



# CIBC 2019

Chicago International Breast Course  
The Westin Chicago River North  
November 1-3, 2019



## BREAST ULTRASOUND AT ITS BEST

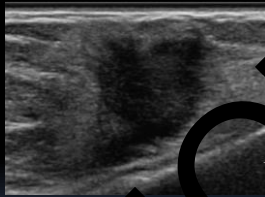
Janet R Szabo MD  
Icahn School of Medicine at Mount Sinai



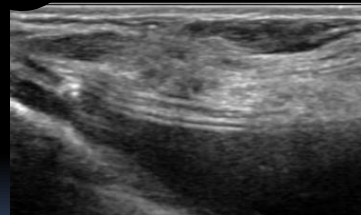
- Disclosures: none

## GOALS AND OBJECTIVES

- Review breast anatomy on US
- Image optimization
- Concordance



## WHAT DO YOU SEE?



- ANATOMY
- TECHNIQUE
- CORRELATION



## ANATOMY

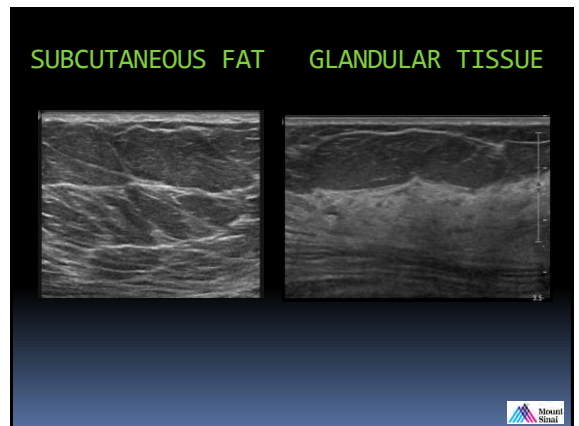
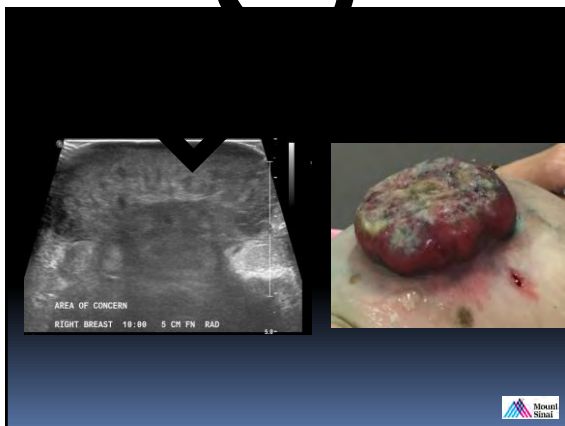
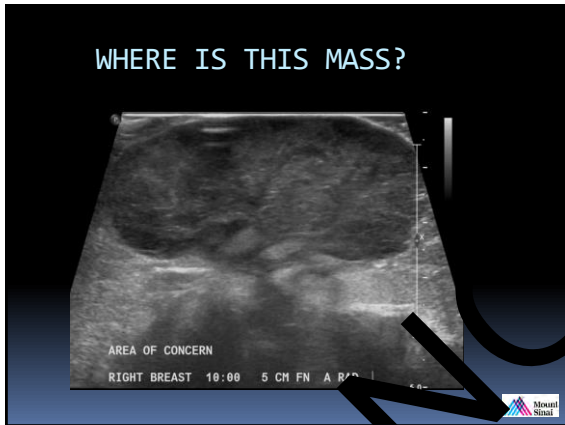
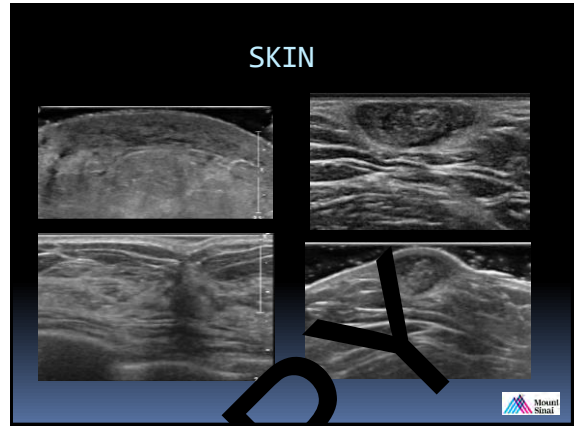
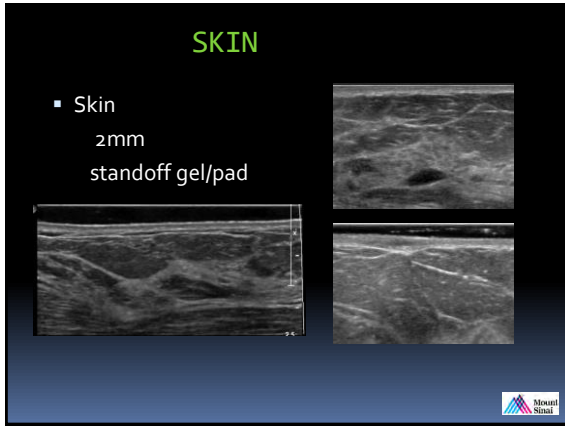
- Skin
- Subcutaneous fat
- Glandular tissue
- Chest wall
- Nipple
- Axilla
- Internal mammary nodes





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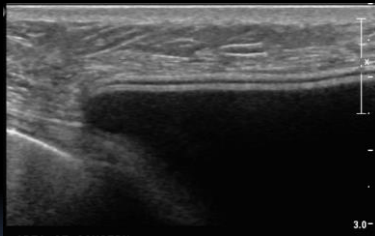
COPY



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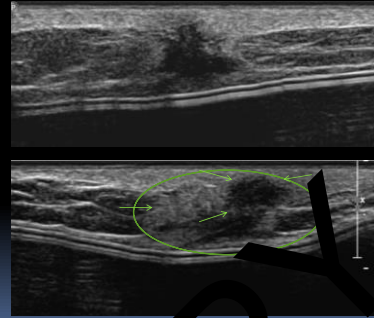
Absence of glandular tissue



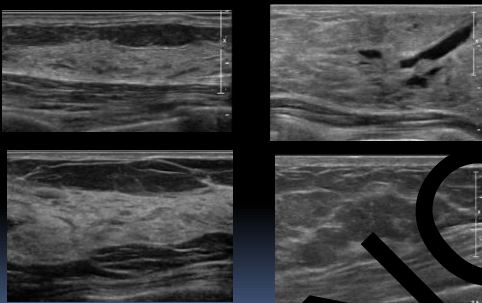
mastectomy



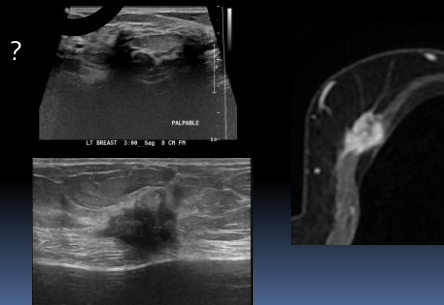
POST MASTECTOMY RECURRENCE



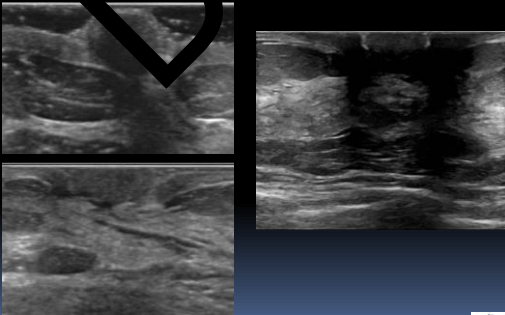
CHEST WALL



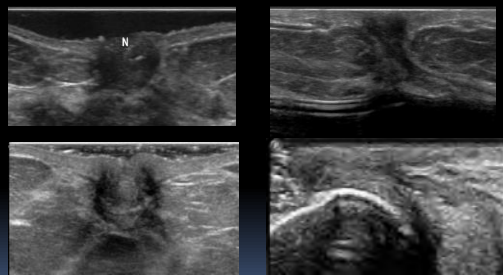
POST MASTECTOMY RECURRENCE WITH PECTORALIS INVASION



NIPPLE



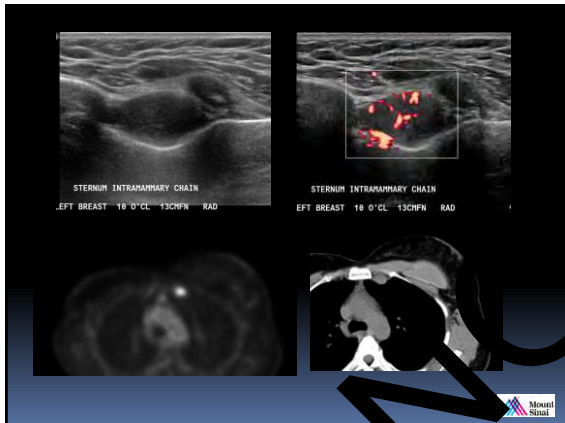
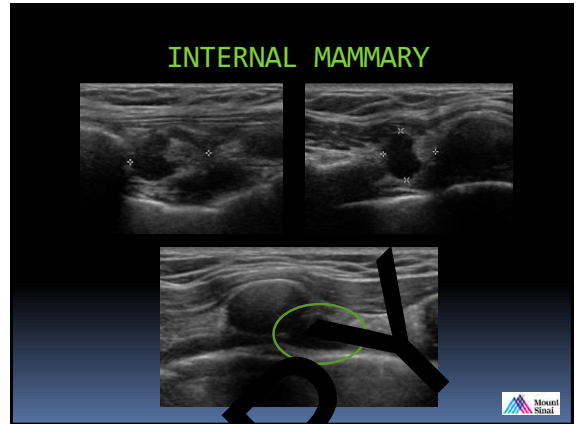
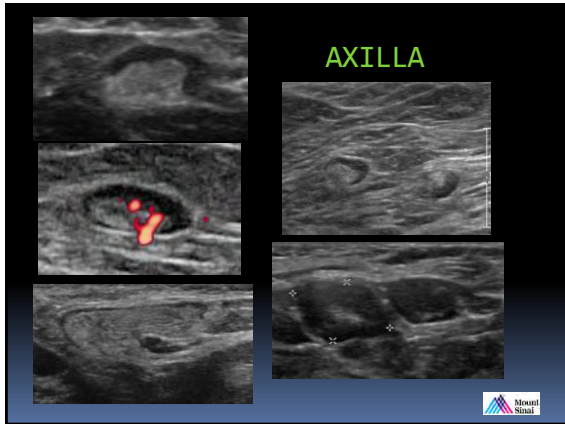
NIPPLE





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**TOOLS**

- ANATOMY
- CORRELATION
- TECHNIQUE
- TOOLS
- EXAM OPTIMIZATION

**TOOLS**

- FOV
- Transducer
- Focal zone
- Time-gain compensation curve
- Total gain
- Dynamic range
- Spatial Compounding
- Harmonics
- Doppler
- Extended field of view
- Speed of sound
- Elastography

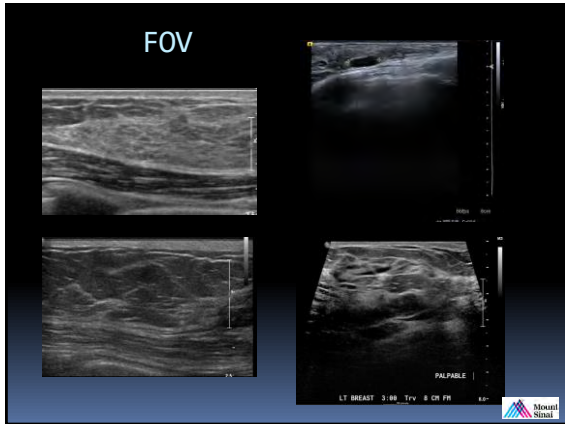
**TOOLS**

- FOV
  - skin to chest wall
  - no lung !
  - patient position



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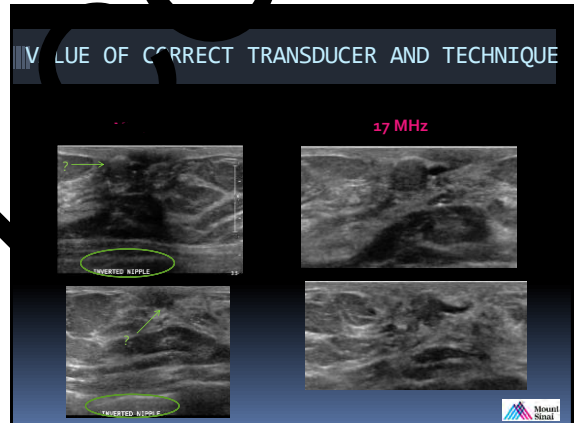
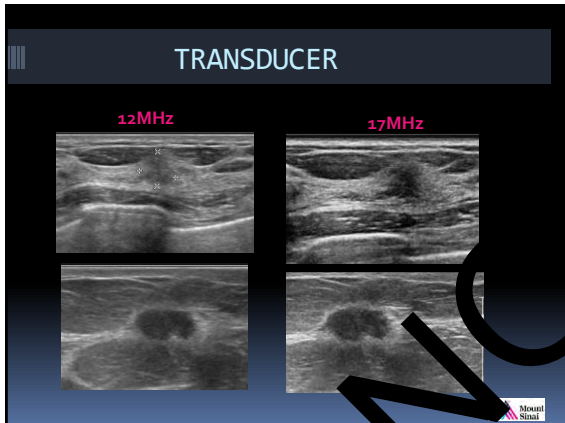
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**TOOLS**

- **Transducer**  
highest frequency that yields quality images  
  
linear 17-5/18-6 MHz  
linear 12-5 MHz

penetration inversely proportion to frequency  
adequate pressure



**TOOLS**

- **Focal zone**  
optimal center of area of interest  
minimally posterior

**TOOLS**

- **Gray scale**
- fat = isoechoic, standard  
mid level gray at all levels  
★ 33.3% breast cancers are isoechoic
- anechoic = simple cyst, high grade malignancy
- hypoechoic = most solid masses
- echogenic  
skin  
Cooper ligaments  
fibroglandular tissue  
calcium  
cancer-rarely



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## TGCCURVE

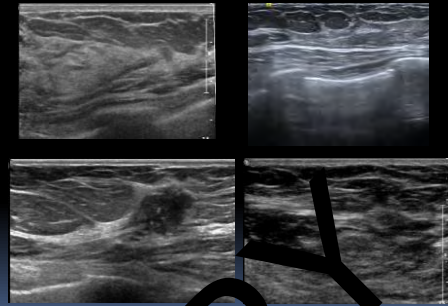
- Beam attenuation
- gradually with depth
- like tissues appear similar despite different depths
- Adjust for special cases

## TOTAL GAIN

- overall brightness
- brightness  $\neq$  penetration
- accentuate incorrect TGC curve



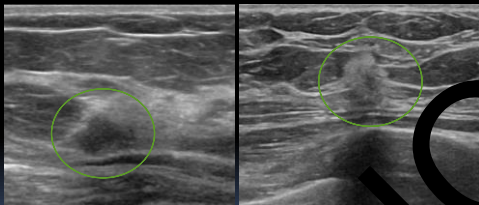
## GRAY SCALE/TGC CURVE



## INVASIVE CANCER

ISOECHOIC

HYPERECHOIC



## TOOLS

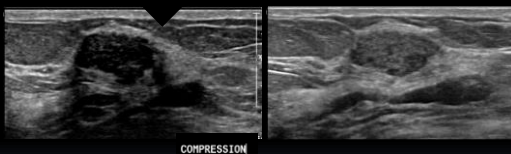
### Dynamic range

- "Compression"
- range of processed/ displayed echoes
- optimal 55–80 dB
- too narrow = mass appears anechoic
- too wide = mass appears isoechoic undetectable



## Dynamic range

### MASS-SCALOR OR MICROCYSTS?



TOO NARROW

CORRECT



## TOOLS

### Spatial Compound imaging

- artifact and noise
  - critical angle phenomenon
  - posterior features
- high contrast
  - spatial resolution
- better edge evaluation
- calcifications

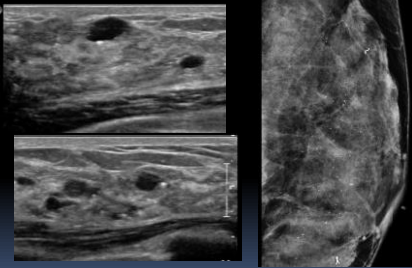




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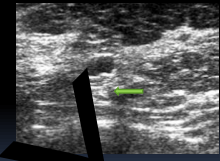
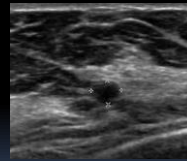
## FIBROCYSTIC CALCIFICATIONS



## POSTERIOR FEATURES

with spatial compounding

without spatial compounding



## TOOLS

### Harmonics

- improves lesion conspicuity in adipose tissue
- enhances contrast
- sharpen margin
- clears low level echos
- deceiving areas of shadowing

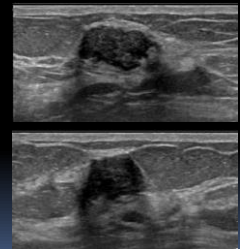
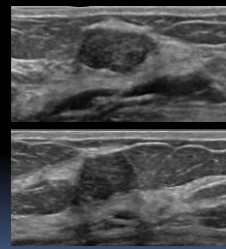


## HARMONICS

contrast and margin

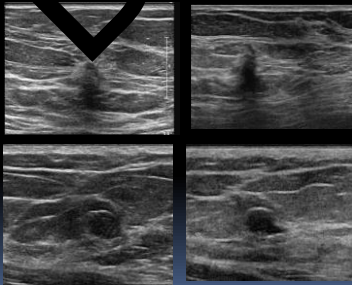
WITHOUT

WITH



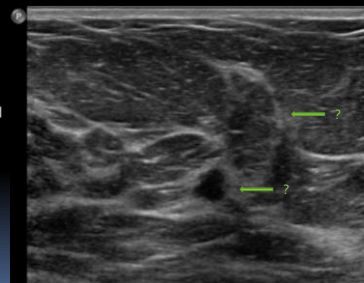
## HARMONICS

target darker than fat



## BIOPSY TARGET?

2D  
55%  
C 72  
P Med  
Res  
TAC1



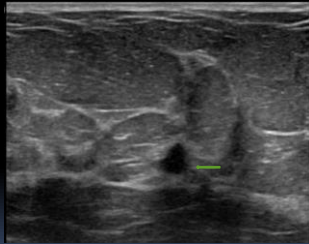


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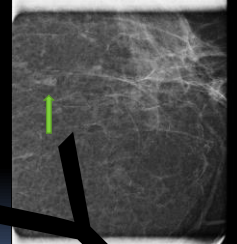
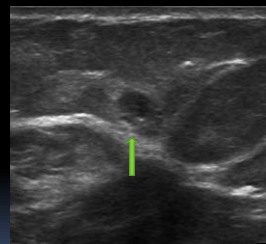
## HARMONICS RESOLVES THE ISSUE AND IDENTIFIES TARGET

2D  
73%  
C 72  
P Med  
HRes  
TACT



## PAPILLOMA IN FATTY BREAST

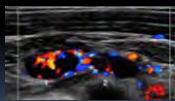
target is darker than fat



## DOPPLER

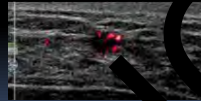
### Color

- direction
- velocity of flow

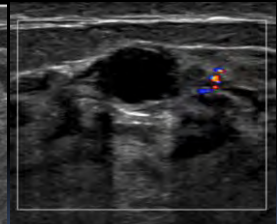
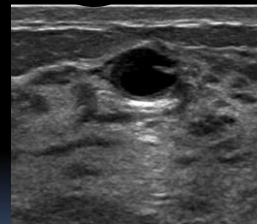


### Power

- signal amplitude
- higher sensitivity for low-flow vessels



## FAE W/O DOPPLER

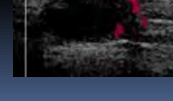
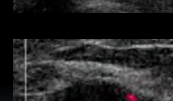
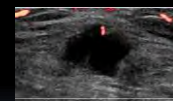
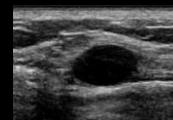
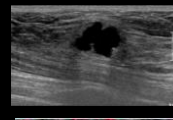


## CRITICAL USE OF DOPPLER

- Anechoic masses
  - cyst
  - high-grade invasive cancer
  - replaced metastatic lymph node
- Hyperechoic mass
- Duct evaluation
  - mass vs debris
  - DCIS
- flow requires biopsy



## TNBC





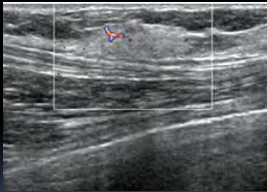


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Echogenic mass w/ vascularity = bx

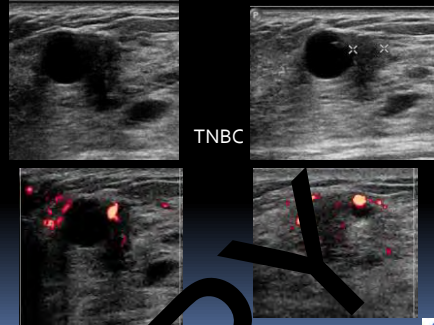
ILC



RadioGraphics 2013; 33:419-434



30 YO W PALPABLE MASS



TNBC

## DOPPLER ARTIFACT

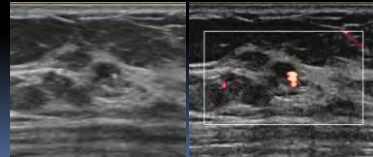
- Twinkle
- Flash
- Fremitus



## DOPPLER ARTIFACT

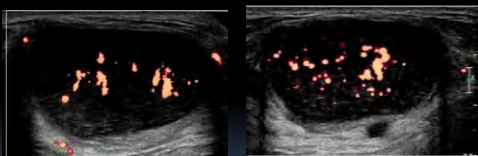
Twinkle

- indicate turbulent flow
- behind strongly echogenic interface
- parenchymal calcification
- biopsy marker clip



## DOPPLER ARTIFACT

Flash  
Motion tissue/cyst contents  
transducer  
patient



## DOPPLER ARTIFACT

- Fremetus
  - acoustic vibrations from the chest wall
  - like tissue vibrates the same
- differentiate
  - isoechoic tumor vs fat lobule
  - multifocal isoechoic disease

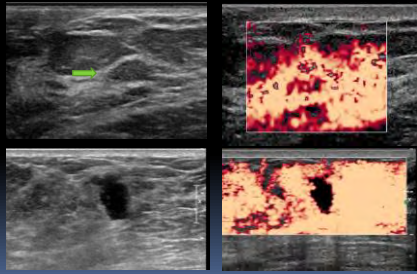




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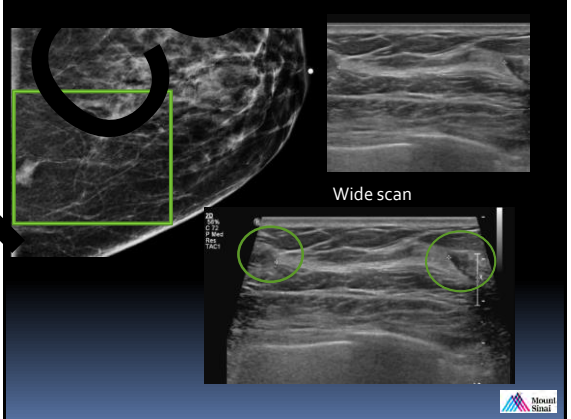
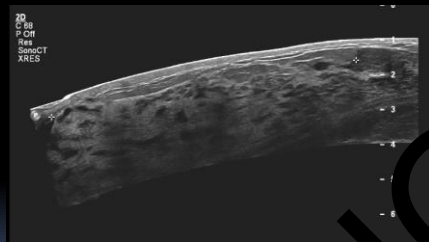
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## Power Doppler Vocal FREMITUS



## TOOLS

- Extended field of view
  - very large masses
- multifocal disease
  - same quadrant / duct system
  - within 4-5 cm
- multicentric disease
  - different quadrant / duct system
  - greater than 4-5 cm

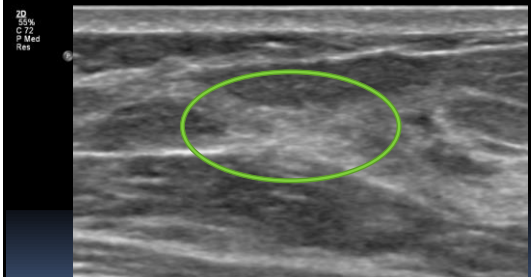


## TOOLS

- Spec of sound
  - set to uniform 1540 m/sec
  - speed of sound in fat = 1430-1470 m/sec
  - interfaces, mass margins and calcifications



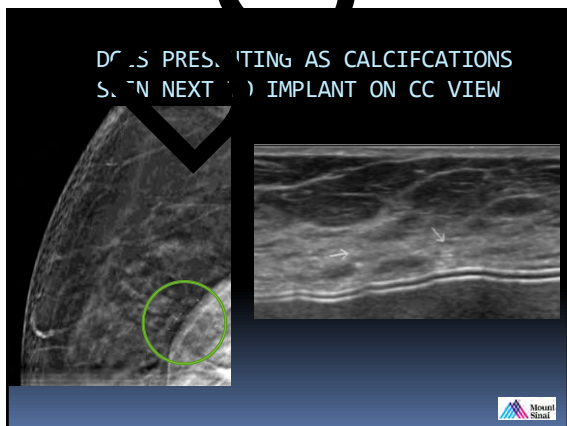
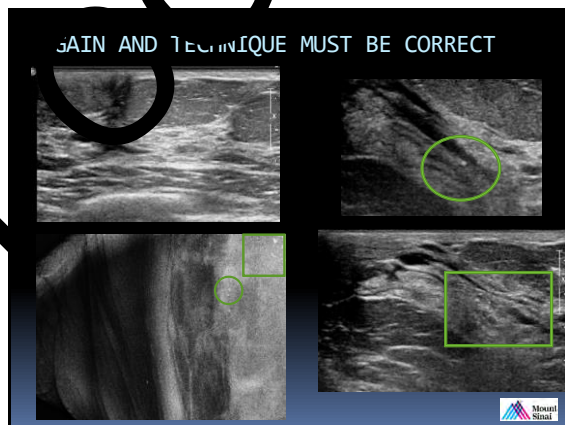
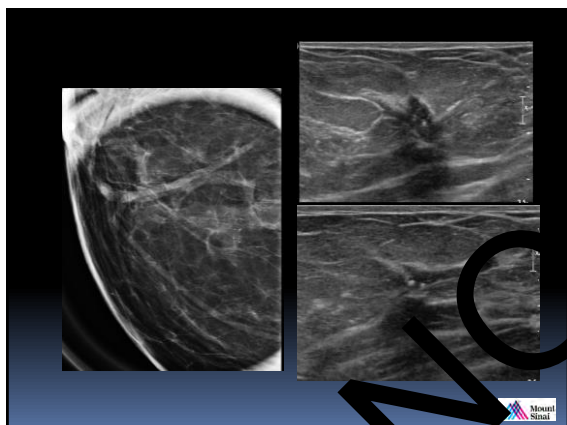
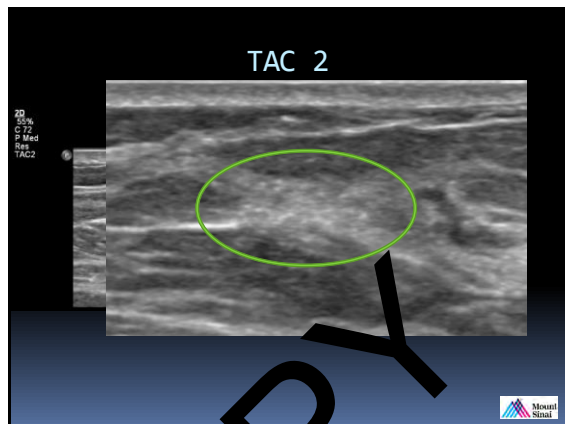
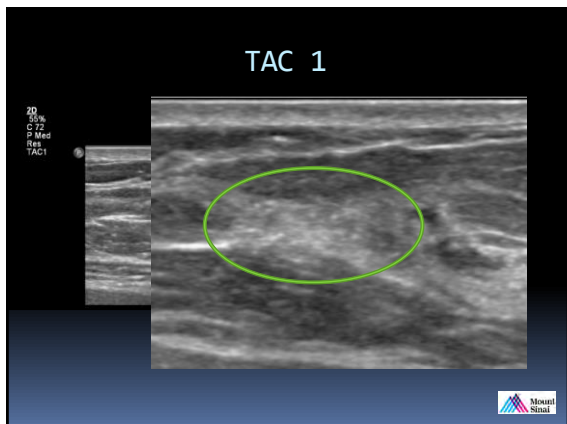
## NO TAC





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TOOLS


- Elastography
  - improve specificity of solid mass stiffness
    - strain vs shear wave
    - less accurate at depth > 2 cm



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- TECHNIQUE
- CORRELATION

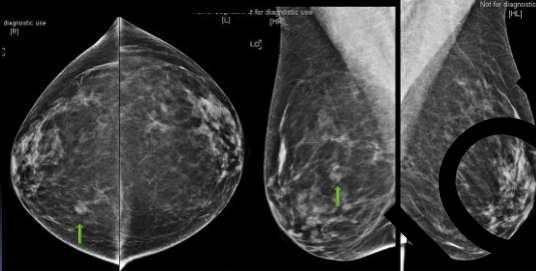



### CORRELATION

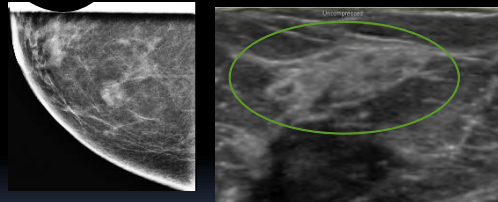

- Mammographic/MRI finding on US :
  - location in the breast
  - surrounding tissue
  - lesion characteristics
    - size / shape - should be similar
    - internal contents
    - landmarks



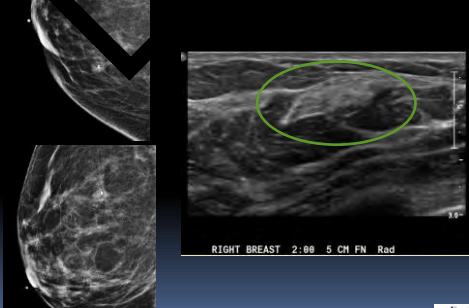

### SCREENING

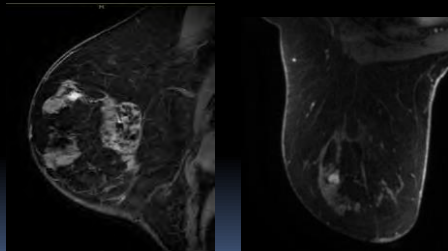

Similar shape  
surrounded by and containing fat

### Dense stromal fibrosis

### Enhancing mass at edge of glandular tissue

COPY

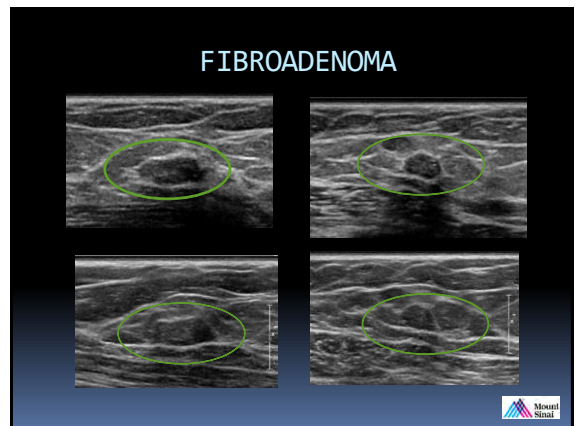
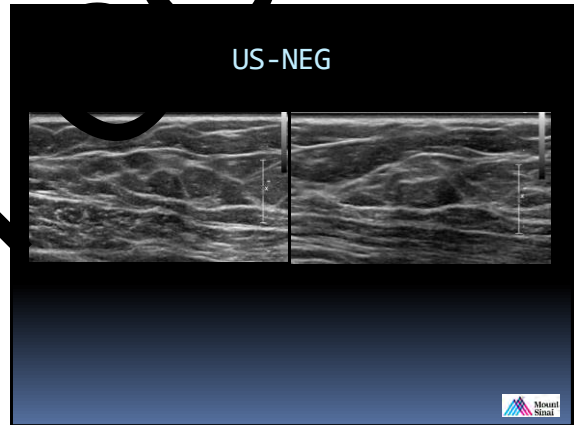
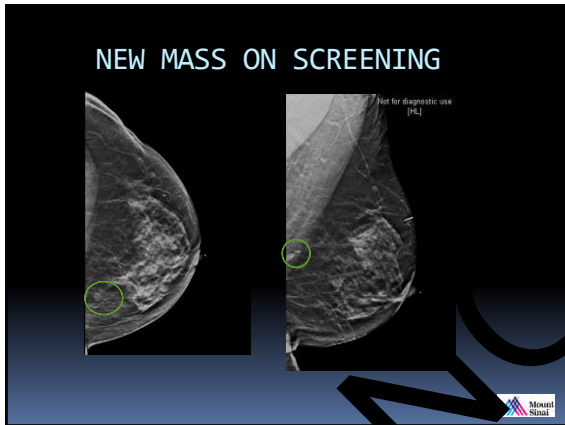
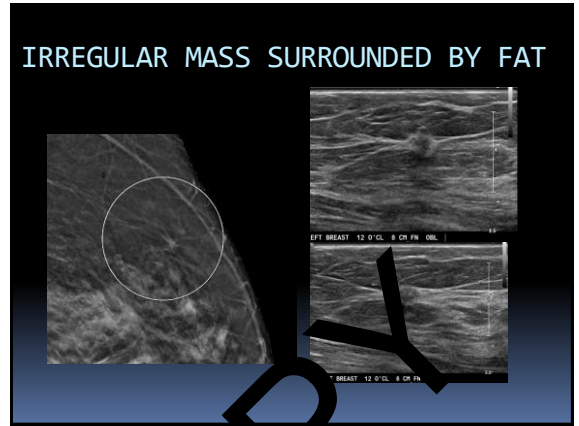
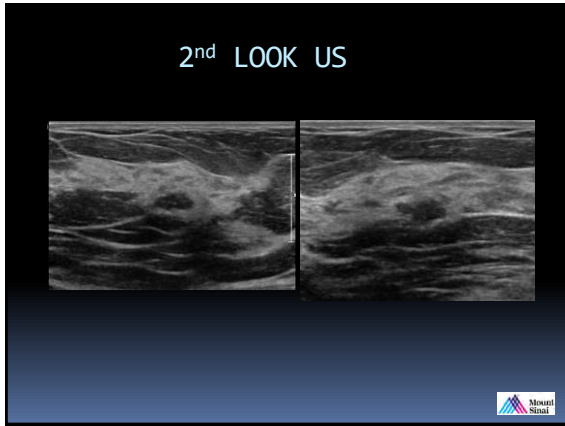
COPY

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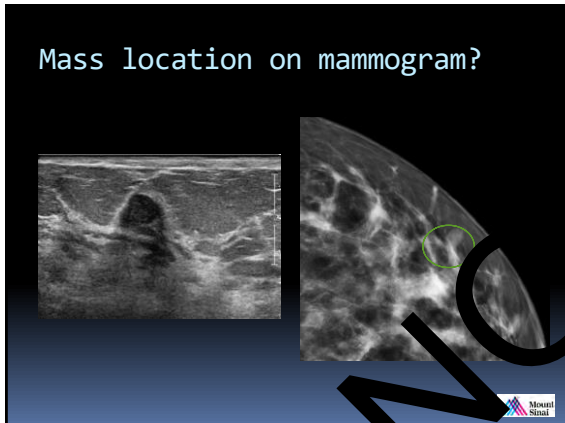
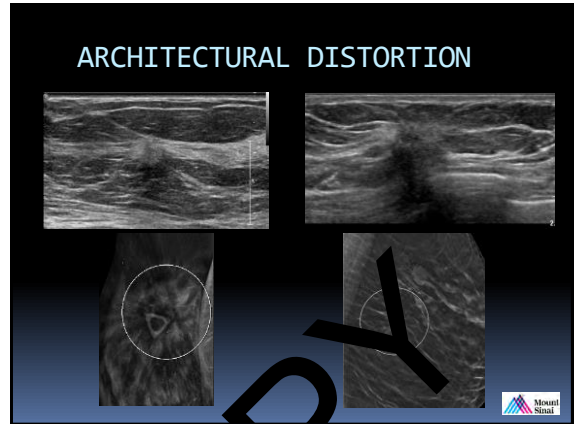
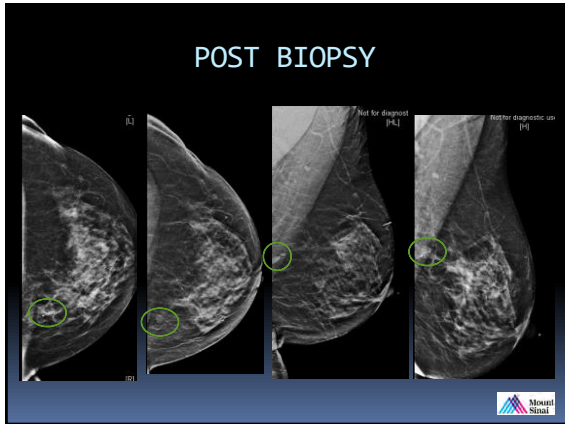
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### CONCLUSION

Help yourself with appropriate positioning and scanning technique

- Use landmarks and tissue planes to locate findings
- Customize your scan for the given problem
- Not every significant finding is a mass and therefore careful evaluation of tissue planes is needed

Mount Sinai

