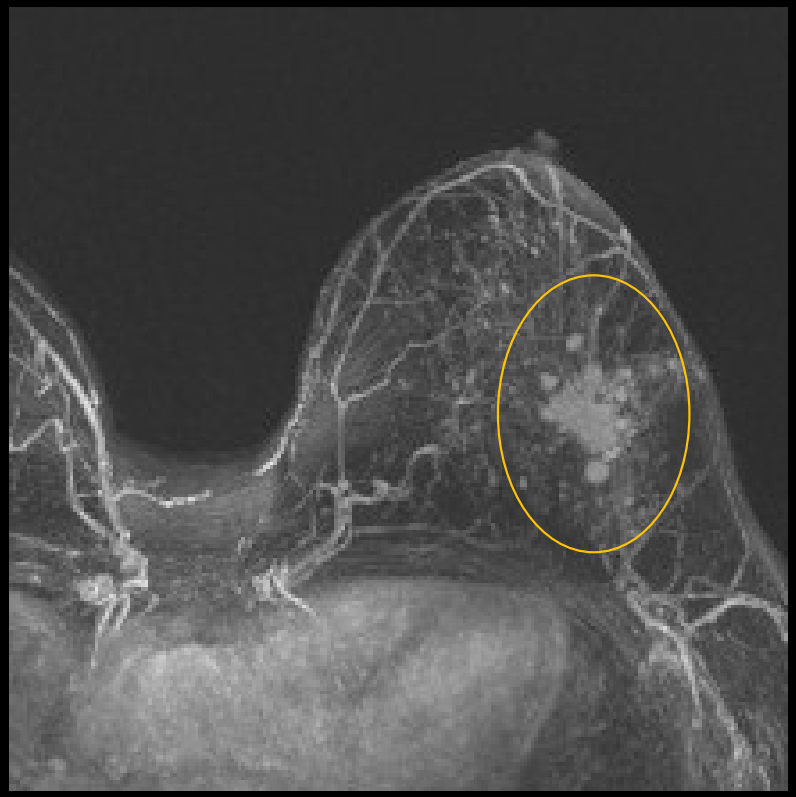
Mass



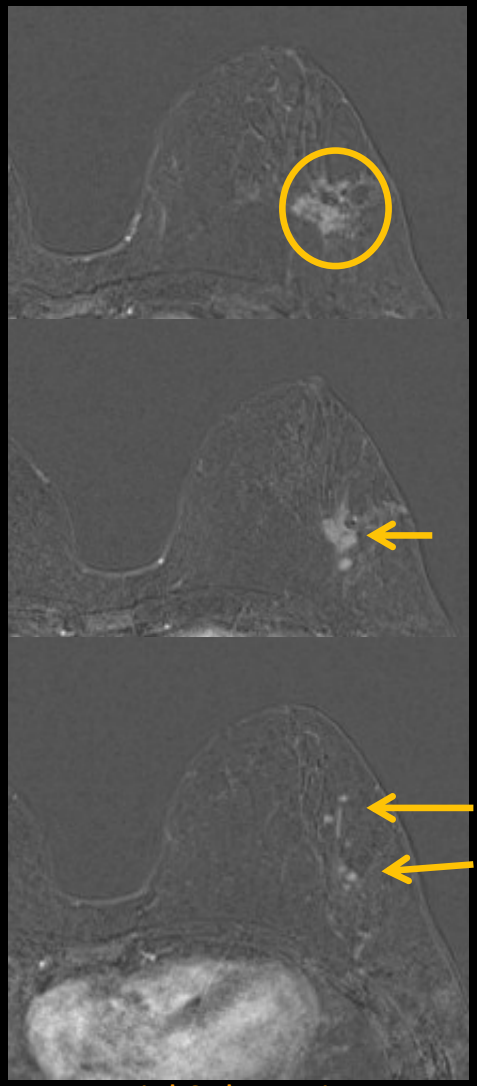


- Shape
  - IRREGULAR
- Margins
  - NOT CIRCUMSCRIBED
  - IRREGULAR
- Internal Enhancement pattern
  - HOMOGENOUS

Maximum Intensity Projection MIP



Total Extent of Disease



Axial Subtraction

- Shape
  - IRREGULAR
- Margins
  - NOT CIRCUMSCRIBED
  - IRREGULAR
- Internal Enhancement pattern
  - HOMOGENOUS

Multiple additional satellite masses

Further characterization of enhancement

- Analyze region of enhancement on other sequences
  - T1 non Fat Sat
  - T2 weighted images
  - T1 post contrast non subtracted (source)
  - Sagittal post delayed
    - Size, distribution, position, shape
- Evaluate the delayed imaging
  - Especially important in neoadjuvant response to therapy examination
  - Source images (not subtracted):
    - Evaluate musculature, axilla, skin, findings outside breast, nipple areolar complex
    - Pectoralis muscle involvement is not considered chest wall invasion
- Correlate with mammogram and ultrasounds

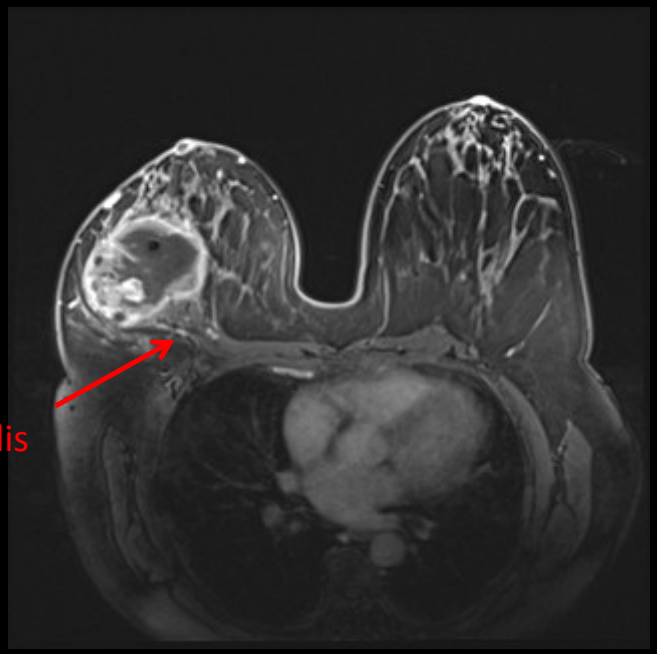
Sagittal Imaging

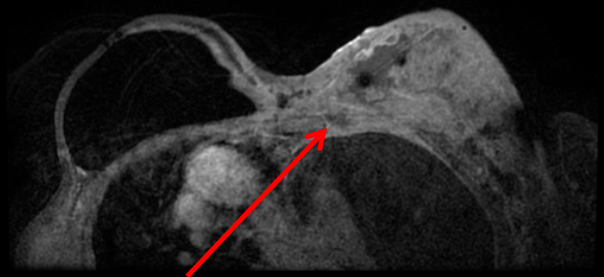
Further characterization of enhancement

Aids in evaluation of **size, distribution, position, shape**

Source (Non subtracted) Imaging

- Evaluate involvement chest wall, musculature, skin, nipple areolar complex
- Axilla
- Evaluate findings outside breast

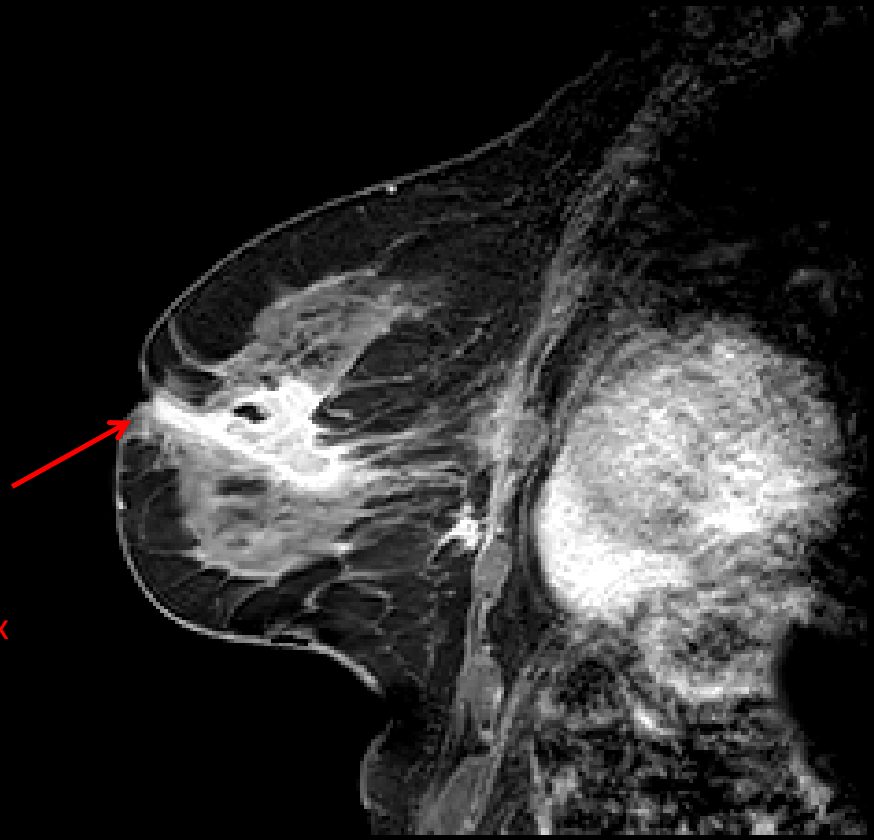




Pectoralis Muscle Invasion ≠ Chest Wall Invasion

Source (Non subtracted) Imaging

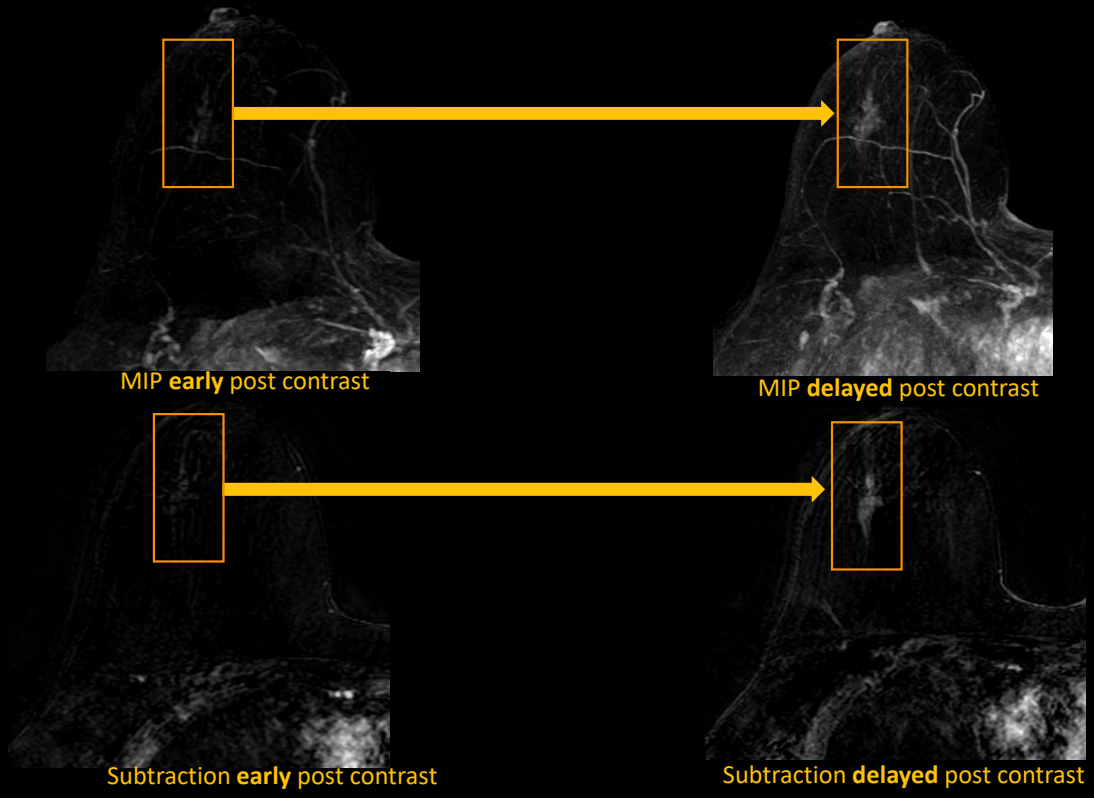
- Evaluate involvement chest wall, musculature, skin, nipple areolar complex
- Axilla
- Evaluate findings outside breast



T1 post contrast fat sat

Delayed Post Contrast Imaging

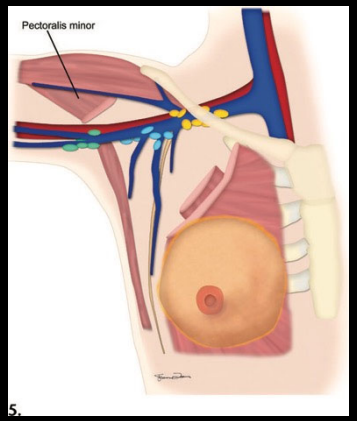
Response to Neoadjuvant Systemic Therapy

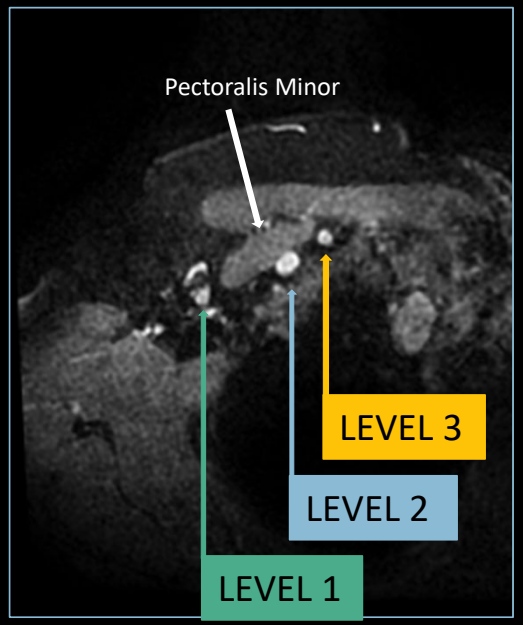


Delayed post contrast may assist in the detection of residual disease in patient undergoing neoadjuvant systemic therapy

Evaluation of Axillary Lymph Nodes

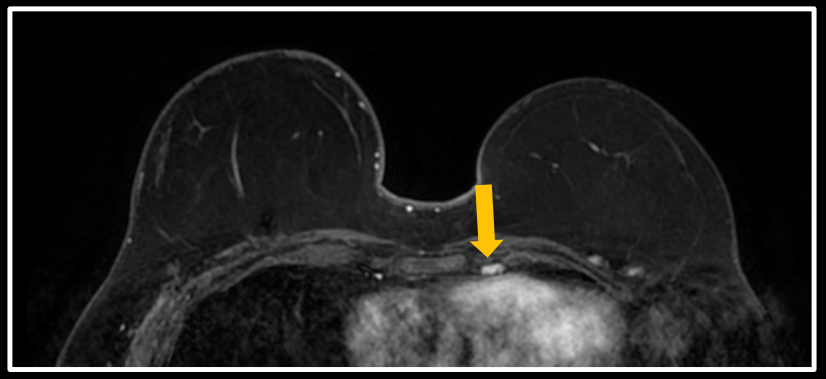
- **Level I** - lateral to the lateral border of the pectoralis minor muscle
- **Level II** - between the medial and lateral borders of the pectoralis minor muscle and also include the interpectoral (Rotter's) lymph nodes.
- **Level III** - medial to the medial margin of the pectoralis minor muscle and inferior to the clavicle.



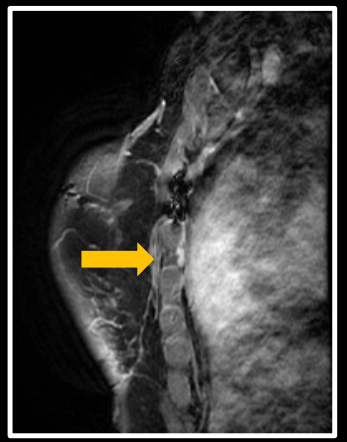


Evaluation of Lymph Nodes

- Internal mammary chain lymph nodes
  - Changes the radiation field
  - 5mm or greater



Axial T1 post contrast fat sat

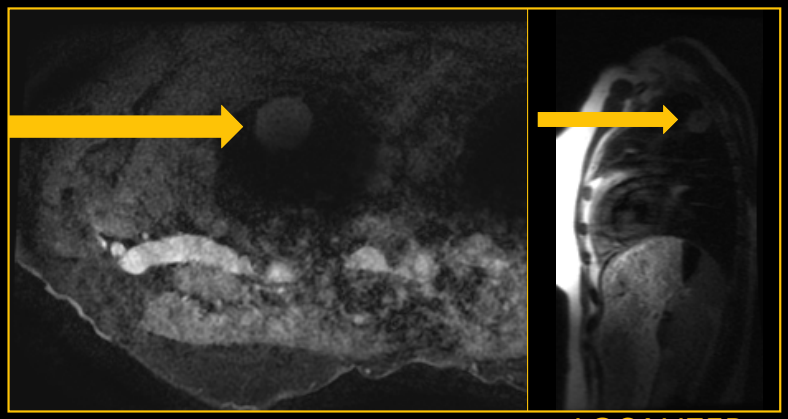


Enlarged internal mammary chain lymph node

Sagittal T1 post contrast fat sat

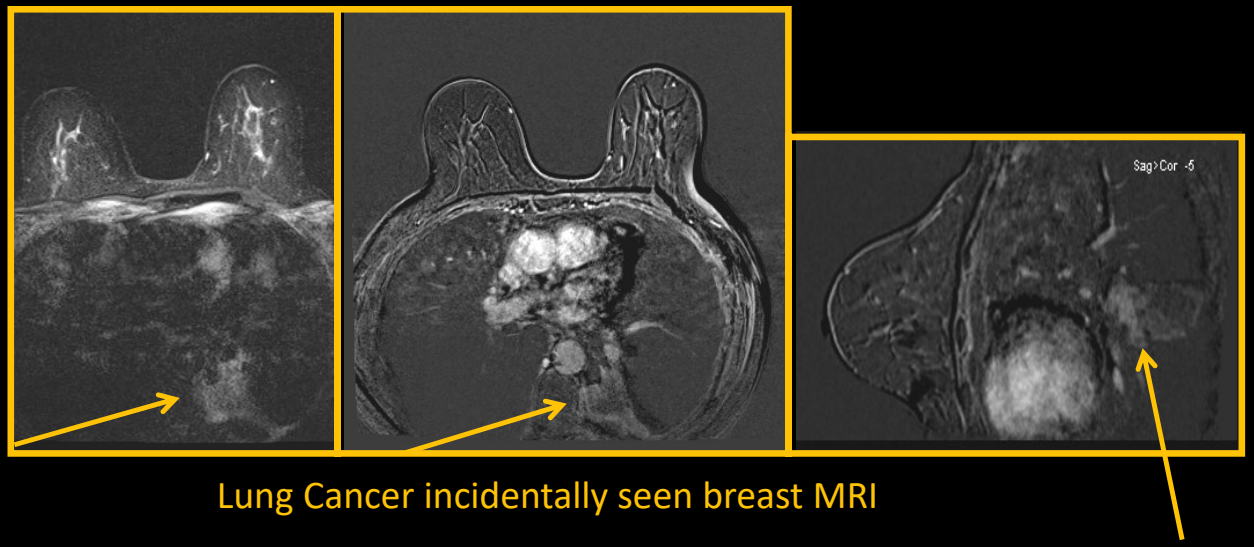
Evaluation of Areas Outside of Breast

- Non breast finding
  - Review localizer images
  - T2
  - Source images (non subtracted)



T1 POST FS LOCALIZER

Phyllodes pulmonary metastasis



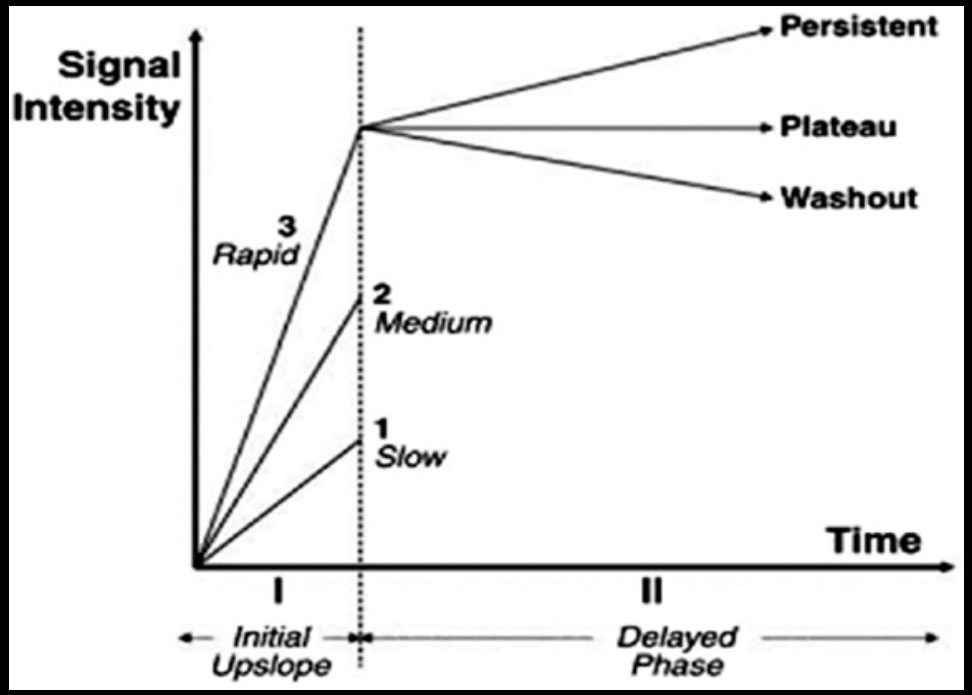
Lung Cancer incidentally seen breast MRI

KINETIC Evaluation

- Evaluate LAST
- May assist in final management
- If suspicious finding identified on kinetics, then review
  - Possibly a benign lymph node
  - Area of fat necrosis

Kinetic Curves

- Type 1
  - Rapid rise and persistent
  - 6% change of malignancy
- Type 2
  - Rapid rise and plateau
- Type 3
  - Rapid rise and washout
  - 29-77% chance of malignancy



Summary

- Apply an Organized and Systematic Approach
- Review indication, history and prior exams
- Evaluate Exam Quality
- Determine Background Parenchymal Enhancement
- Identify imaging findings and evaluate thoroughly on all sequences
- Utilize kinetics
- Remember to look outside of breast for any abnormalities