WHAT'S OLD & NEW IN BREAST IMAGING 2011

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Screening Breast Imaging

- Mammography
- Ultrasound
- MRI
- Nuclear Imaging
- Investigational Modalities
  - Thermography

Mammography

- Screening – Patient without symptoms, low risk
- Proven to decrease both mortality and morbidity due to breast cancer

  - Radiology 2011- Random Control Trial – Tabar et al
    - Two County Trial in Sweden - 29 year follow up of 130,000 women 40 -74 y/o
    - ½ invited to screening mammogram over 7 years – 85% screened
    - ½ not asked to screen
    - 30% decrease in breast cancer deaths in screened group

Screening Mammography Current Recommendations

- American Cancer Society
- American College of Obstetricians and Gynecologists – July 2011
  - Women at average risk (< 20%)
    - Annual screening starting at age 40
    - No upper age limit – unless life expectancy is less than 5 years or significant co-morbidities
- U.S. Preventive Services Task Force
  - 2009 – **Not implemented due to controversy**
    - Only Screening for ages 50 – 74 every other year

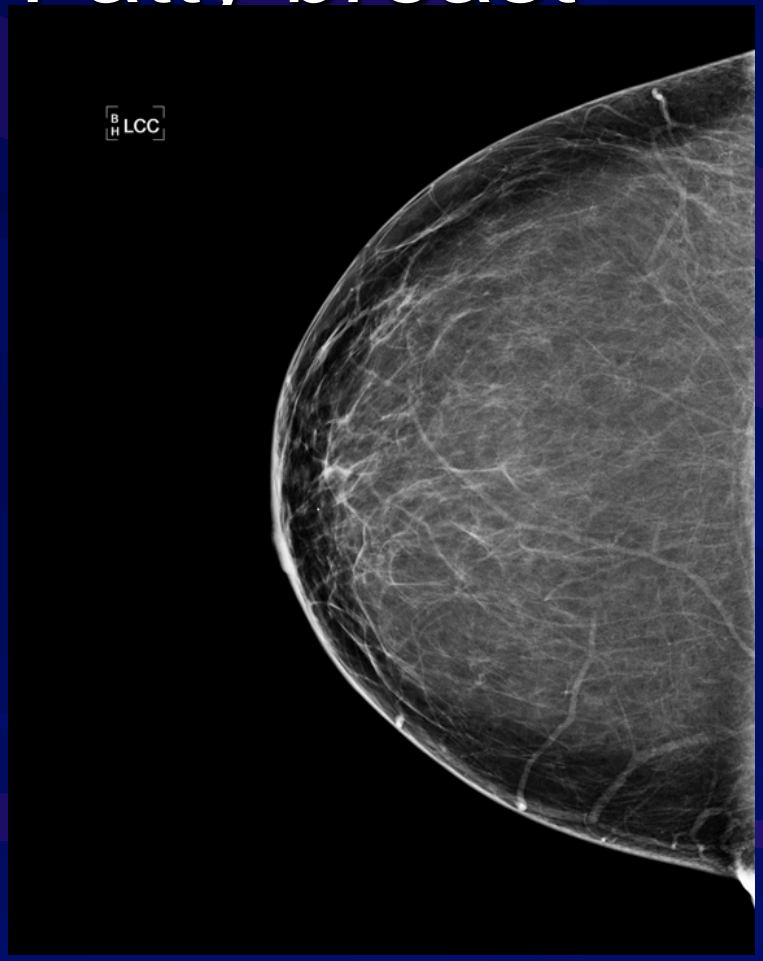
USPSTF Guidelines

- **Not implemented** – put on hold
- The reasons USPSTF Mortality reduction was low (15%) for <50 years
  - They utilized flawed Canadian NBSS trial with poor mammography technique
  - Excluding NBSS trial increases mortality reduction to 26 -30%
- They also recommend screening based on risk factors
  - Although 80% of patients diagnosed with breast cancer have no high risk factors

What's the problem with Mammography

NORMAL DIGITAL MAMMOGRAMS

Fatty breast



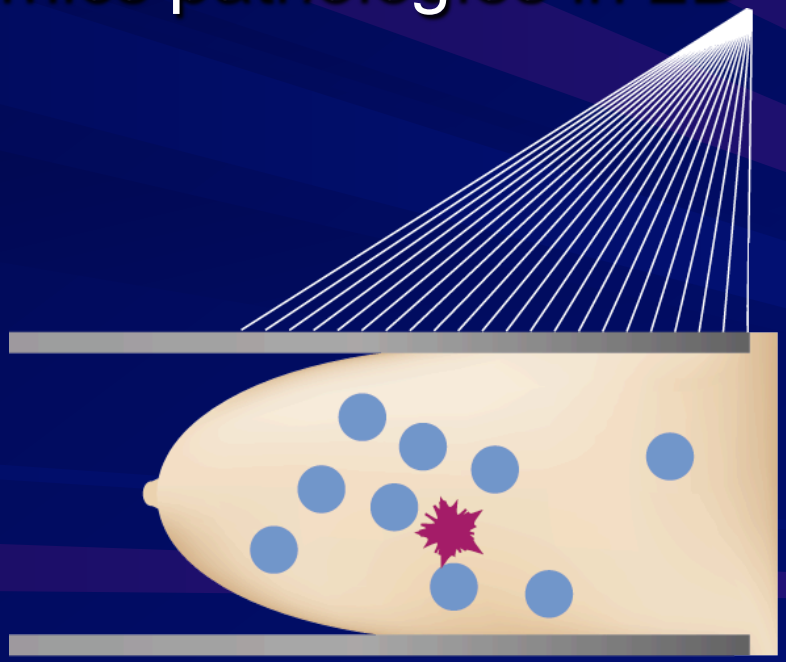
CC view

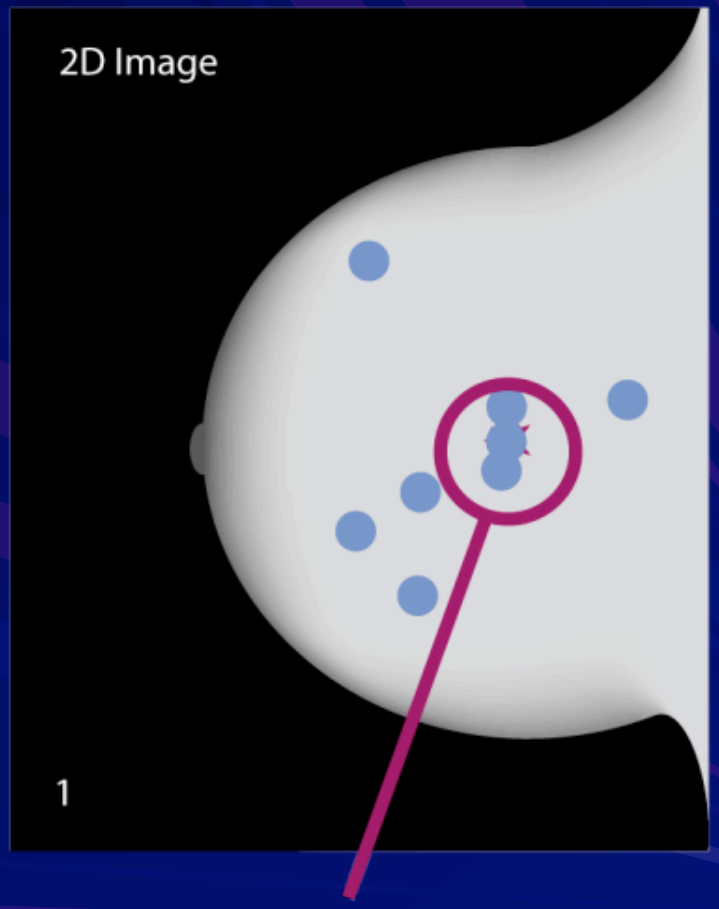
Dense breast

MLO View

Digital Mammography

- Tissue superimposition hides pathologies in 2D
- Tissue superimposition mimics pathologies in 2D





Lesion Superimposed in 2D

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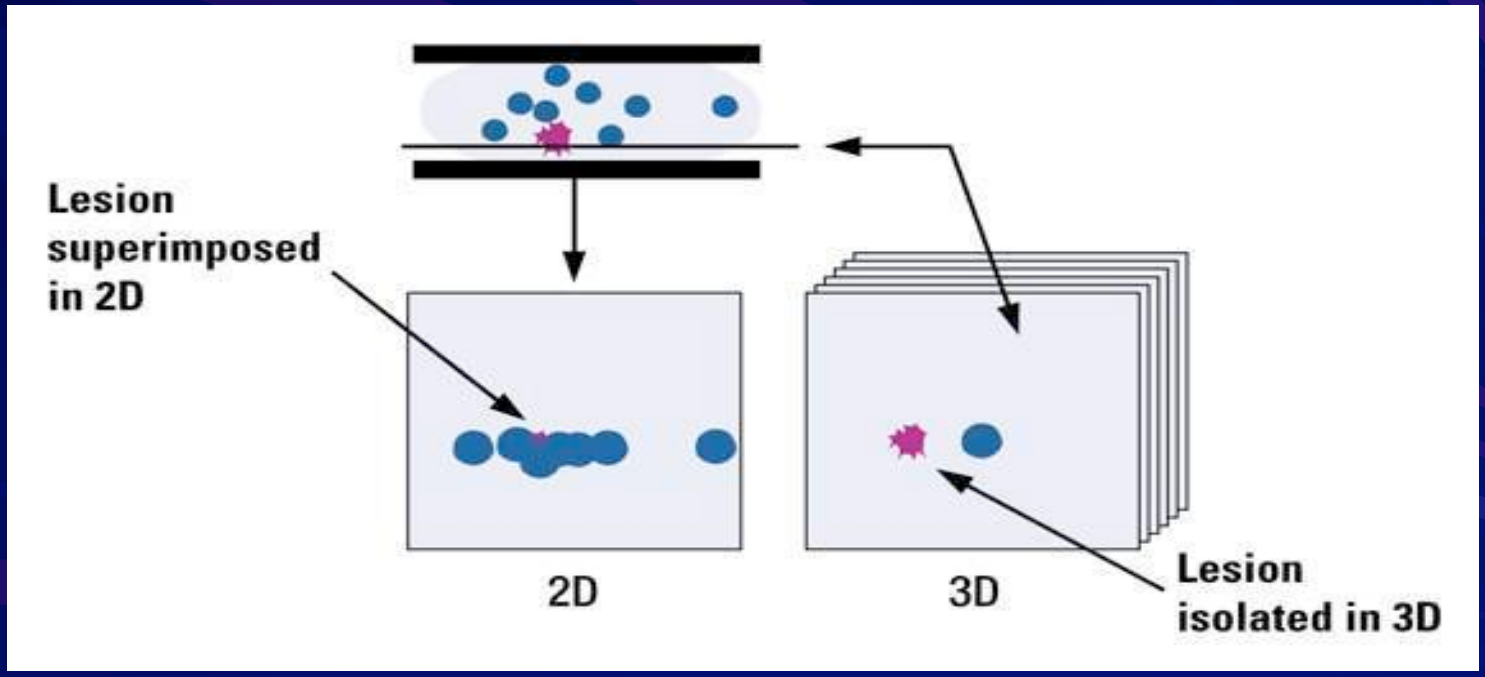
What's new in evaluating the dense breast ?

One Solution is TOMOSYNTHESIS

Tomosynthesis is a three-dimensional mammographic examination that **can minimize the effects of structure overlap** within the breast



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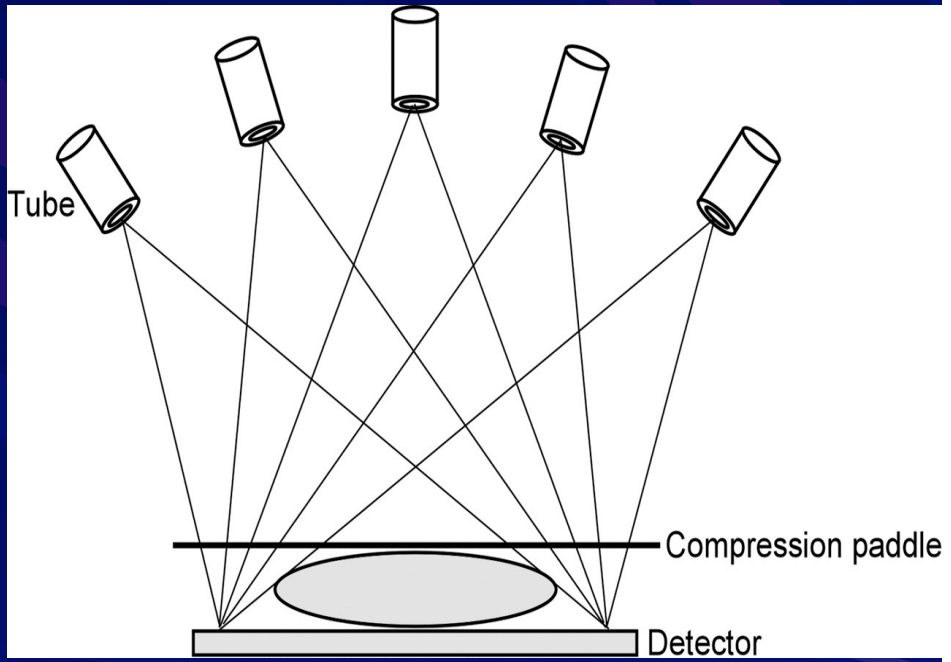
Digital Breast Tomosynthesis

- Takes Digital Mammographic images (~25 over 13 sec) as the x-ray tube moves in a narrow arc
- Reconstructed images with multiple 1mm slices parallel to detector (MLO and CC)
- Helpful to identify masses hiding in dense tissue, decrease recall rate for densities that are due to superimposition of tissues (pseudo lesions)

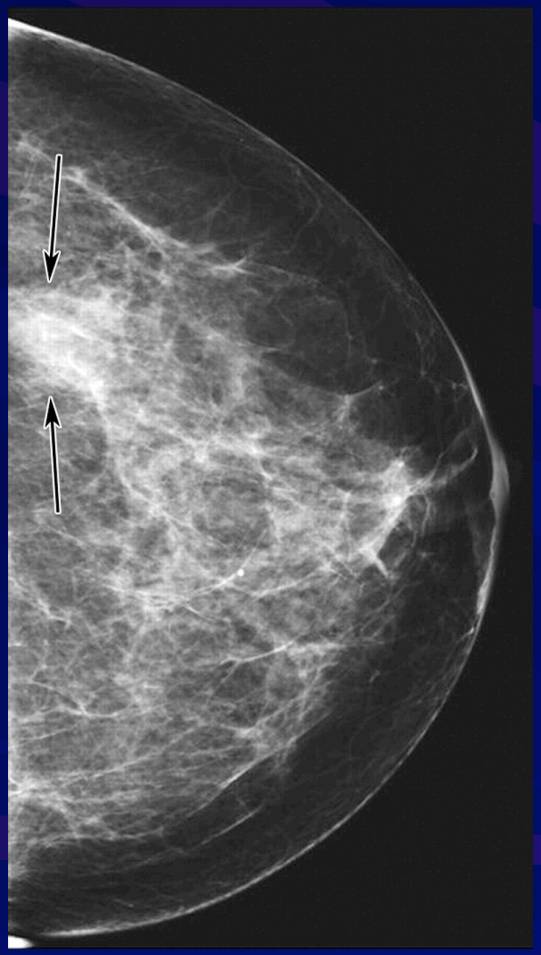


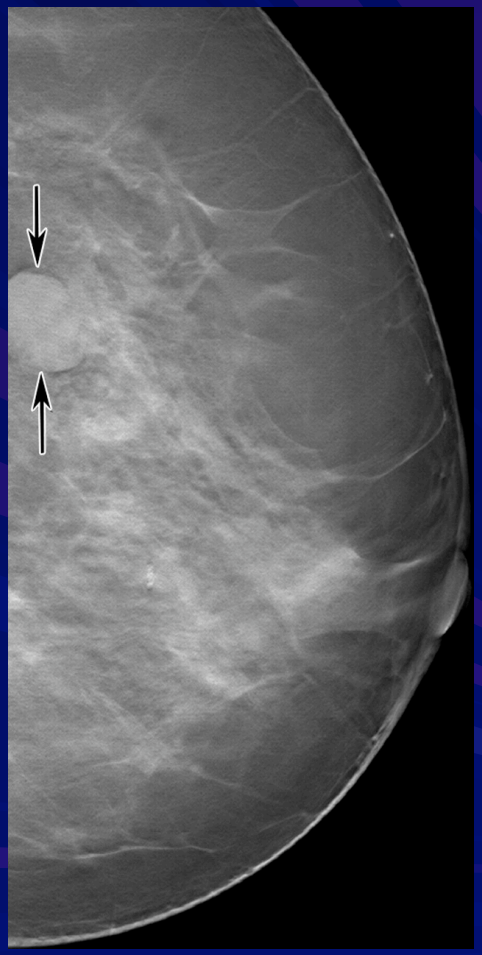
Breast tomosynthesis unit

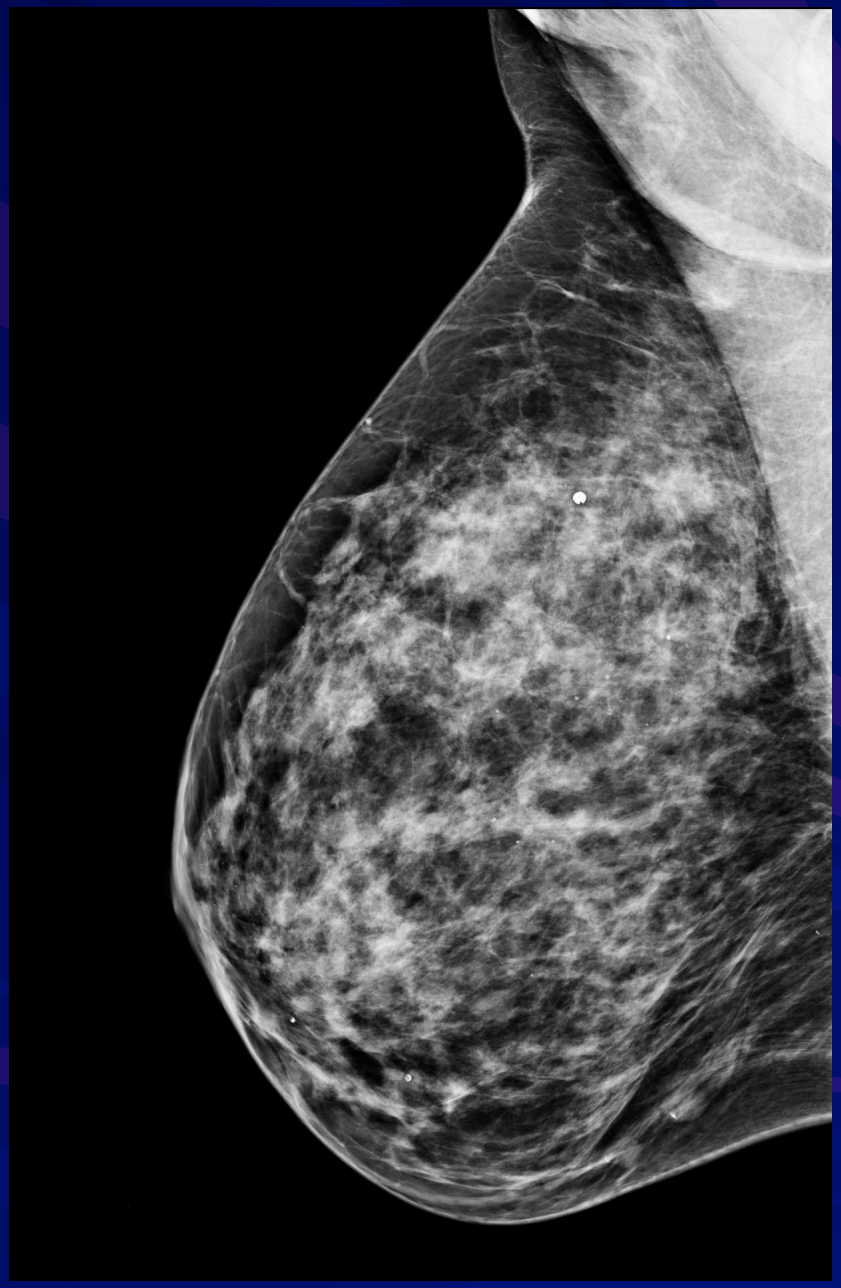
Park J M et al. Radiographics 2007;27:S231-S240

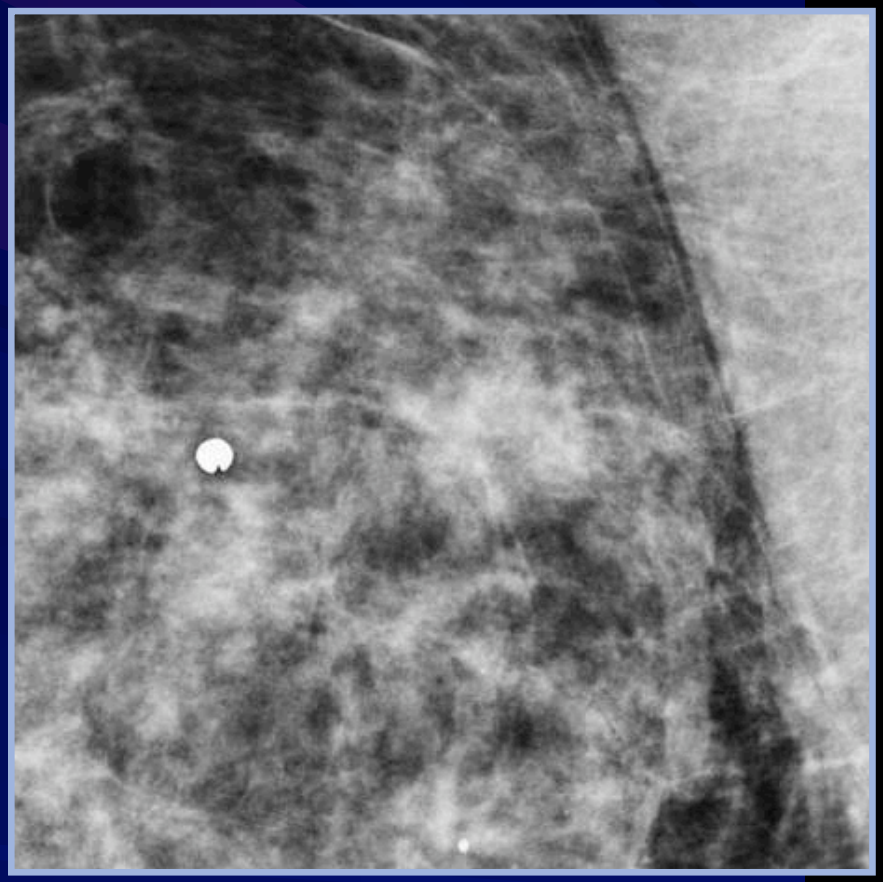
RadioGraphics

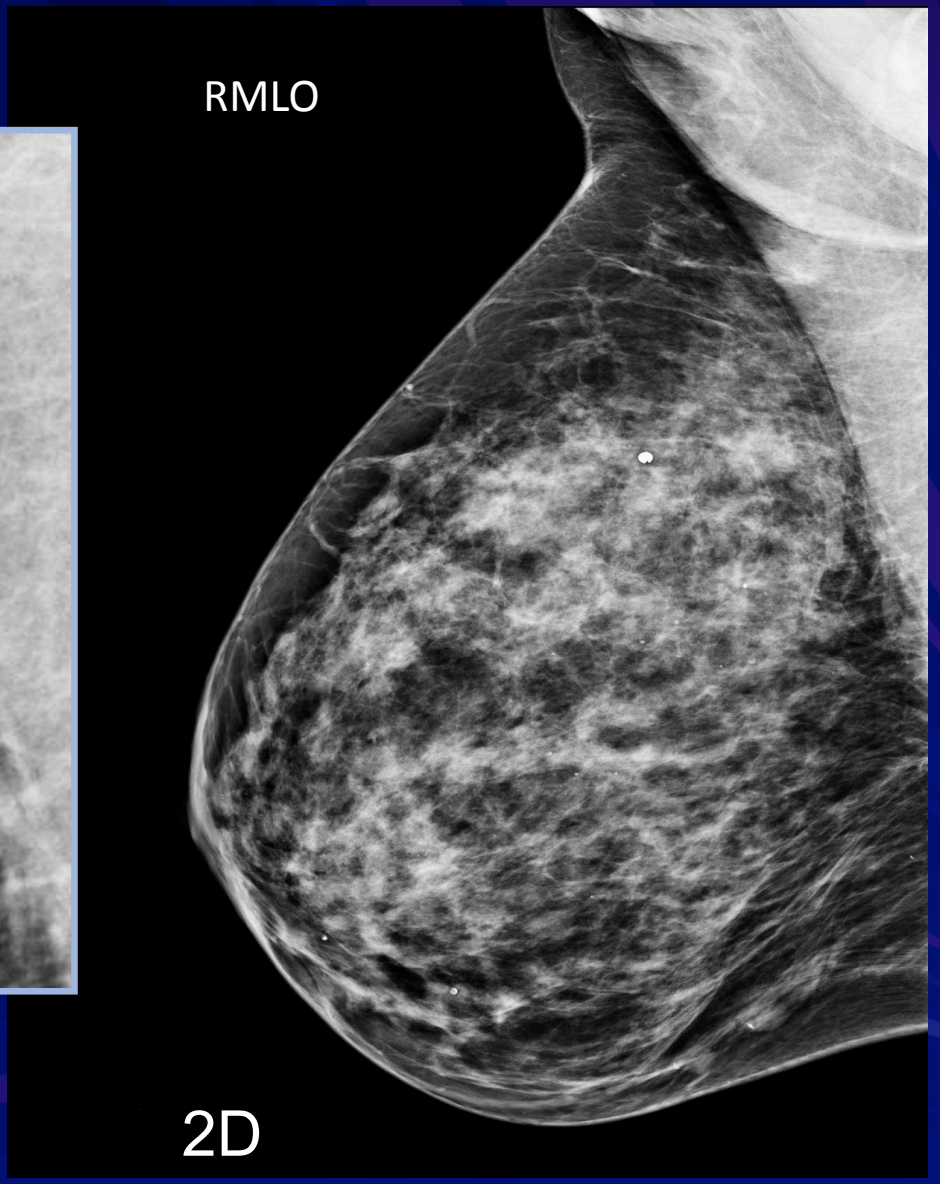
2D Digital Mammogram vs Tomosynthesis











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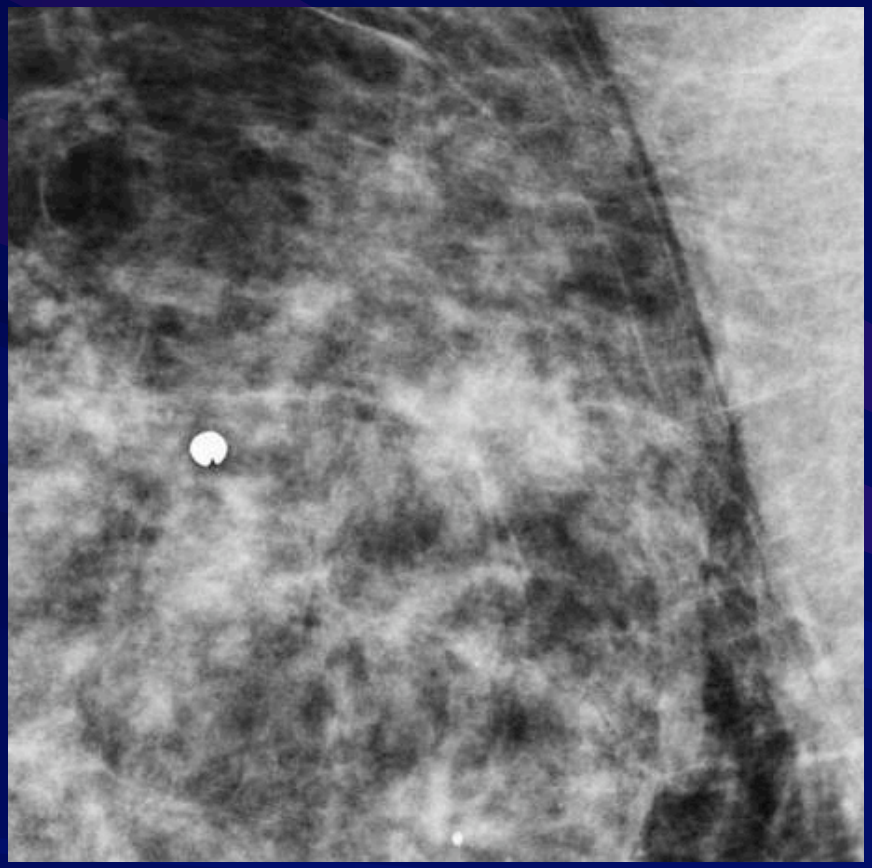
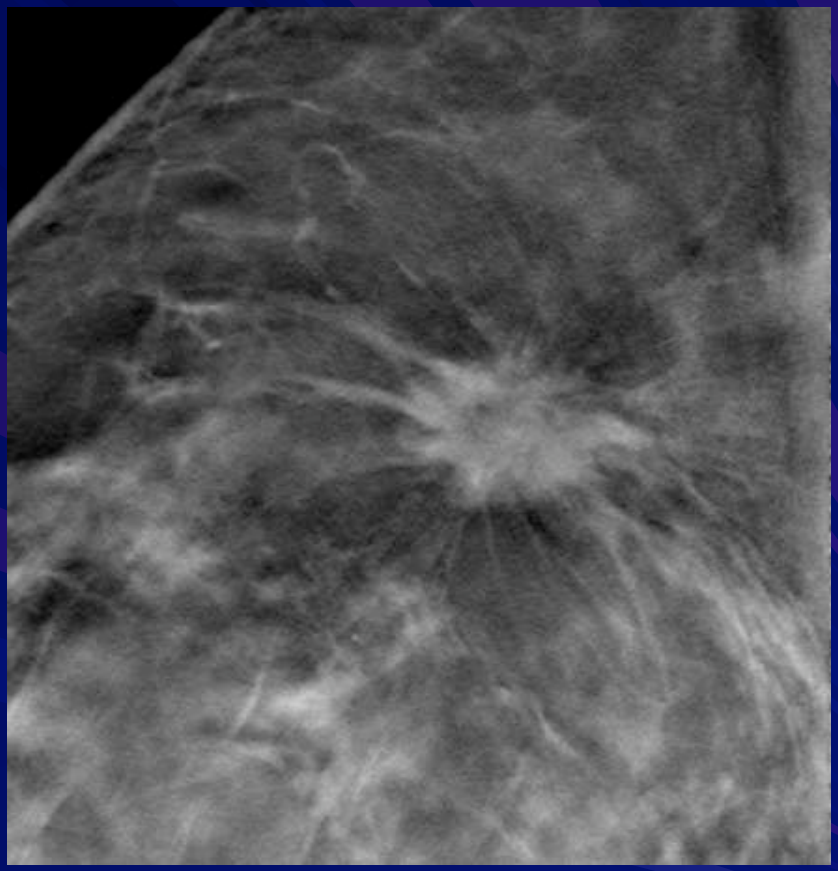
February 2011

PRE-00023

2D Mammogram



Tomosynthesis



Hologic

Ultrasound

- Whole Breast Screening
  - Automated
    - Pros - Reproducible, “complete” coverage of the breast tissue, currently investigational
  - Hand held
    - Cons – Operator (tech) dependent, difficult to document inclusion of the entire breast tissue in a reproducible manner
  - RRC does not offer Whole breast screening Ultrasound

American Cancer Society Guidelines for Screening Breast MRI as Adjunct to Mammography

- Recommend annual MRI screening (based on consensus opinion)
  - >20% lifetime risk (BRCA 1st degree relative or self)
  - Radiation to chest between ages 10 and 30
  - Li-Fraumeni syndrome and first-degree relatives of people with the syndrome
  - Cowden and Bannayan-Riley-Ruvalcaba syndromes and first-degree relatives

Insufficient evidence to recommend for or against MRI screening

- Lifetime risk of 15-20%, models defined primarily dependent on family history
- LCIS or ALH
- ADH
- Heterogeneously or extremely dense breasts on mammography
- Personal history of breast cancer, including DCIS

Recommend Against MRI Screening (based on expert consensus opinion)

- Women with less than 15% lifetime risk
- Premenopausal patients need to be scanned during early phase of menstrual cycle, optimally days 5-10. Otherwise pathology may be covered by hormonally activated tissue enhancement.

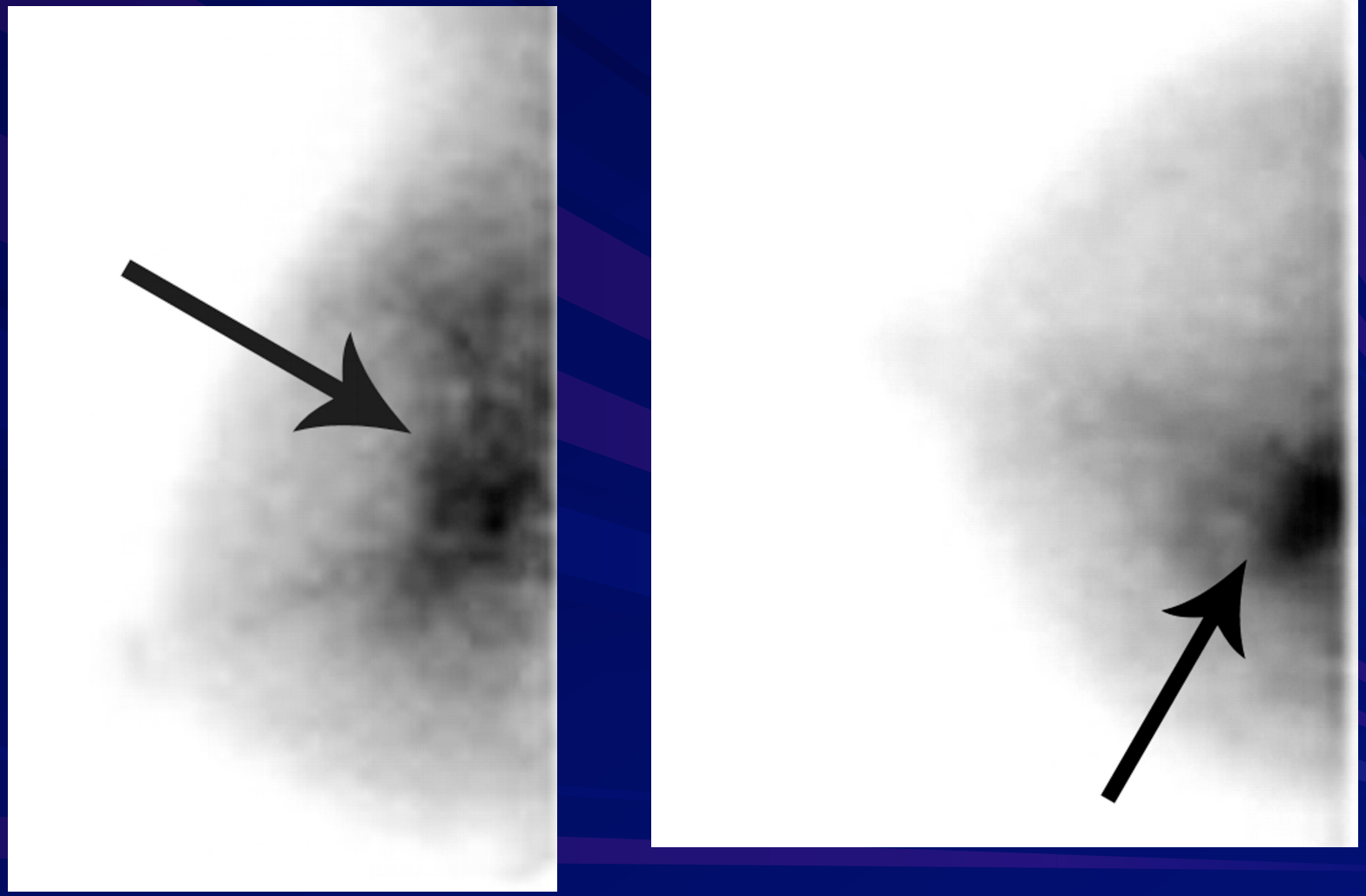
Nuclear Imaging- Molecular Breast Imaging

- Breast Specific Gamma Imaging
- Positron Emission Mammography
  - Both use the increased metabolic activity of cancerous/highly active cells to stand out from the background uptake.
- Cons
  - Not easily biopsied if there is no mammographic or sonographic correlate
  - Low metabolic cancers may remain occult

Nuclear Imaging
Breast Specific Gamma Imaging

- Uses Tc 99m nuclear medicine isotope injected IV with imaging in MLO and CC views with specialized breast Gamma camera
- Increased uptake in tissue with increased mitochondrial activity – seen in cancers
- Can also be seen in fibrocystic breast tissue, some benign masses
- Maybe helpful in patient's who cannot undergo breast MRI due to claustrophobia or kidney disease

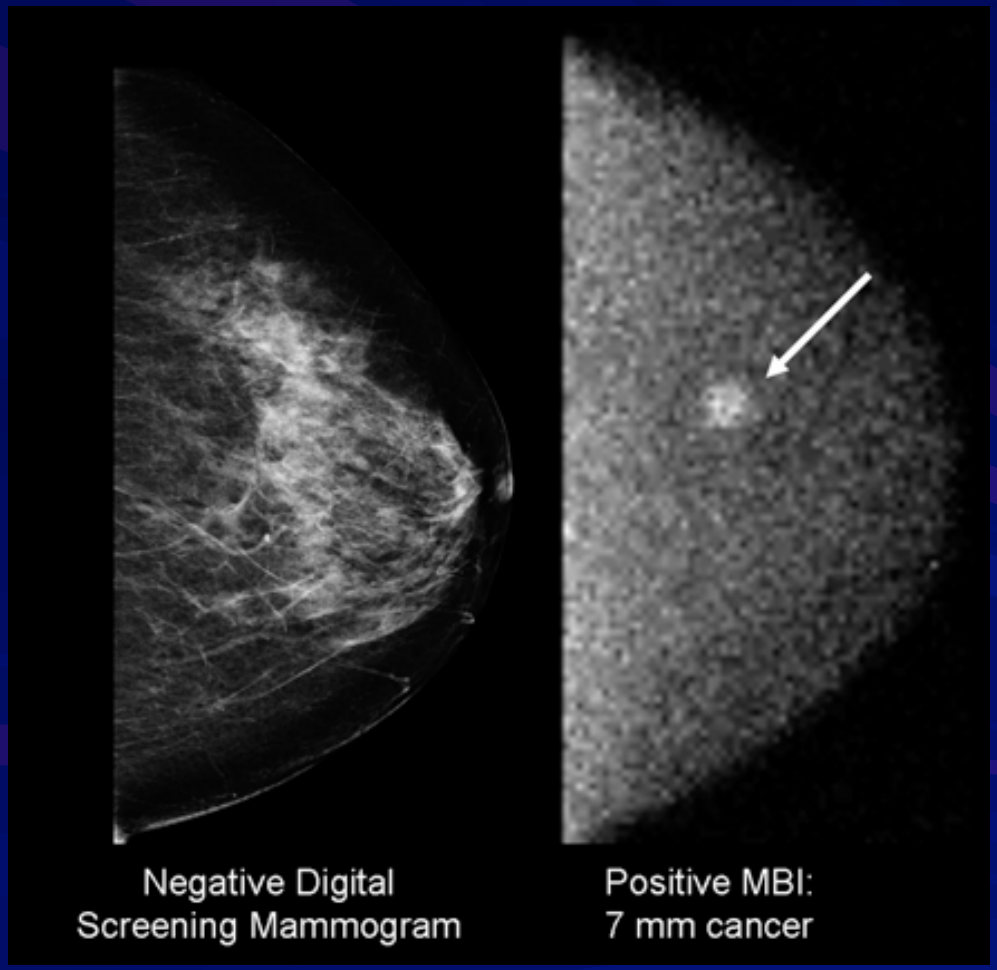
BSGI of 39-year-old woman with new palpable mass in right breast IDC



Brem R F et al. Radiology 2008;247:651-657

Radiology

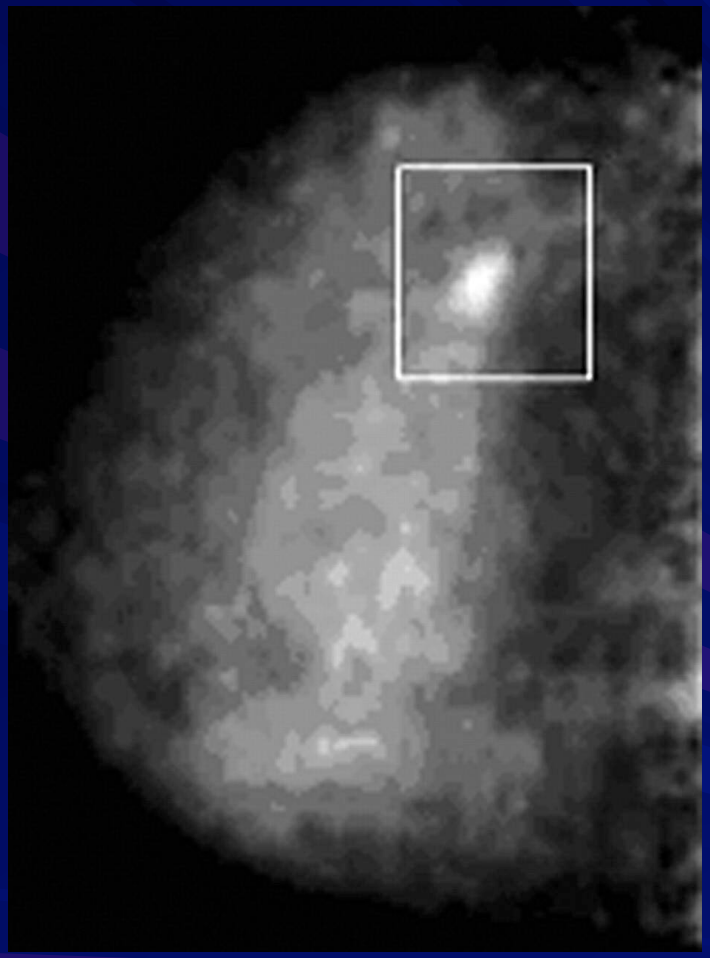
Cancer hidden in breast tissue on mammogram, visualized on Molecular Breast Imaging (BSGI)



Nuclear Imaging
Positron Emission Mammography

- Uses 18F-FDG IV
- Specialized PET imaging of only the breast
- Increased use of glucose (labeled with radioactive 18F) by cancers

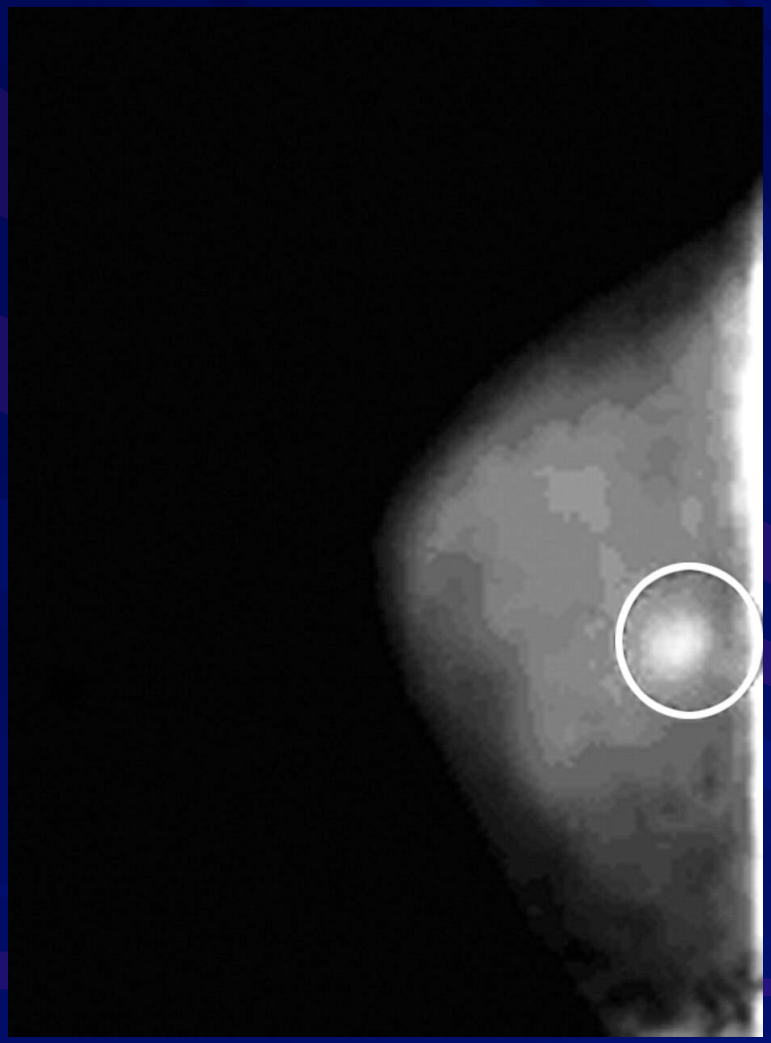
Small invasive breast carcinomas with FDG PEM



Rosen E L et al. Radiographics 2007;27:S215-S229

RadioGraphics

Small invasive breast carcinomas with FDG PEM



Rosen E L et al. Radiographics 2007;27:S215-S229

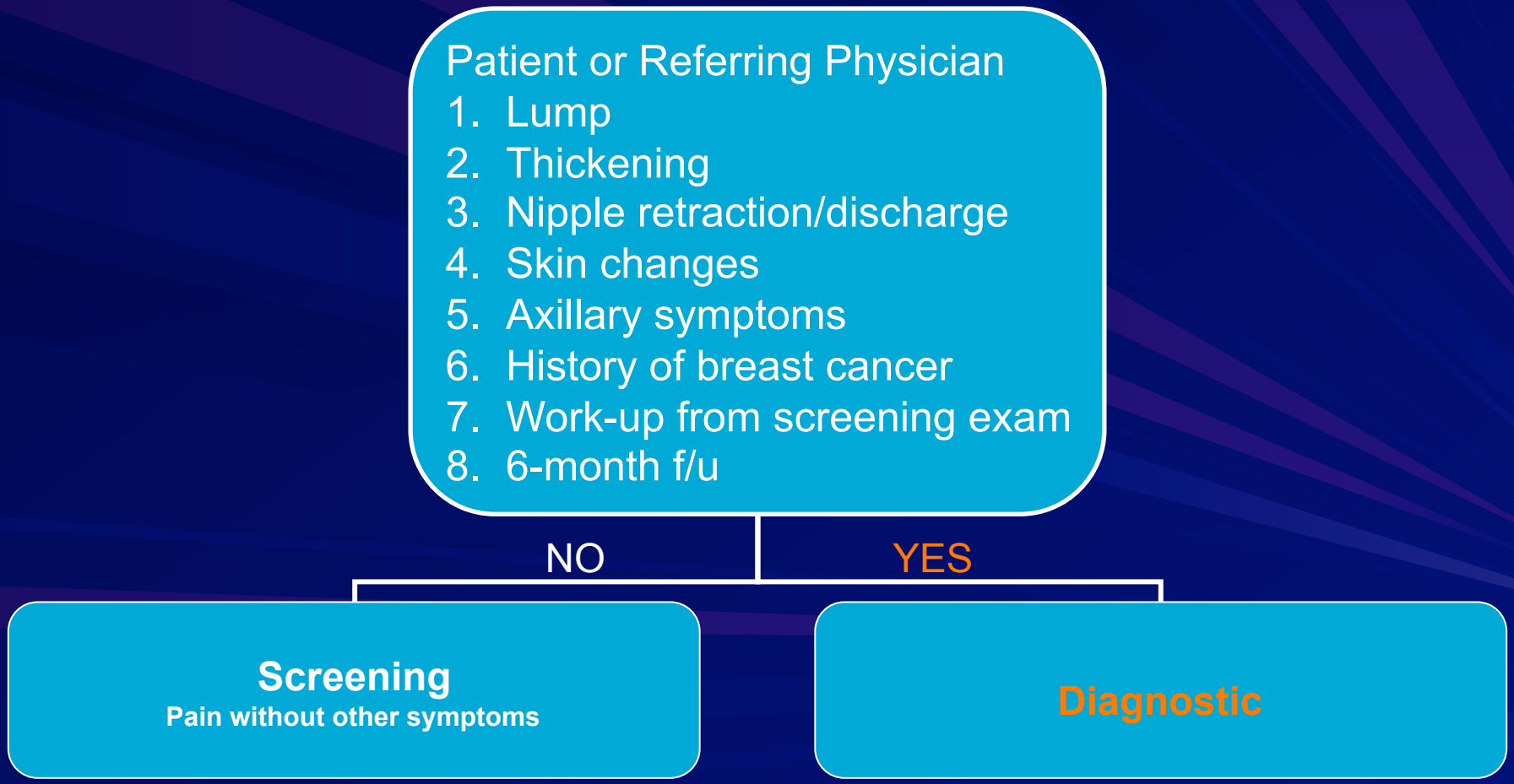
RadioGraphics

Investigational Imaging

- Thermography – Theory: Increased blood flow to malignancies will be visible as increased temperature on the surface of the breast

- **June 2, 2011 - FDA Safety Communication: Breast Cancer Screening - Thermography is Not an Alternative to Mammography**
  - **No research supporting Web site claims that thermography can detect early breast cancers or characterize clinical or imaging findings.**

Screening vs Diagnostic



Diagnostic Breast Imaging at RRC

- <28 years old and no high risk history
  - Start with Ultrasound for mass
  - Mammography as needed
    - Bilateral to compare amount and distribution of fibroglandular tissue
- >/= 28 years
  - Start with bilateral mammography
  - Ultrasound as needed

What the Radiologist needs to Know

- Lumps/Bumps/Thickening
  - **Location** – Clock position and distance from the nipple – *marked on Rx* (many patients will not know at the time of imaging, was marked on breast but she took a shower and washed it off)
  - **Size** – golf ball vs pea
- Nipple Discharge
  - **Suspicious**
    - Bloody/Clear
    - Spontaneous
    - Unilateral
  - Benign
    - White- usually hormone related – Prolactinoma
    - Bilateral

Diagnostic Breast Imaging

- INDICATIONS
  - Lump
  - Thickening
  - Nipple retraction/discharge
  - Skin changes
  - Axillary symptoms
  - History of breast cancer/ high risk (Atypia)
  - Work-up from screening exam
  - 6-month f/u
  - Family history of early breast cancer – BRCA genes

Diagnostic Mammography

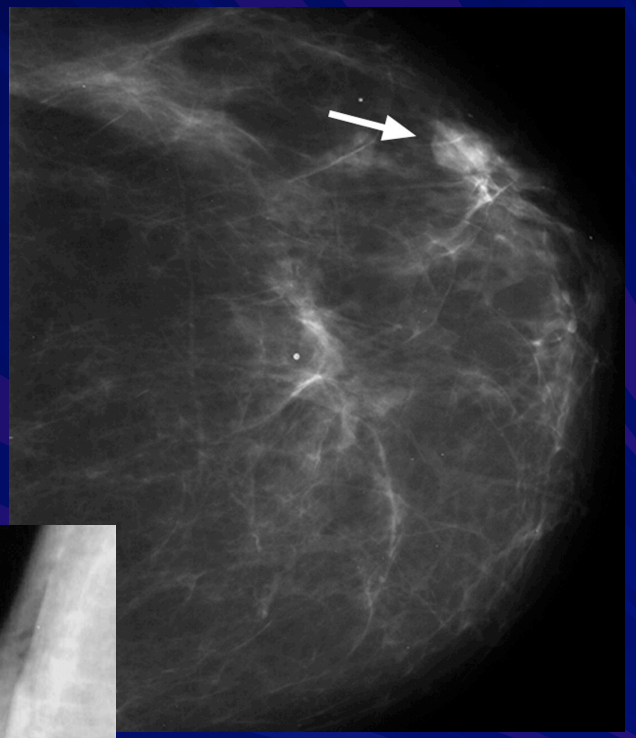
- Why do I need extra mammographic images
  - True lesions vs Pseudolesion
  - Characterization
    - Masses
      - Benign vs Suspicious
    - Calcifications
      - Benign vs Indeterminate vs Suspicious
  - Extent of a suspicious mass or calcifications

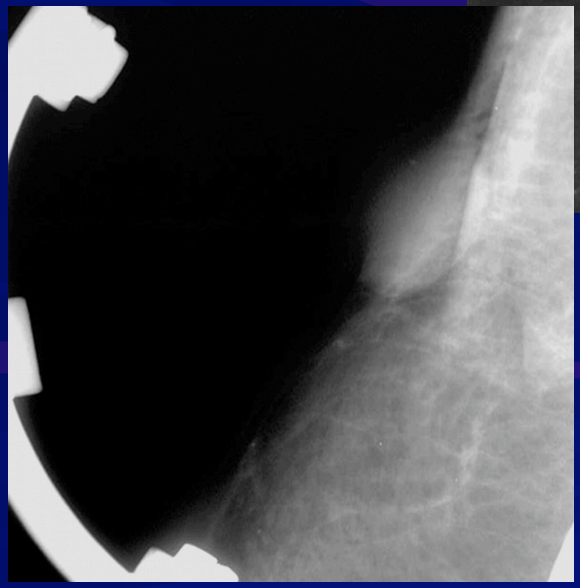
Mass, palpable, asymmetric density, architectural distortion

- Identify location
  - Need two orthogonal views to pinpoint location
  - Especially important to direct ultrasound evaluation / biopsy
- Characterize abnormality
  - Density
  - Borders
  - Associated calcifications

Benign Masses

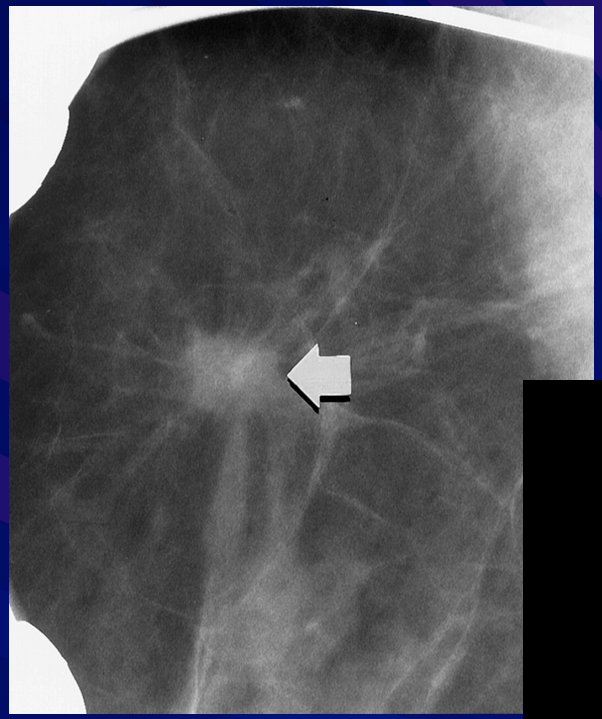
- Calcified Fibroadenoma
- Intramammary Lymph Node
- Hamartoma
- Skin masses

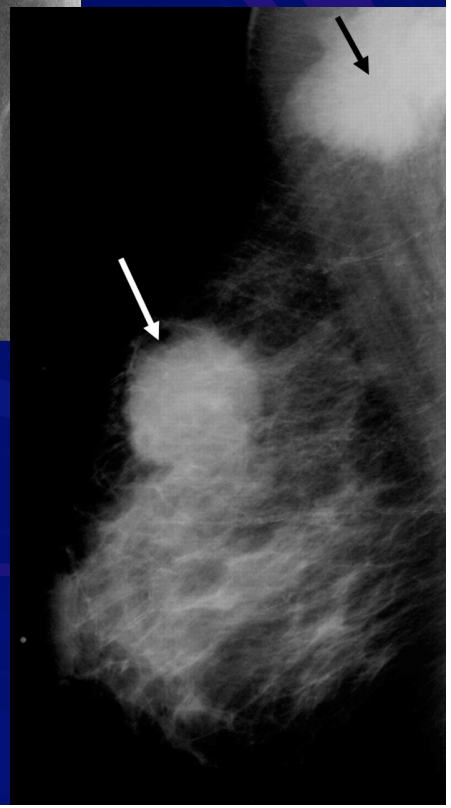




Malignant Masses

- Spiculated borders
- Irregular shape
- Associated suspicious calcifications
- Distortion in the absence of prior surgery
- Higher density than surrounding tissue



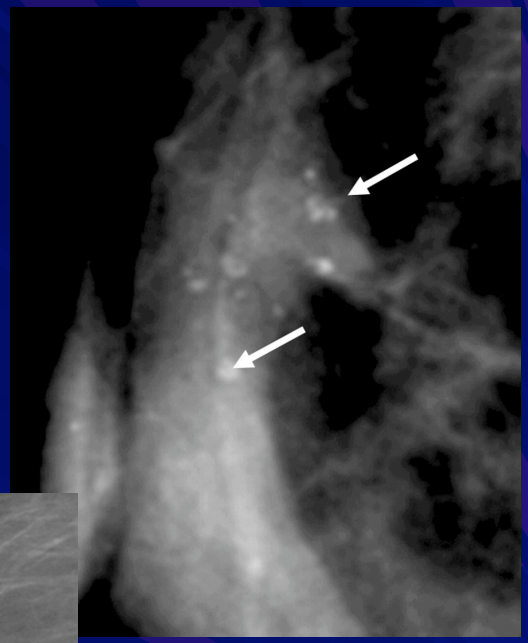


Calcifications

- Why do we care
  - Some cancers will become apparent only as calcifications
    - Mostly Ductal Carcinoma in Situ (DCIS)
    - But some Invasive (Infiltrating) cancers will not have a visible mass only calcifications
- Typically Benign Calcifications (no further work up)
- Certain to be Malignant
- Indeterminate- 10-20% chance of malignancy

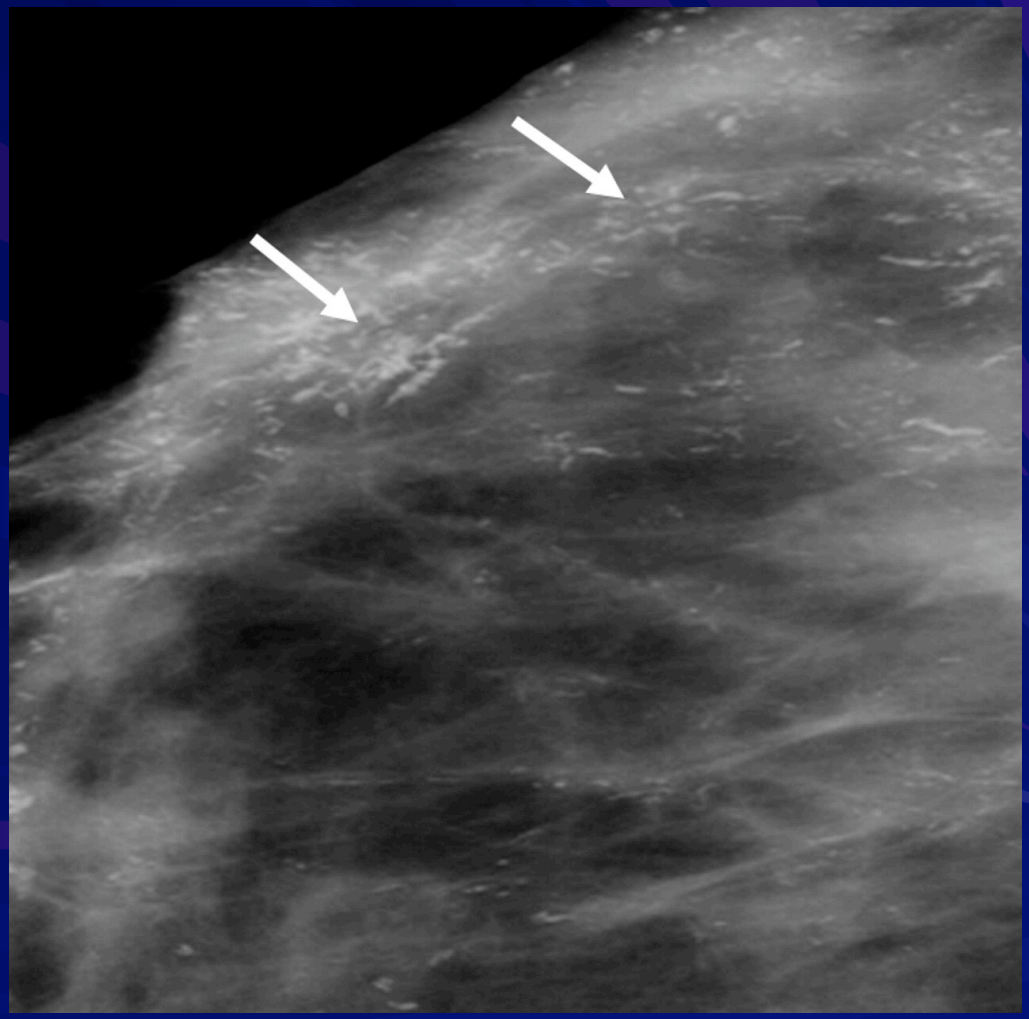
Typically Benign Calcifications (no further work up)

- Vascular
- Rim calcified oil cysts
- Skin (dermal)
- Milk of Calcium
- Secretory
- Macrocalcifications
- Diffusely scattered and bilateral

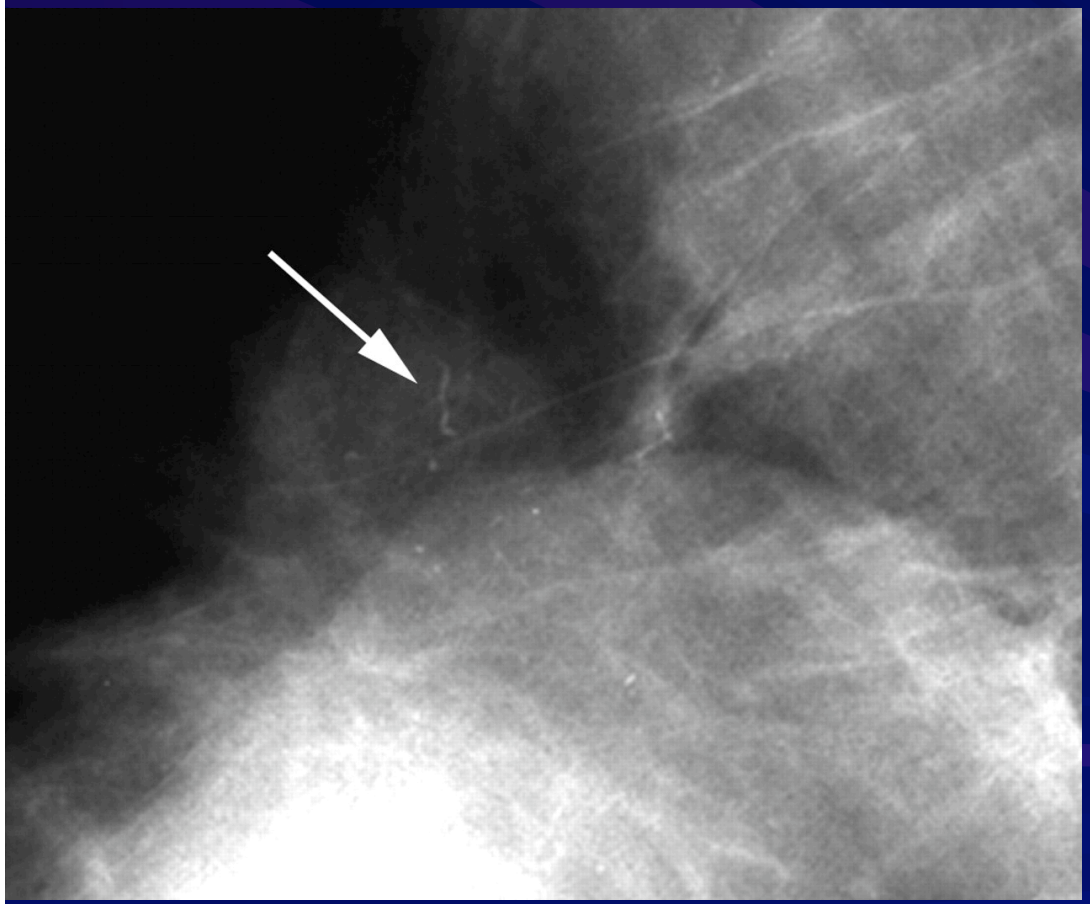


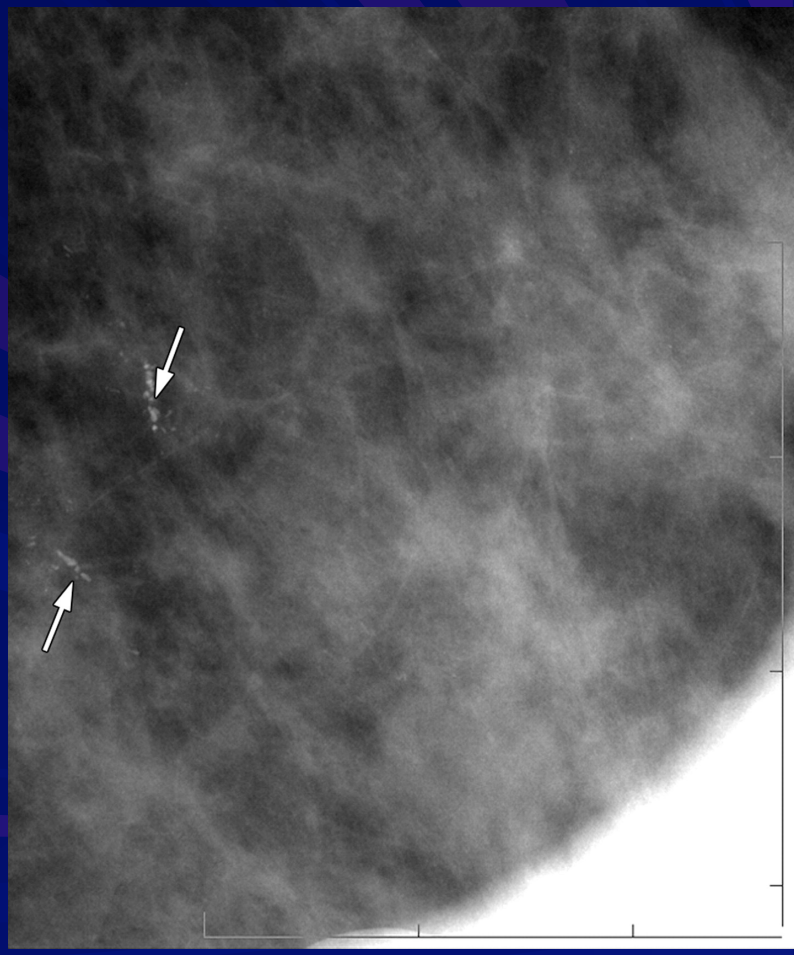
Certain to be Malignant Microcalcifications

- crushed stone appearance
- fine linear branching
- dot-dash linear
- Triangular distribution pointing to the nipple



Certain to be Malignant Microcalcifications





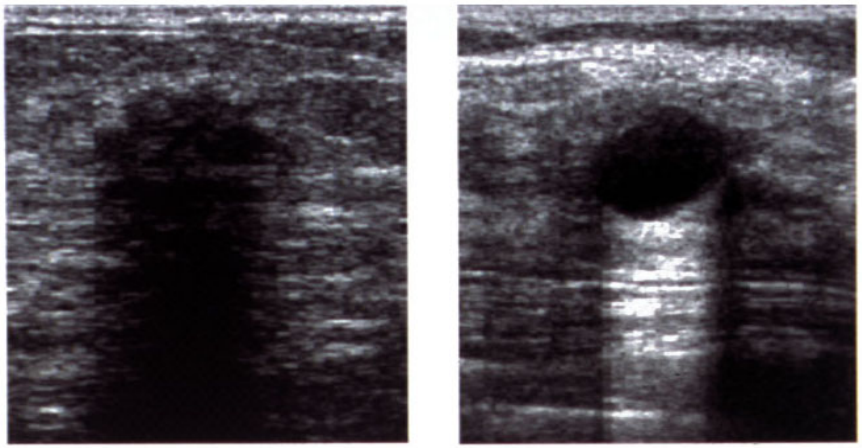
Diagnostic Ultrasound

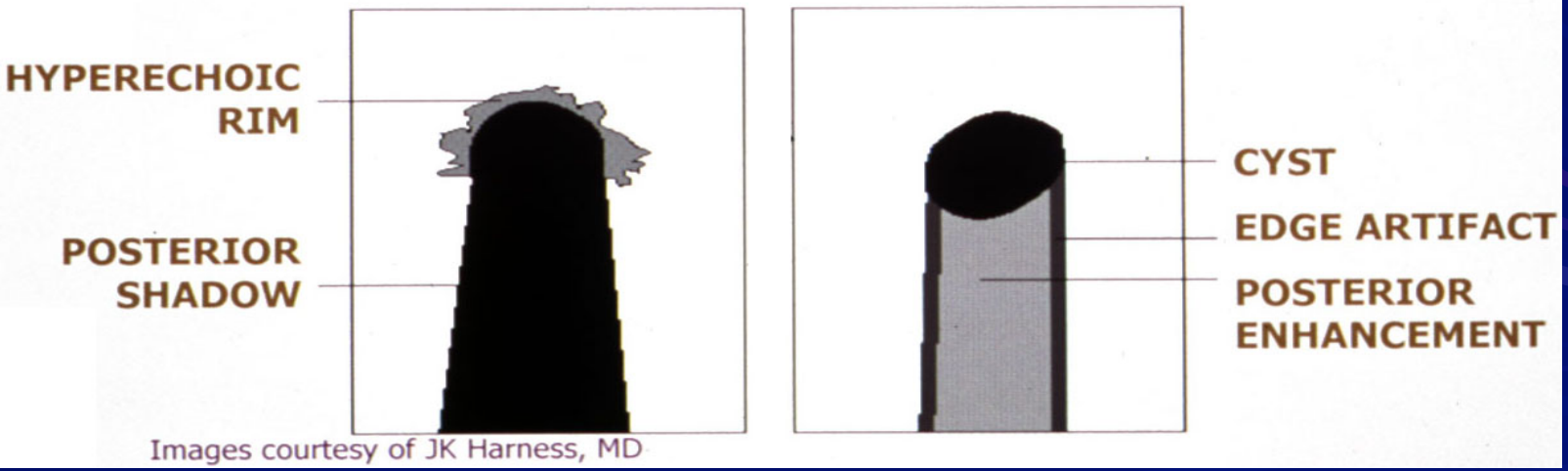
- Evaluate Palpable
- Characterize mass
  - Shape
  - Shadowing
  - Echogenicity
- Elastography

Diagnostic Ultrasound

- To assess a mammographically apparent mass
  - Cyst vs solid
  - To identify mass so ultrasound biopsy can be performed
- Evaluate a palpable
- Evaluate for an underlying mass when malignant appearing calcifications are present
  - allowing for easier biopsy and better chance of biopsying the invasive portion of the cancer
- Evaluate ducts for masses when clear or bloody nipple discharge is present
- Evaluate axillary lymph nodes

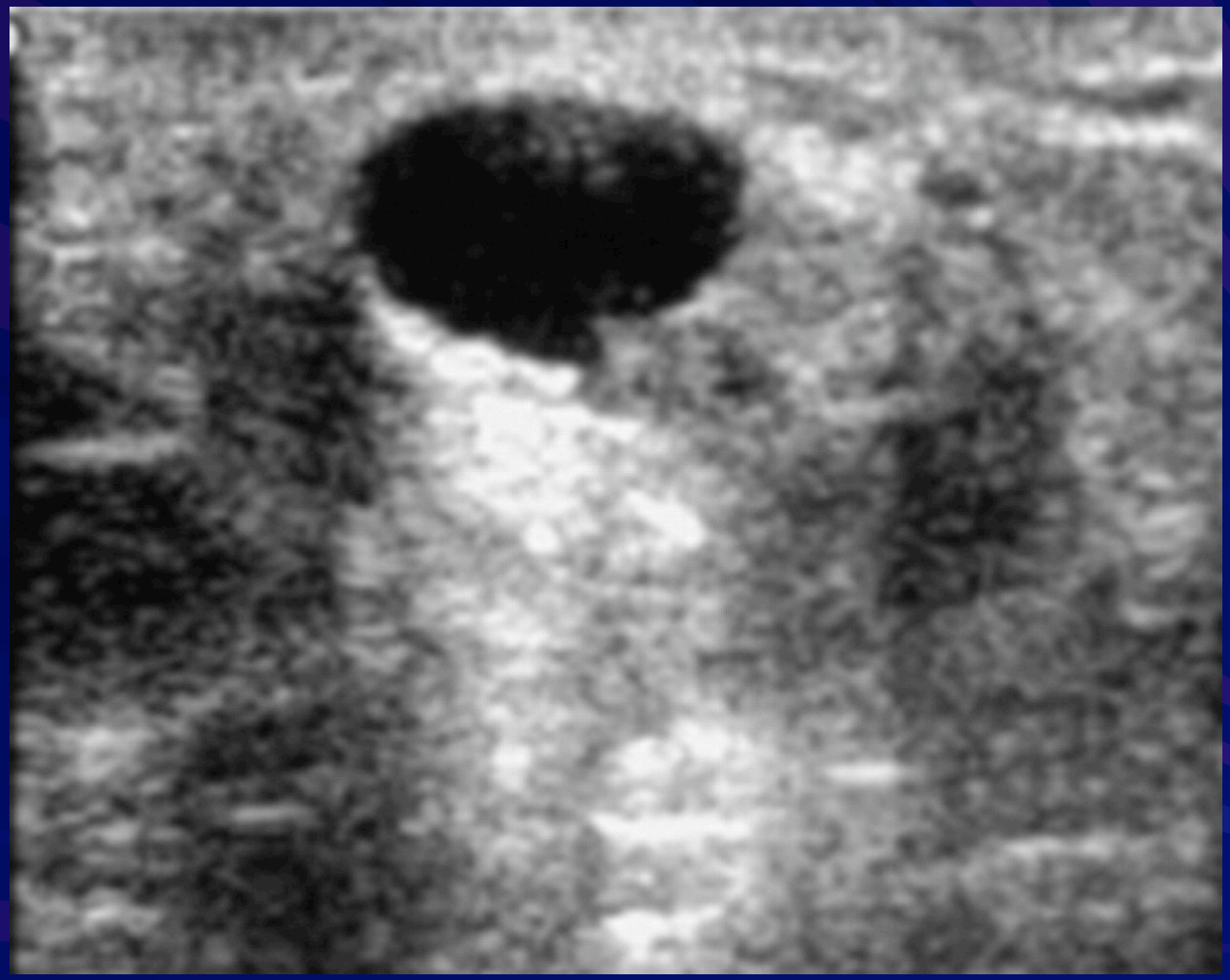
Breast Ultrasound
Malignant Benign





Images courtesy of JK Harness, MD

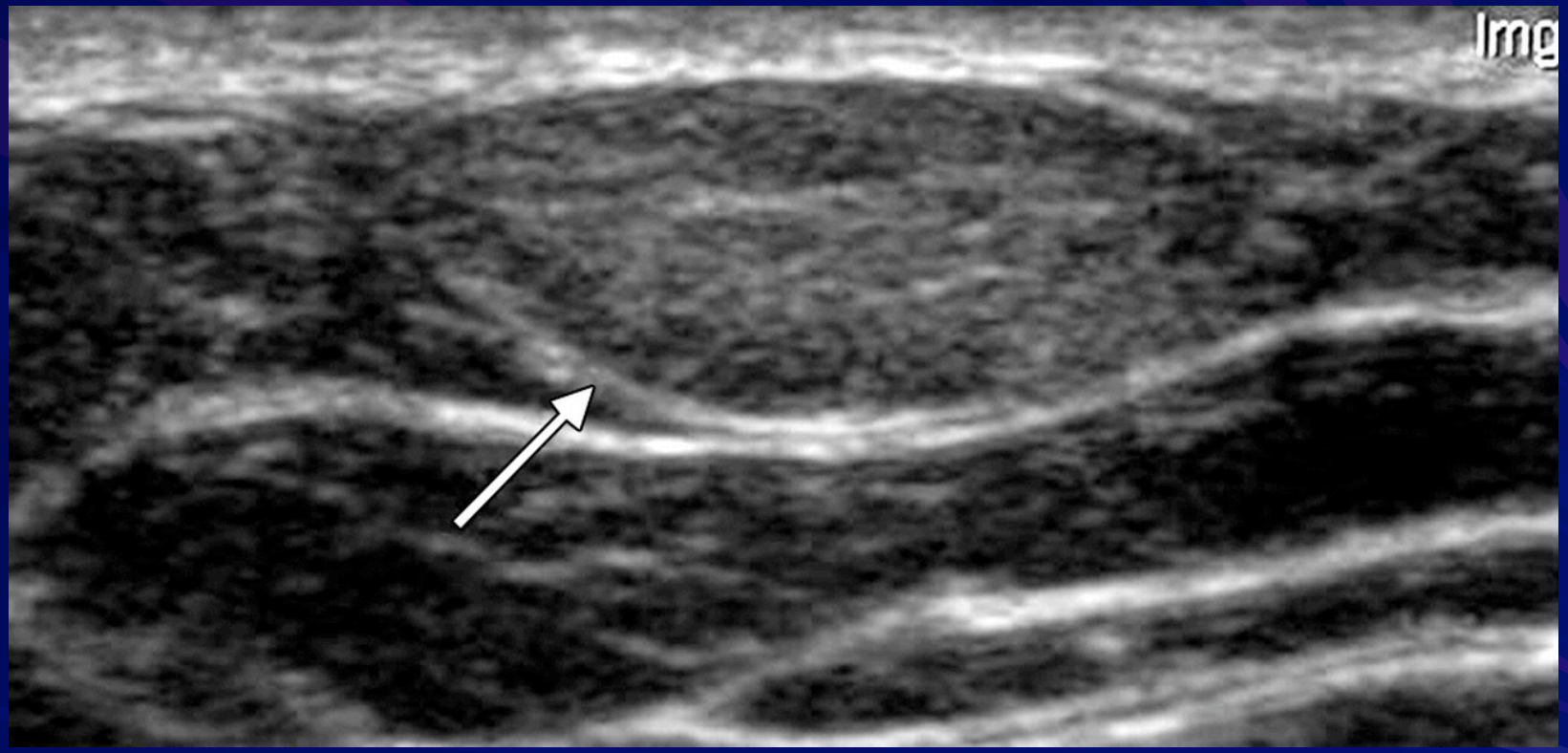
Simple Cyst



Da Costa D et al. Radiographics 2007;27:S65-S77

RadioGraphics

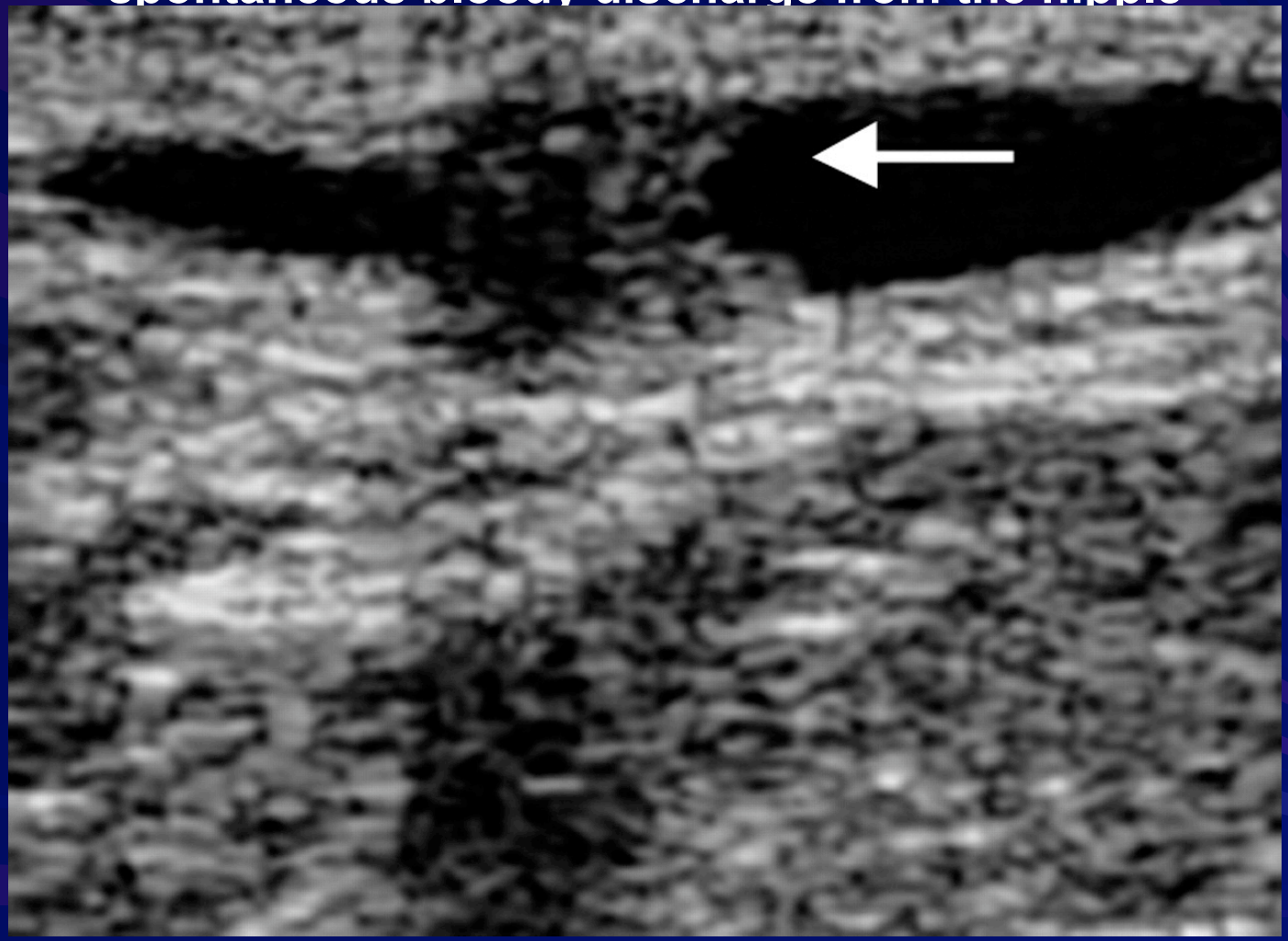
Lipoma



Chen L et al. Radiographics 2006;26:993-1006

RadioGraphics

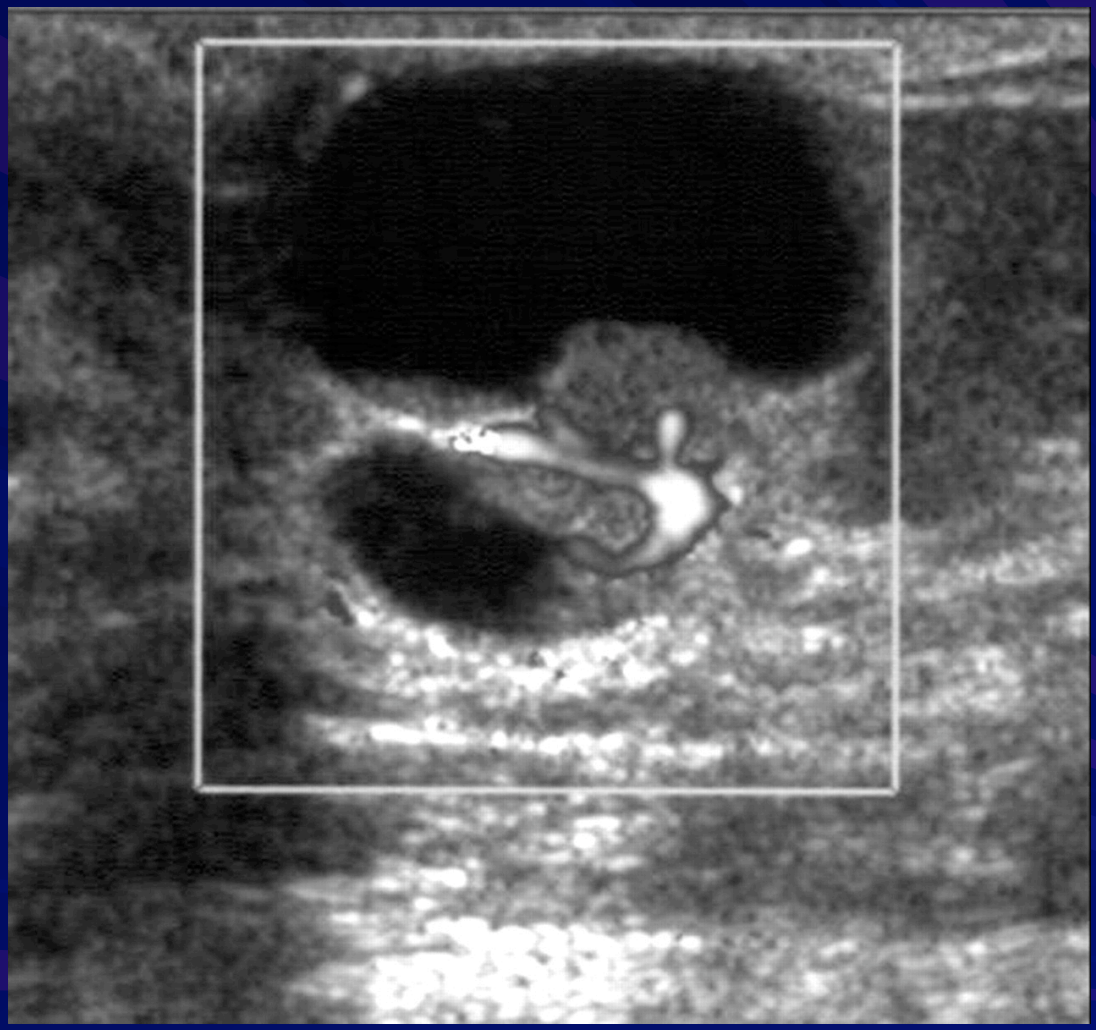
Intraductal lesion in a 42-year-old woman with recent onset of a spontaneous bloody discharge from the nipple



Da Costa D et al. Radiographics 2007;27:S65-S77

RadioGraphics

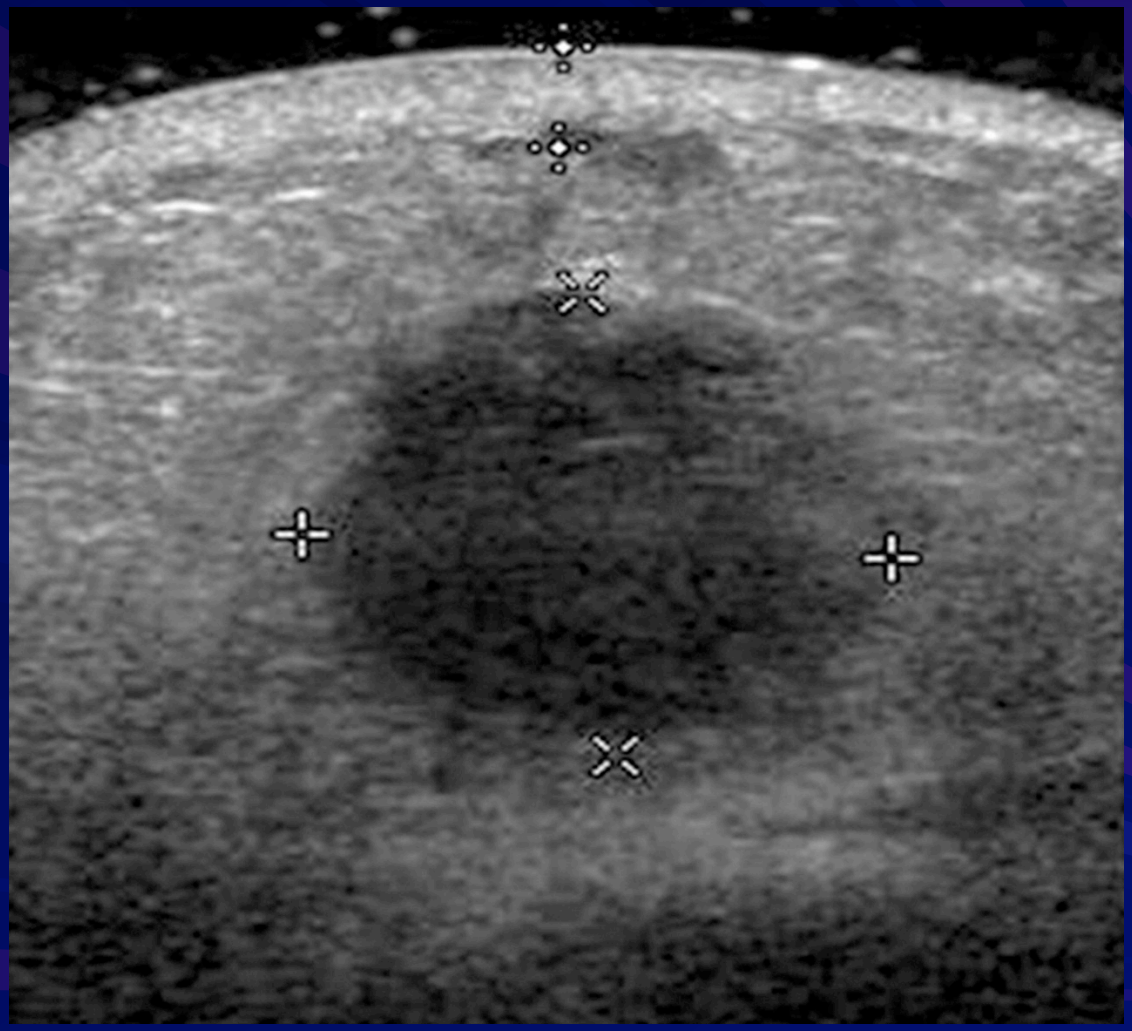
Papilloma in a 71-year-old woman



Doshi D J et al. Radiographics 2007;27:S53-S64

RadioGraphics

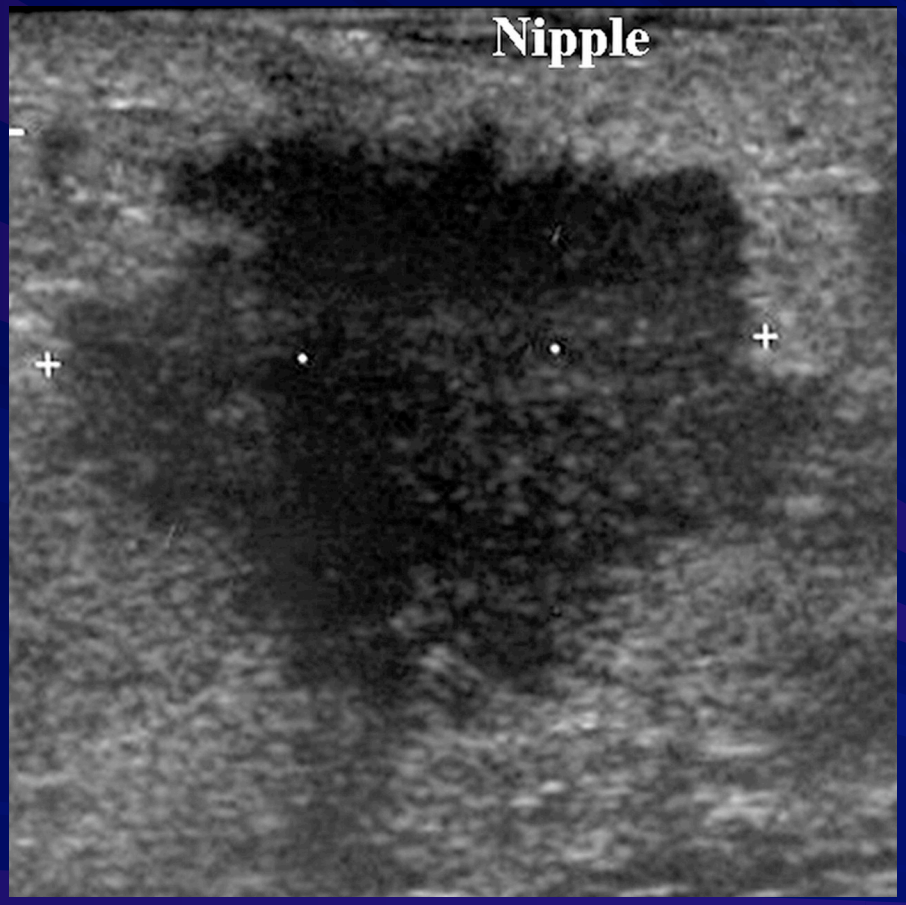
Invasive ductal carcinoma in a 52-year-old man with a palpable mass



Chen L et al. Radiographics 2006;26:993-1006

RadioGraphics

Bilateral invasive ductal carcinoma with bilateral axillary lymph node metastases in a 48-year-old man with Klinefelter syndrome and a history of bilateral breast lumps for several months.



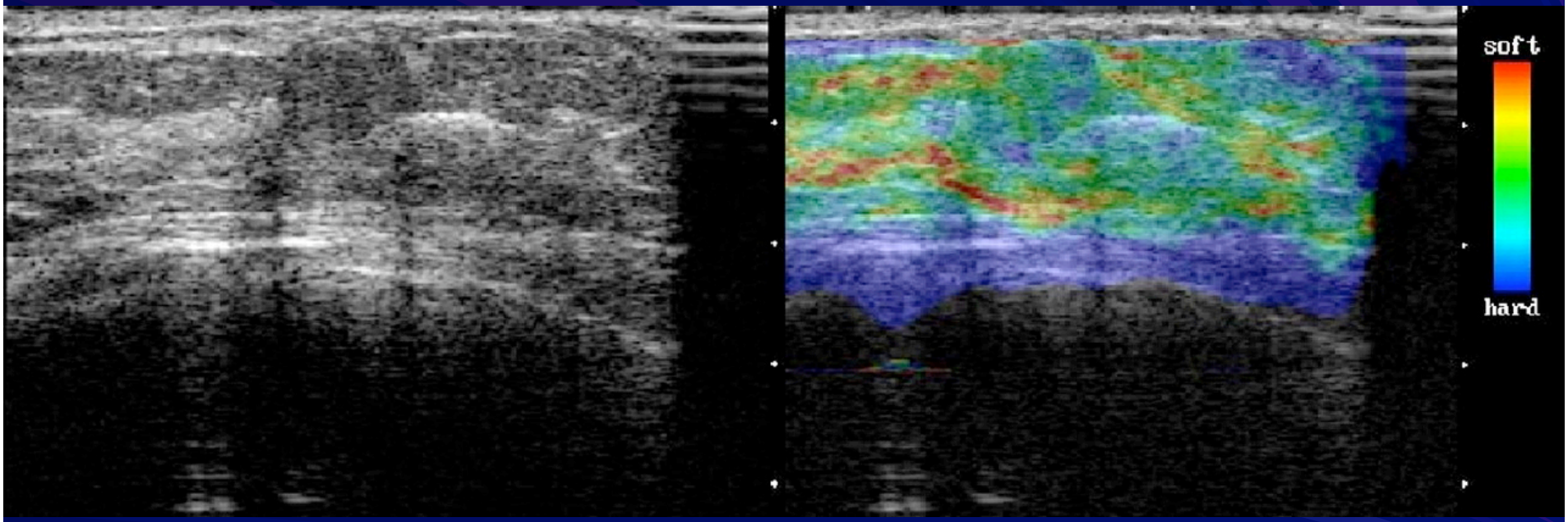
Chen L et al. Radiographics 2006;26:993-1006

RadioGraphics

Ultrasound Elastography

- Evaluates solid masses to determine the ability of the tissue to deform and return to normal
- Color coded
  - Benign masses more easily deform and return to normal than malignant masses. Thus may be followed instead of biopsied.

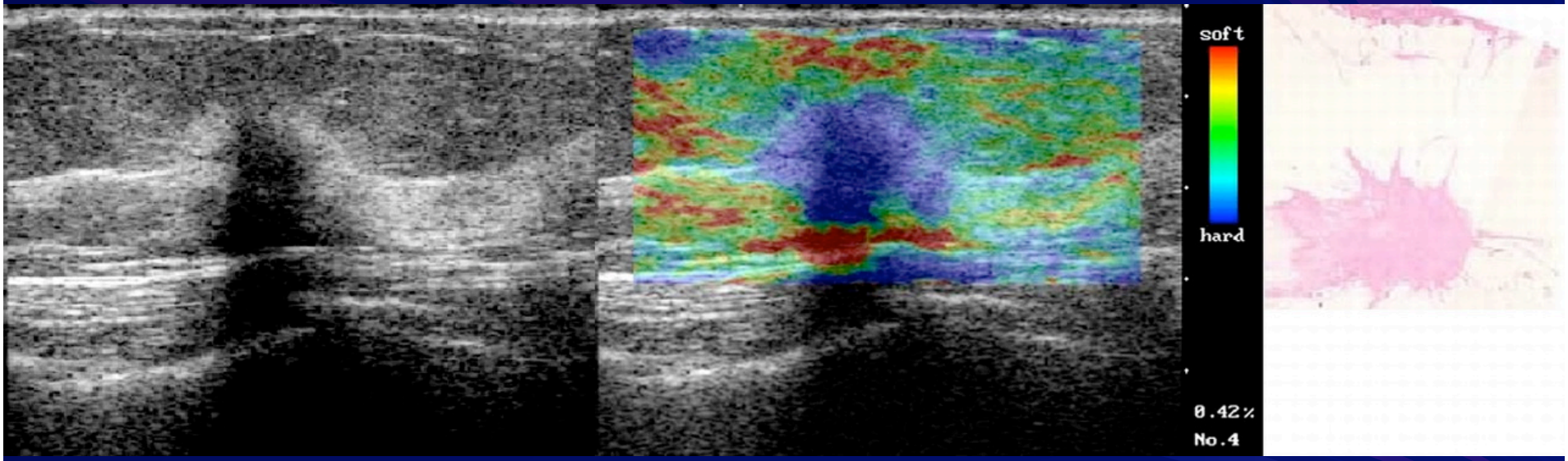
Fibroadenoma with elasticity score of 1 in 51-year-old



Itoh A et al. Radiology 2006;239:341-350

Radiology

Scirrhous type invasive ductal carcinoma with elasticity score of 5 in 55-year-old woman



Itoh A et al. Radiology 2006;239:341-350

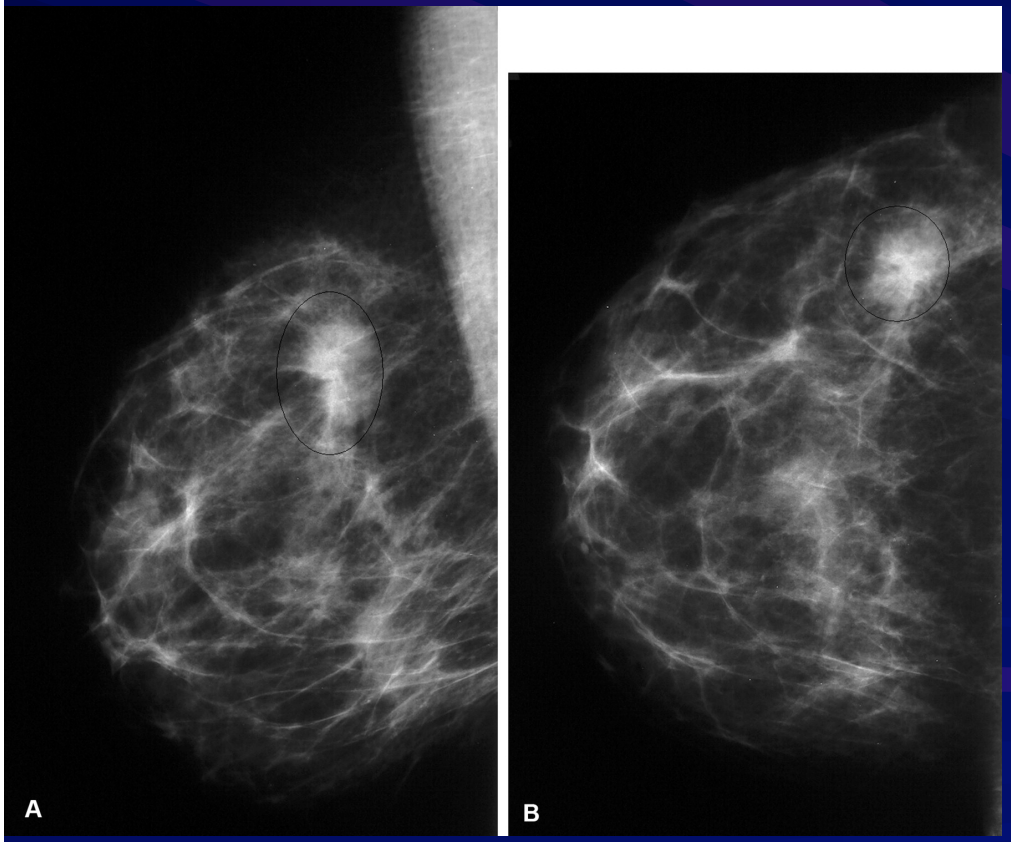
Radiology

Diagnostic MRI

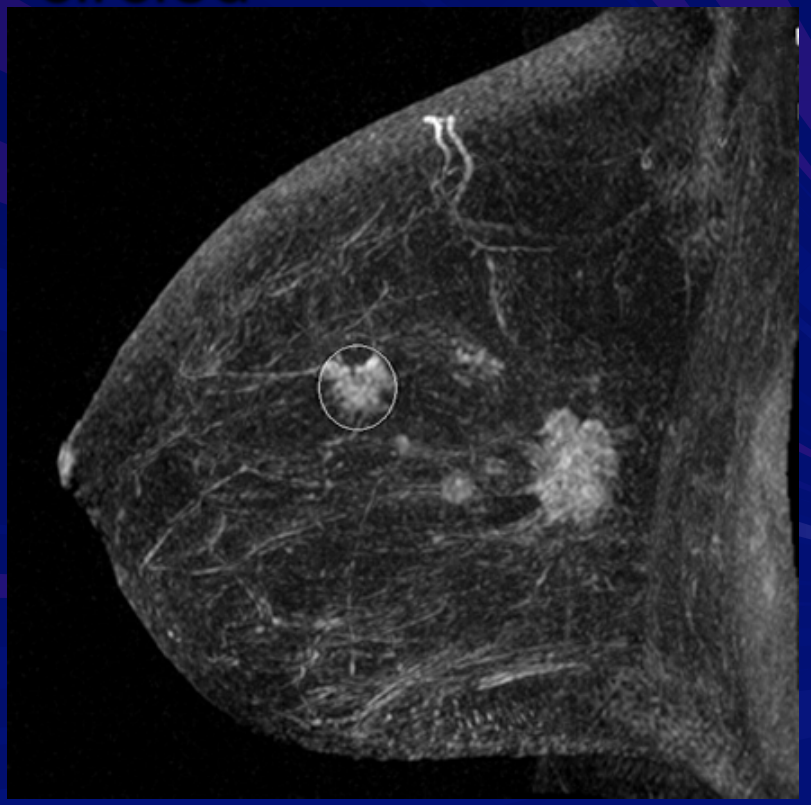
- Characterize abnormality on Mammography/Ultrasound
- Palpable Without Imaging correlate
  - May be denied by insurance
- Evaluate for extent of Newly diagnosed cancer prior to treatment
- Evaluate for response to Neoadjuvant chemotherapy
- Evaluate for recurrent breast cancer

Same patient

- Mammogram



- MRI of the breast – additional cancer circled



Breast Biopsy Facts

- More than 1.8 million biopsies performed each year
- 80% are benign
- The standard of care is percutaneous biopsy if possible

American Cancer Society 2007 - 2008 Cancer Facts & Figures

American Society of Breast Surgeons 2006 Official Statements

Millenium Research Group, Hologic 2006

Intervention

- **Percutaneous Image guided biopsy**
  - Stereotactic
  - Sonographic
  - MRI
- **Surgical biopsy – of imaging abnormality**
  - Wire localization
  - Radioactive Seed localization
    - New method to mark the abnormality instead of using a wire

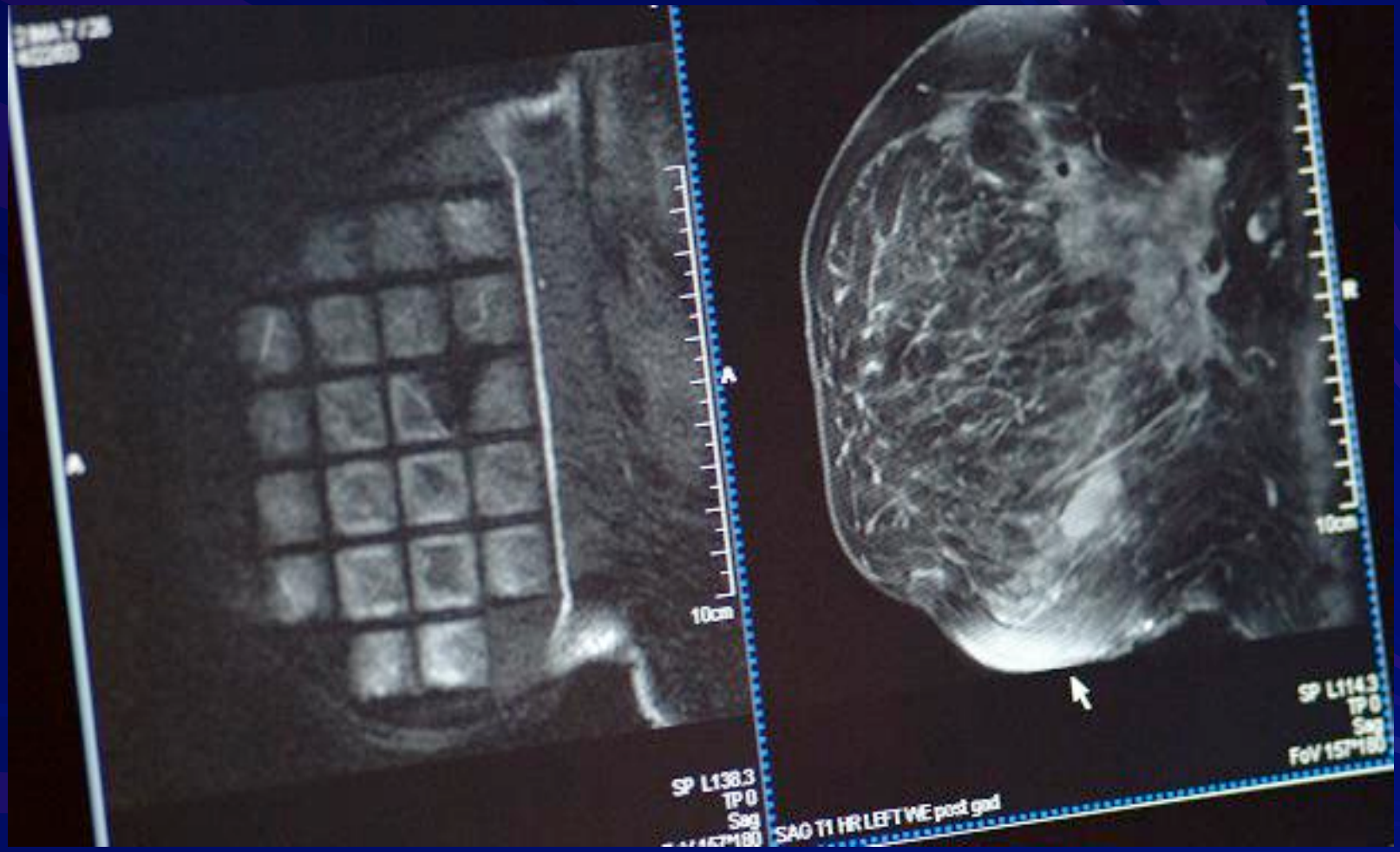
Stereotactic Biopsy

Radiology Regional Center

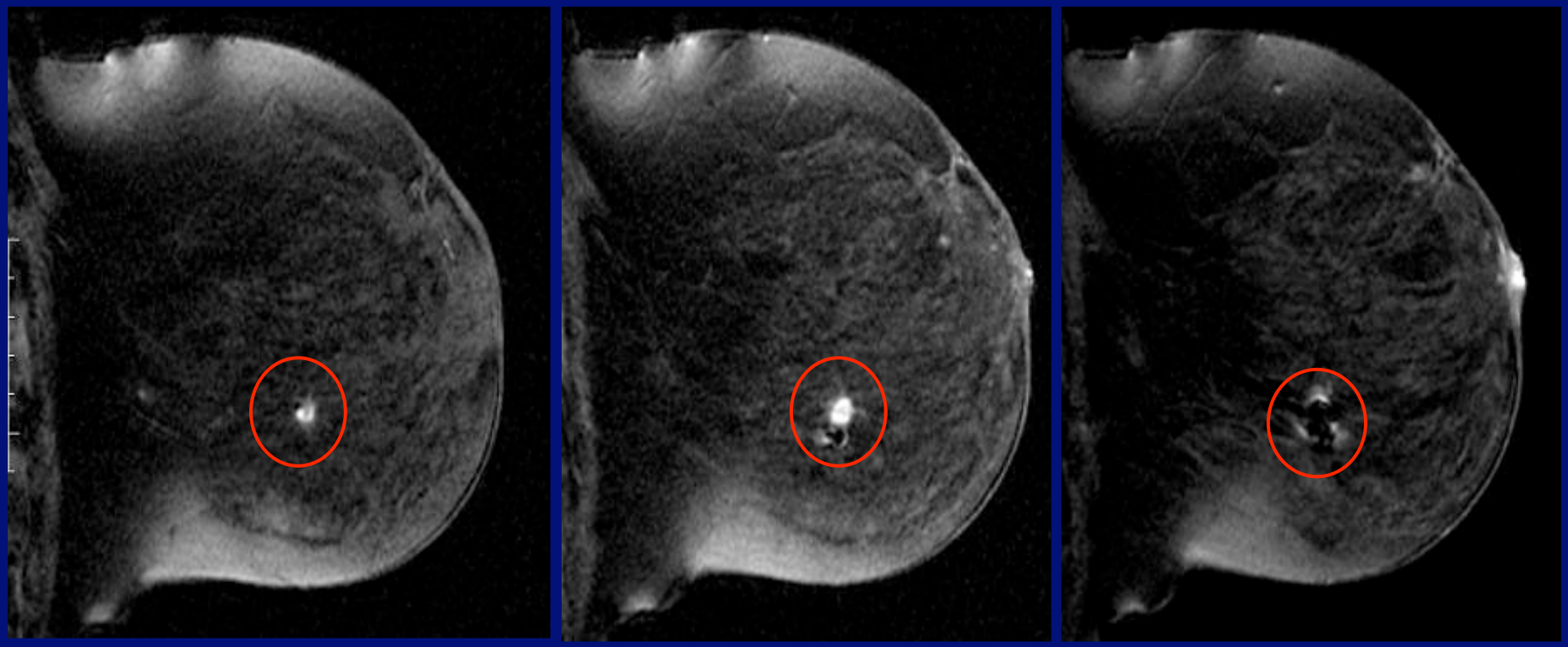
Ultrasound-Guided Biopsy

MRI-Guided Biopsy

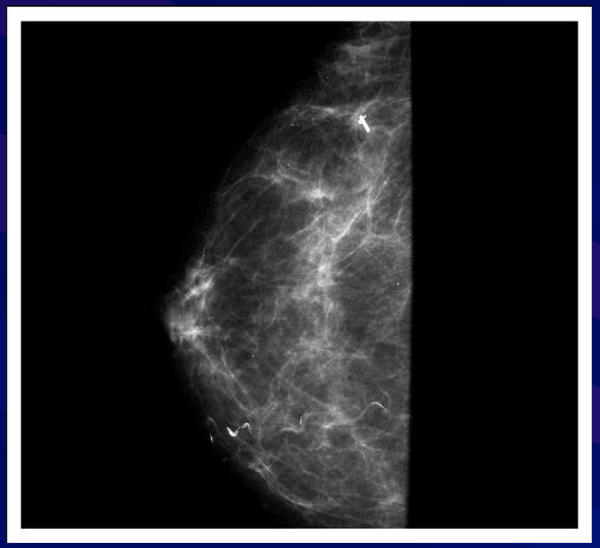
MRI-Guided Biopsy

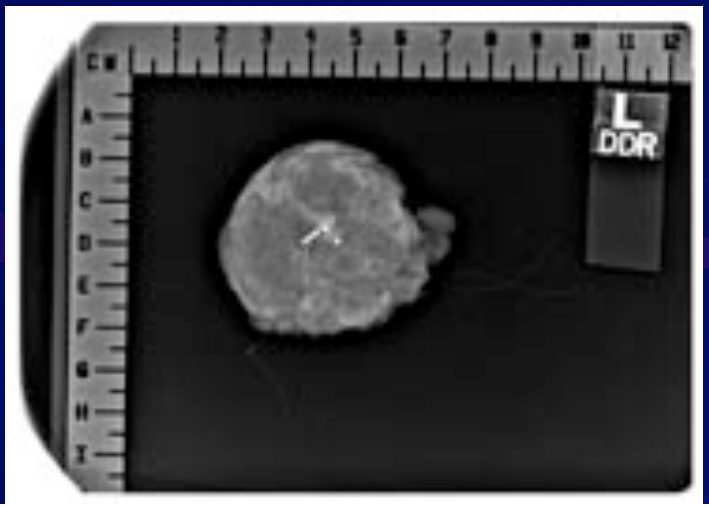


MRI-Guided Biopsy



Radioactive Seed Localization



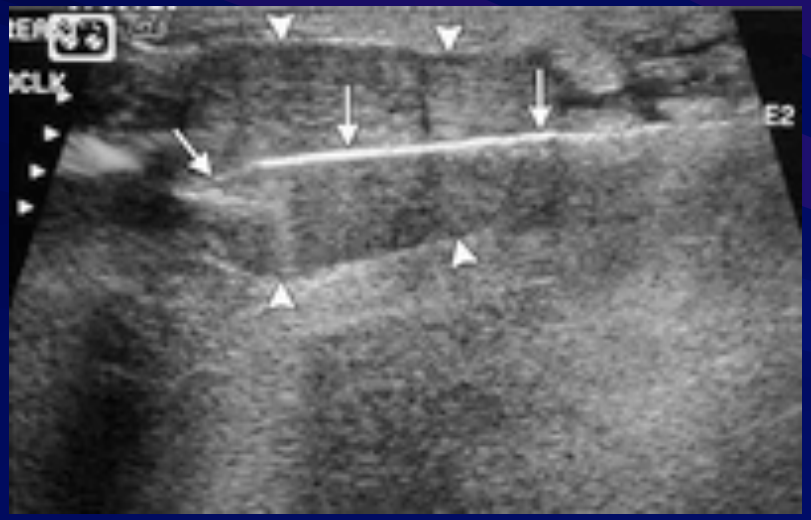


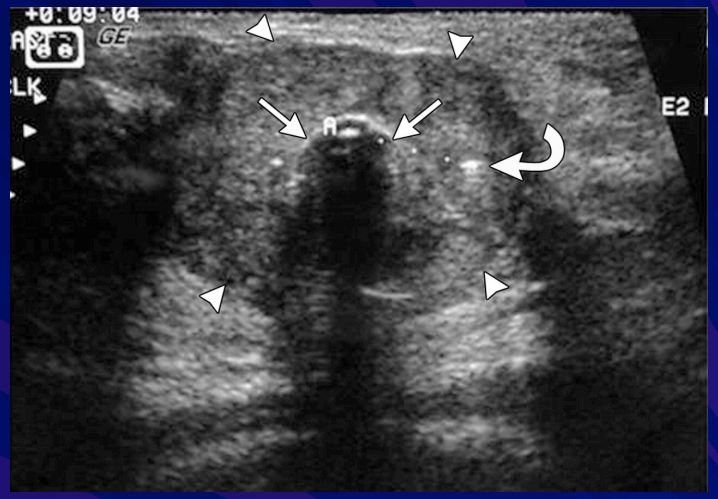
- Up to 5 days prior to surgery.
- Guided by either mammogram or ultrasound, a radiologist places one 4.5×0.8 mm titanium radioactive seed which contains 0.1 to 0.24 mCi of iodine, into a lesion using an 18-gauge spinal needle.
- At surgery, the surgeon uses a gamma probe to locate the seed, and then excises both the lesion and the seed, which is disposed of later following nuclear regulatory guidelines.
- The incidence of positive margins was reduced from 24% to 10% in Mayo Clinical trial.
- Offered at RRC Broadway office in conjunction with trained Breast surgeons.

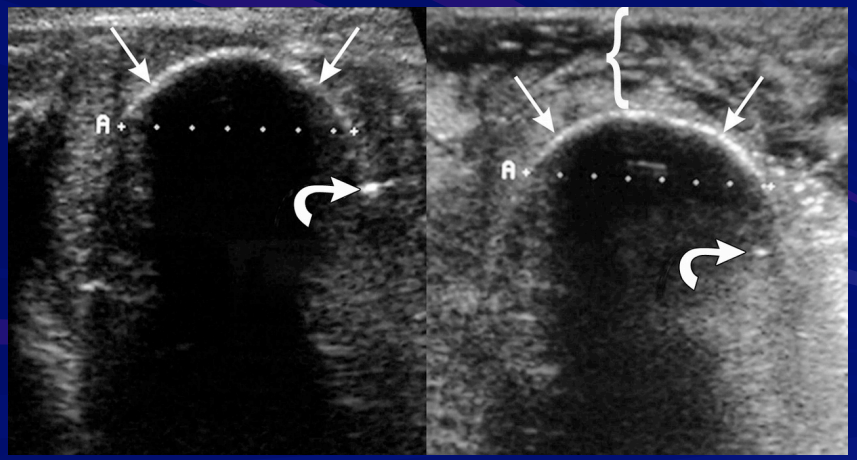
Image Guided Treatment

Sonographically Guided Cryotherapy

- Cryotherapy of a fibroadenoma







Littrup P J et al. Radiology 2005;234:63-72

ACCESS

- LEE COUNTY:
  - PARTNERS FOR BREAST CANCER CARE
  - FROM OUR HEARTS (PINE ISLAND)
  - LEE WE CARE
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- AMERICAN CANCER SOCIETY
- KOMEN FOUNDATION
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