



Ultrasound in Breast diseases a vital modality

Sunil Bajaj MD

Karmanos Cancer Hospital

Epidemiology of breast cancer

- Leading cause of death after lung cancer
- 210,000 new cases of breast cancer/year
- 35,000 new cases of DCIS/year
- 40,000 deaths due to breast cancer/year
- 1,500 of male breast cancers/year

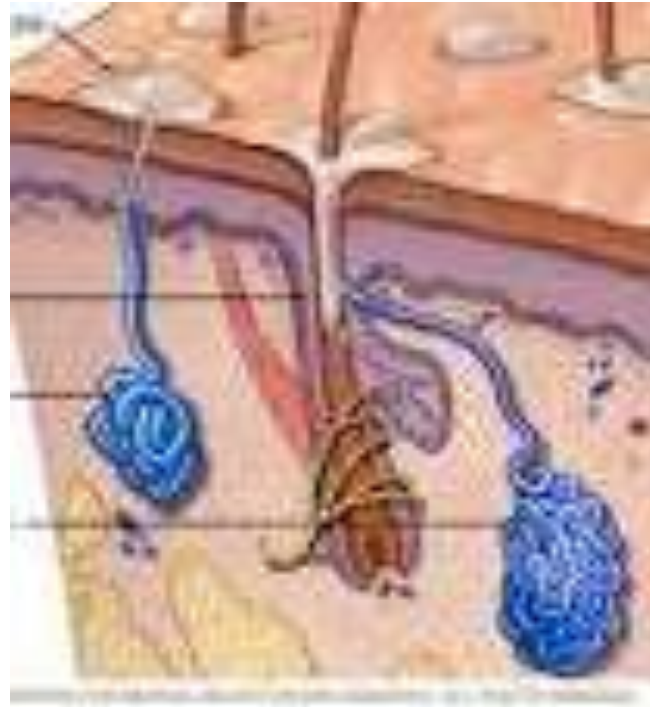
Epidemiology

- Life time risk in a female is 14%(1 in every 7)
- 2-8 new cancer per 1,000 mammogram

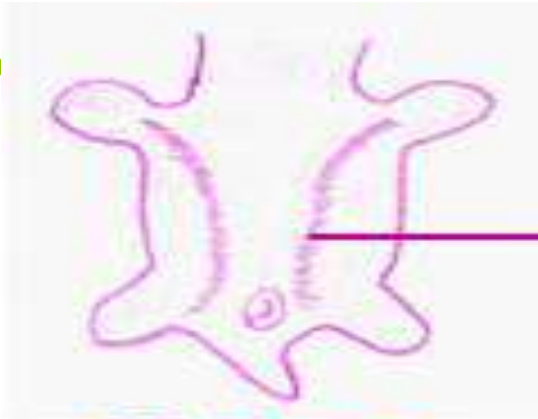
Anatomy of Breast

- Breast is a modified sweat gland along the mammary ridge
- Mammary ridge extends from base of forearm bud to the medial end of the hind arm bud
- Majority of the mammary ridge disappears
Breast develops from mid third of the upper mammary ridge extending into axilla
- Accessory breast develops along the mammary ridge

Sweat Gland



N



28 Days

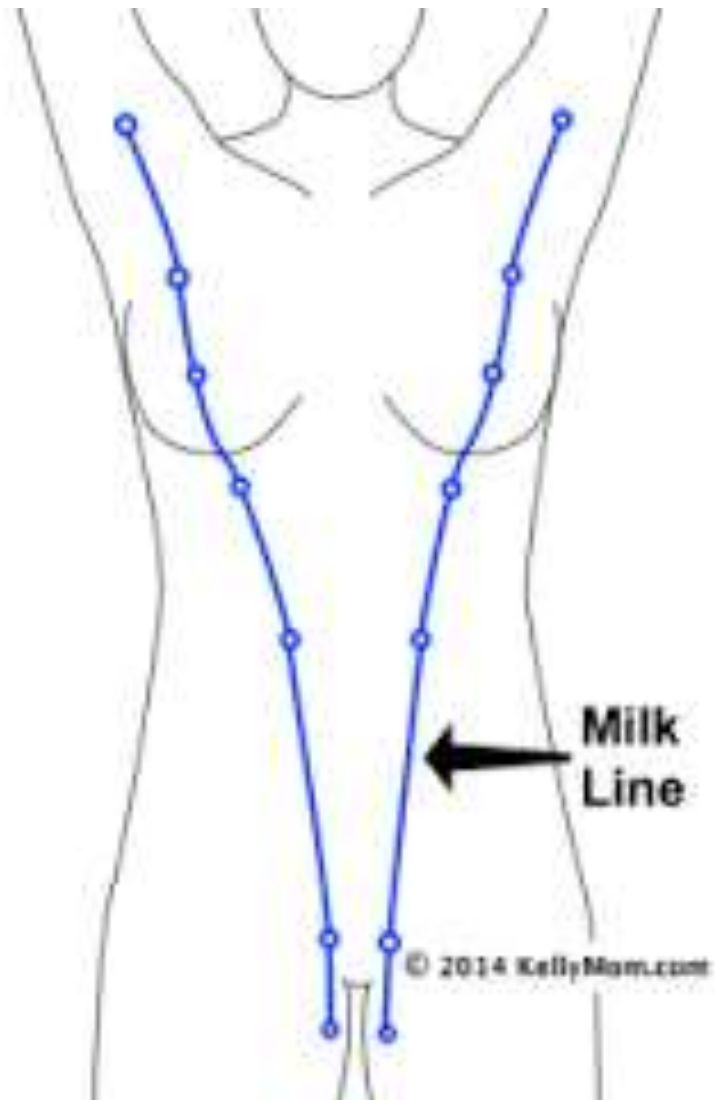
Mammary ridge



6 weeks

**Remnant of
Mammary ridge**

Mammary ridge

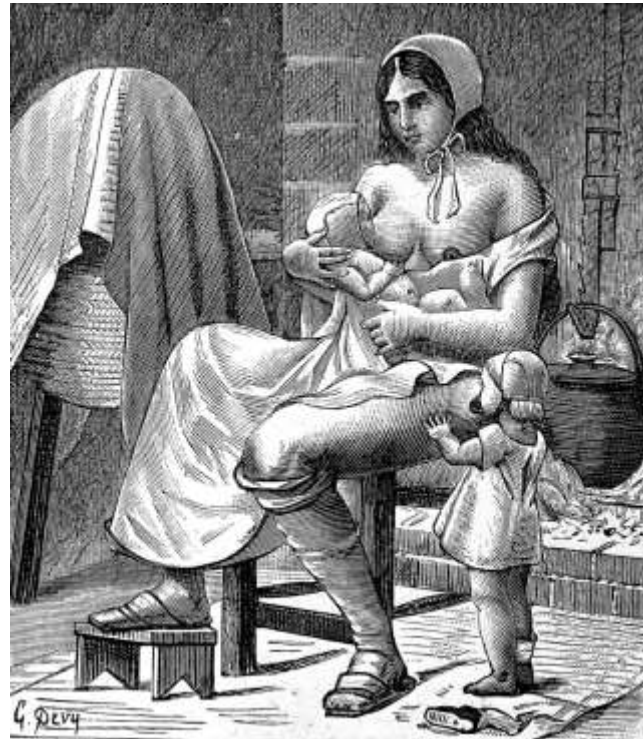




Axillary breast



Accessory breast



Accessory nipple



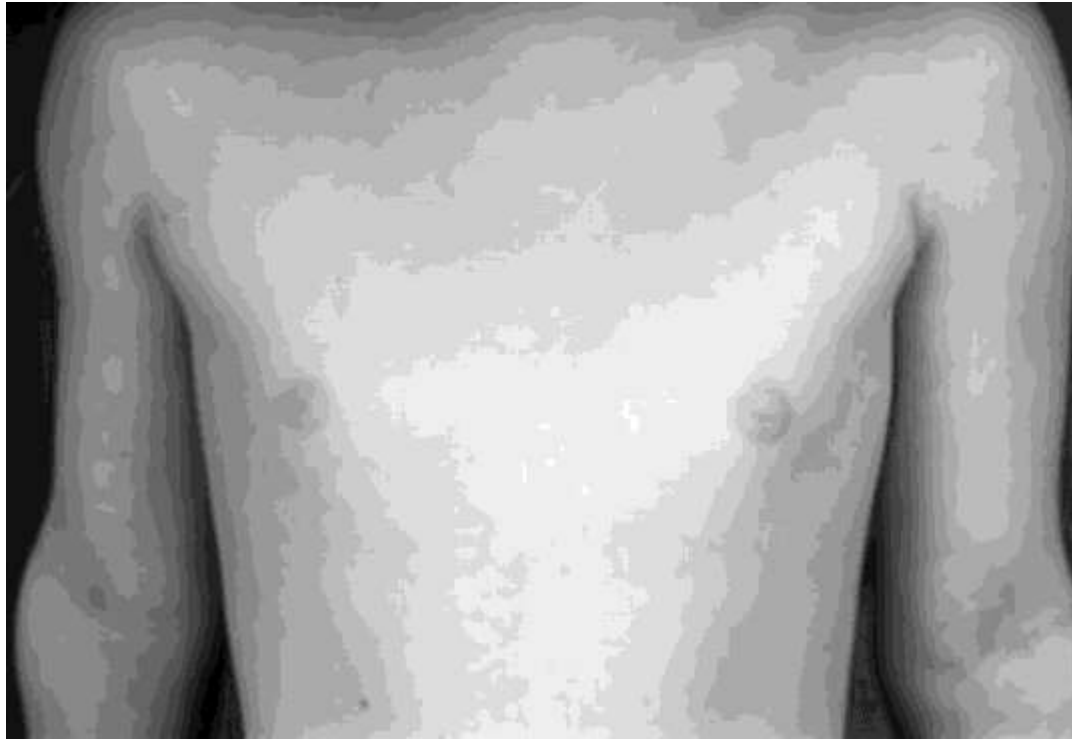
Anatomy

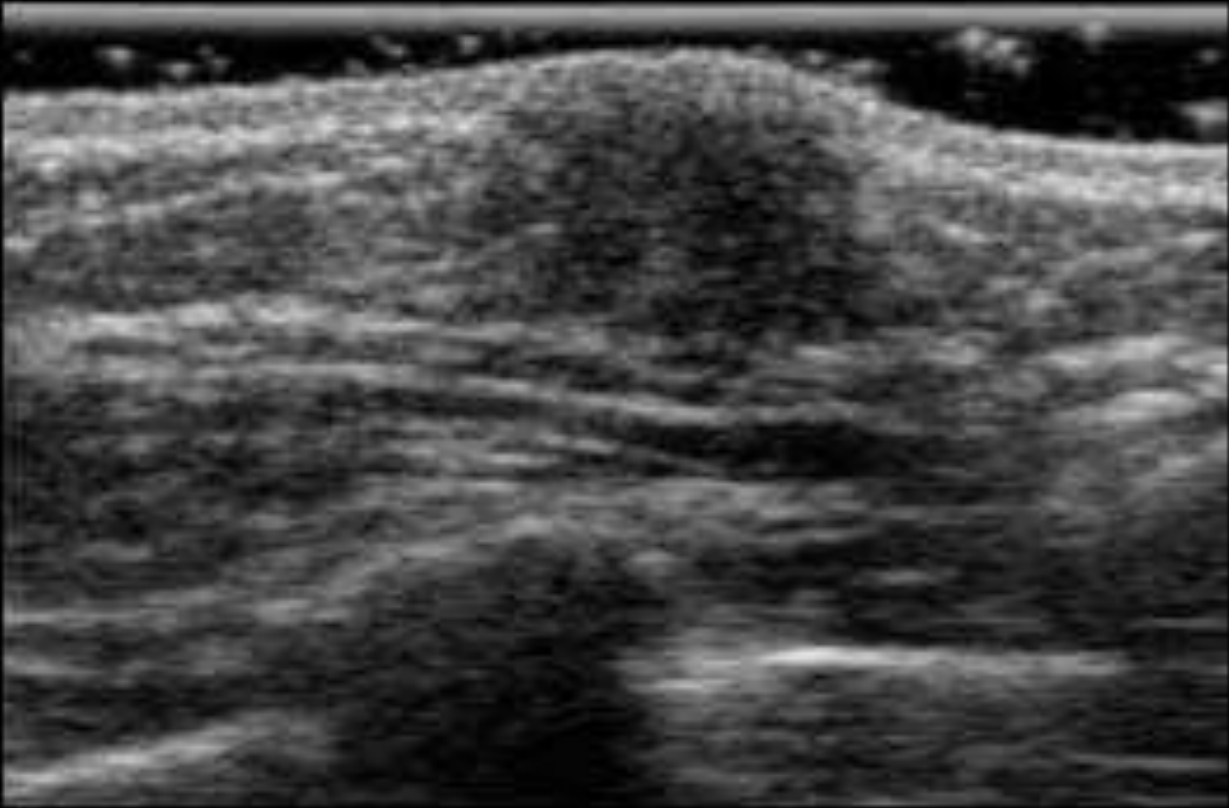
- Primitive ectodermal bud near upper arm
- Epithelial cell form here grow and penetrate dermis
- At birth there is network of ducts around the nipple
- There may be milky discharge from the neonate's nipple due to maternal hormones
- Lobule and glands mainly develop around puberty

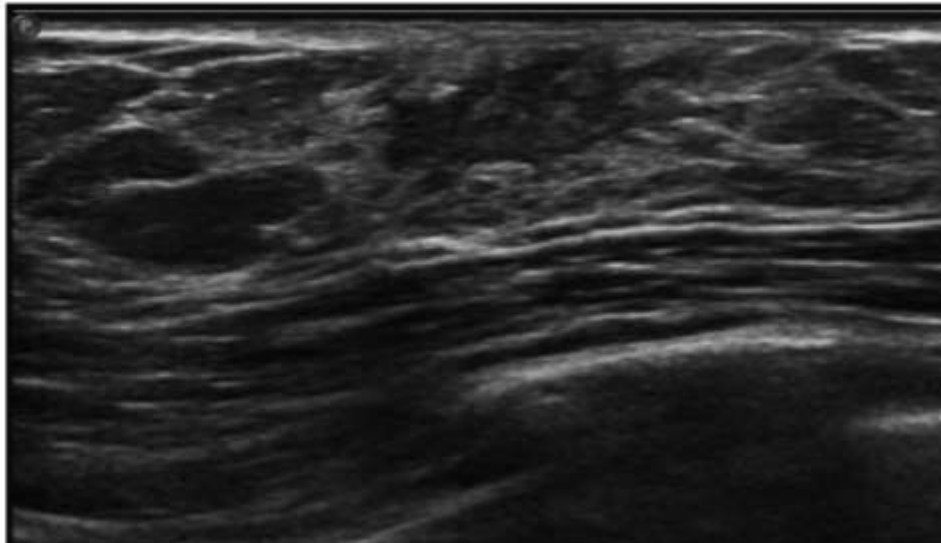
Anatomy

- Thelarche precedes Menarche
- Breast buds enlarge to form palpable disc
- Growth may be asymmetric initially
- With time it becomes symmetric
- In 3% it remains asymmetric

Asymmetric breast bud







Breast cancer in preadolescent

- Very rare
- They are very indolent and less aggressive
- Grow eccentrically
- Biopsy should be performed if the sonographic findings are pathognomonic
- Unnecessary biopsy of breast bud can affect breast development

Breast cancer

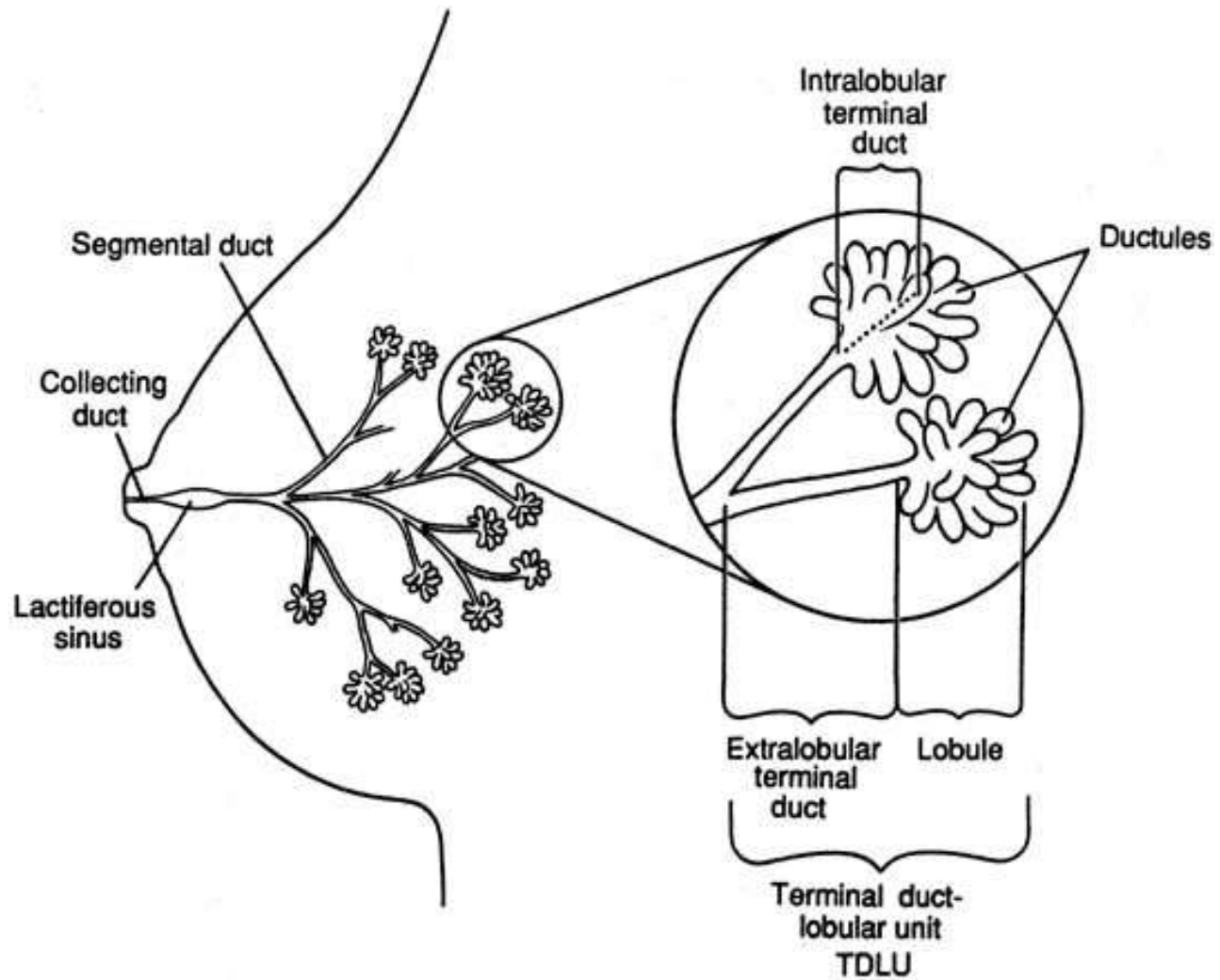


Breast Anatomy: Terminal development

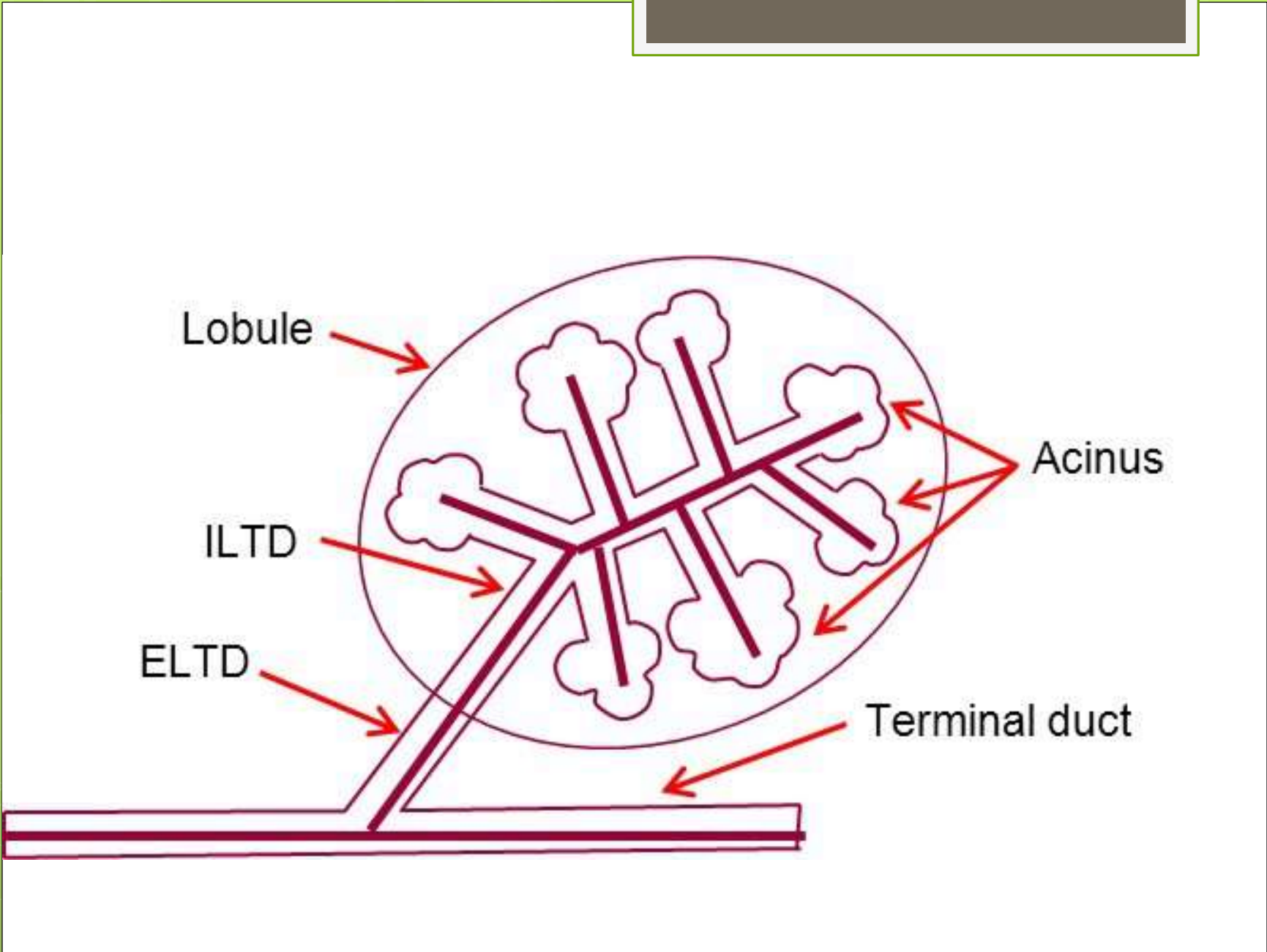
- Ductal element elongates, divide and extend deeper into the subcutaneous tissue
- Adipose and connective tissue increases in volume
- Terminal ducts at the variable end of branching form glandular acini
- Stem cells at the terminal duct end are responsible for this change
- This is the site for rapid cell growth and DNA replication and common site for breast cancer

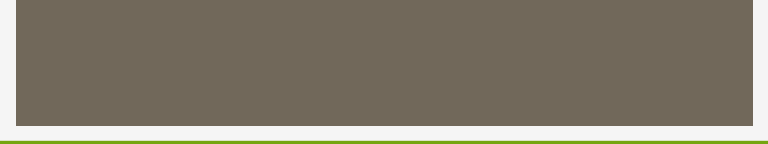
Breast Anatomy

- 7-20 lobes with the duct system
- Ducts converge under areola in a spoke wheel fashion



- Most cancer appear at the terminal duct as it enter and along it course with in the lobule
- Increase cell proliferation can cause faulty DNA replication or Mutation the root cause for cancer.





Prepuberty



♀ Onset of
puberty

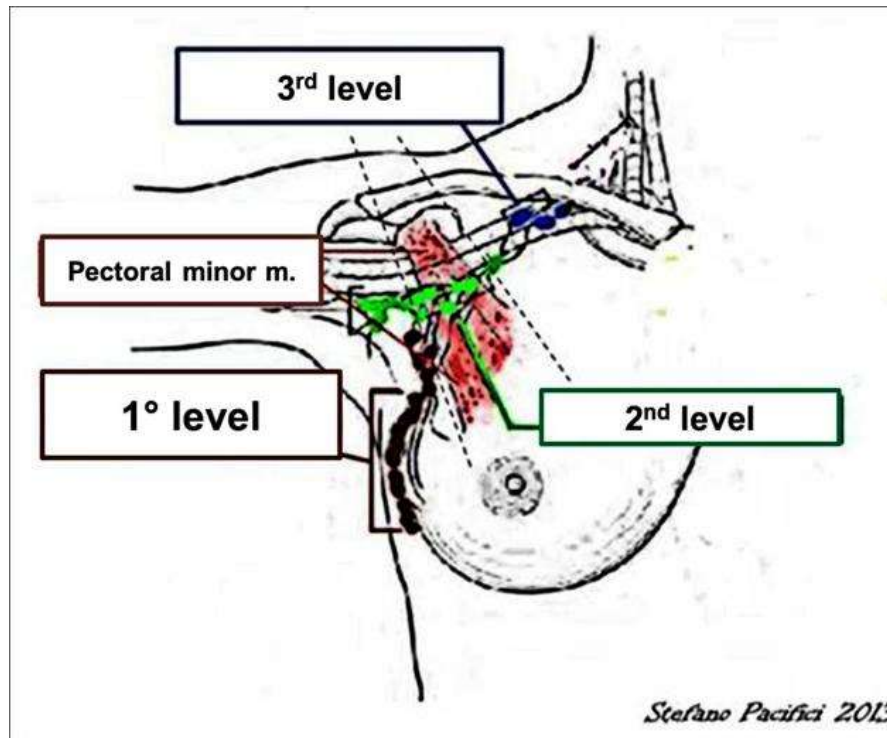


♀ End of
puberty



Lactation

Axillary lymph nodes



Risk Factors

- Age
 - 0.2% of breast cancers before 30 years
 - Incidence start to increase after 35 years
 - PPV of mammogram is 15% at 40 years
 - PPV of mammogram is 50% at 80 years
- Female sex
 - >99% of breast cancers in females

Risk factors

- Duration of hormone exposure
 - Increased cell proliferation and DNA alteration
- Early menarche or late menopause
- 4% increase for every year before 16 year.
- 3% increase for every year after 45 years

Risk Factors: Family History

- First degree relative before menopause: x4
- More than one first degree relative: x6
- First degree relative with bilateral cancer: x9

- 60% of females with cancer have no family history
- Screening to start 10 year earlier than the age of relative at the time of cancer

Risk factors: Genetic susceptibility

BRACA 1: at 17q21

BRACA 2: 13Q

Susceptibility for Breast, Ovary, stomach and Pancreatic cancer

At 40 years: 37%

At 65 years: 55%

Life time risk: 82%

Recent data shows overall risk of 50%

Risk factors: Age at first term pregnancy

- Pregnancy increases the differentiation of terminal bud into TDLU
- Pregnancy at 30 year double the risk of cancer than pregnancy at 18 year
- Pregnancy and lactation suspends ovulation and decreases risk of ovarian cancer

Risk factors: Prior breast cancer

- Risk increases 1% every year up to a maximum of 15%.
- “The Daughter is usually like Mother”

Risk factors: High risk breast lesions

- ADH, ALH, Radial scar and Papillomatosis.
- High risk breast lesions: x 5 times.
- Choices are Lumpectomy/excision biopsy.
- Regular follow up.

No increase risk

- Adenosis
- Cystic changes
- Apocrine metaplasia
- Duct Ectasia
- Squamous metaplasia
- Fibrosis
- Mastitis
- PASH

Risk Factors: Radiation

- Radiation damage the DNA by producing free radicals.
- Exposure of 200 rads double the risk.
- Younger the age of exposure increases the risk.
- Screening should start after 8 years of exposure.

Risk factors: HRT, OCC

- OCC: Low risk if used before first pregnancy
- HRT: x 1.3 to 1.9 times if uses for many years
- CVS and bone health overweighs the risk of breast cancer
- Increases the growth of initiated clones rather than truly increasing the initiation of cancer

Risk factors: Obesity

- Increase risk in postmenopausal females.
- Fat convert androgens into estrogen causing increase proliferation.

Risk Factors: Alcohol consumption

- Alcohol increases the risk x 1.4-1.7 times.
- Alcohol increases the estrogen levels

Risk Factors: Breast Density

- Maximum breast density at 30 years
- 0.1 to 0.2% decrease from 30-45 years.
- 1-2% decrease from 45-65 years
- Plateau after 65 years
- Initial study(Wolfe) estimated a risk of x 37 times than fatty breast: flawed and biased
- Other study (Boyd) found risk of x 3 times
- National screening study of Canada: 9.7%

Breast Density Law

- Breast density notification is currently put into effect in 24 states including Michigan from July
- A breast density notification law requires that physicians notify women who have undergone mammography and were found to have dense breast tissue with increase risk of malignancy
- The intent of such a law was to give women the necessary information to decide on further action if they had dense breast tissue

Breast Ultrasound

- Has been used in breast imaging since 1970'S
- Primary method to differentiate cystic lesion from solid masses
- Can differentiate some benign from malignant masses
- Can detect some cancers occult on clinical and mammographic evaluations
- Not clear whether breast ultrasound screening saves life

Limitations

- Operator dependent: The technique should be reproducible.
- High false positive rates, normal tissue variability could mimic cancer
- Cooper's ligament can produce acoustic shadowing
- A solid lesion could look cystic and vice versa based on settings

Technical details

- Linear array with center frequency of 10 mhz
- Field should include the whole breast and pectoral muscle
- Focal zone at the center of lesion
- Do not zoom or minify the lesion
- Measure lesion in long axis, perpendicular to long axis orthogonal to long axis
- Include distance from the nipple

Take home points

- Cystic mass overlying the axilla is malignant unless proven otherwise
- Ovoid or kidney shaped mass in the medial aspect of breast can not be a lymph node unless proven on pathology
- Always see for flow in a cystic mass in elderly, cyst are uncommon in elderly
- Any cystic mass growing overtime in elderly should raise red flag
- Predominantly cystic mass with fuzzy walls



BI-RADS ASSESMENT

- **Classification**

- The latest version classifies lesions into six categories:

- **BIRADS 0**: incomplete, further imaging or information is required, e.g. compression, magnification, special mammographic views, ultrasound. This is also used when requesting previous images not available at the time of reading

- **BIRADS I**: negative, symmetrical and no masses, architectural disturbances or suspicious calcifications present

- **BIRADS II**: benign findings, interpreter may wish to describe a benign-appearing finding, e.g.

- calcified fibroadenomas
- multiple secretory calcifications
- fat containing lesions such as
 - oil cysts
 - breast lipomas
 - fibroadenolipoma or mixed density hamartomas
 - galactoceles
- simple breast cysts

BI-RADS ASSESMENT

- BIRADS III: probably benign, short interval follow-up suggested. The accent is on the word benign
- BIRADS IV: suspicious abnormality
 - there is a mammographic appearance which is suspicious for malignancy
 - biopsy should be considered for such a lesion
 - these can be further divided as
 - BIRADS IVa: low level of suspicion for malignancy
 - BIRADS IVb: intermediate suspicion for malignancy
 - BIRADS IVc: moderate suspicion for malignancy
- BIRADS V: there is a mammographic appearance which is highly suggestive of malignancy, action should be taken
- BIRADS VI: known biopsy proven malignancy

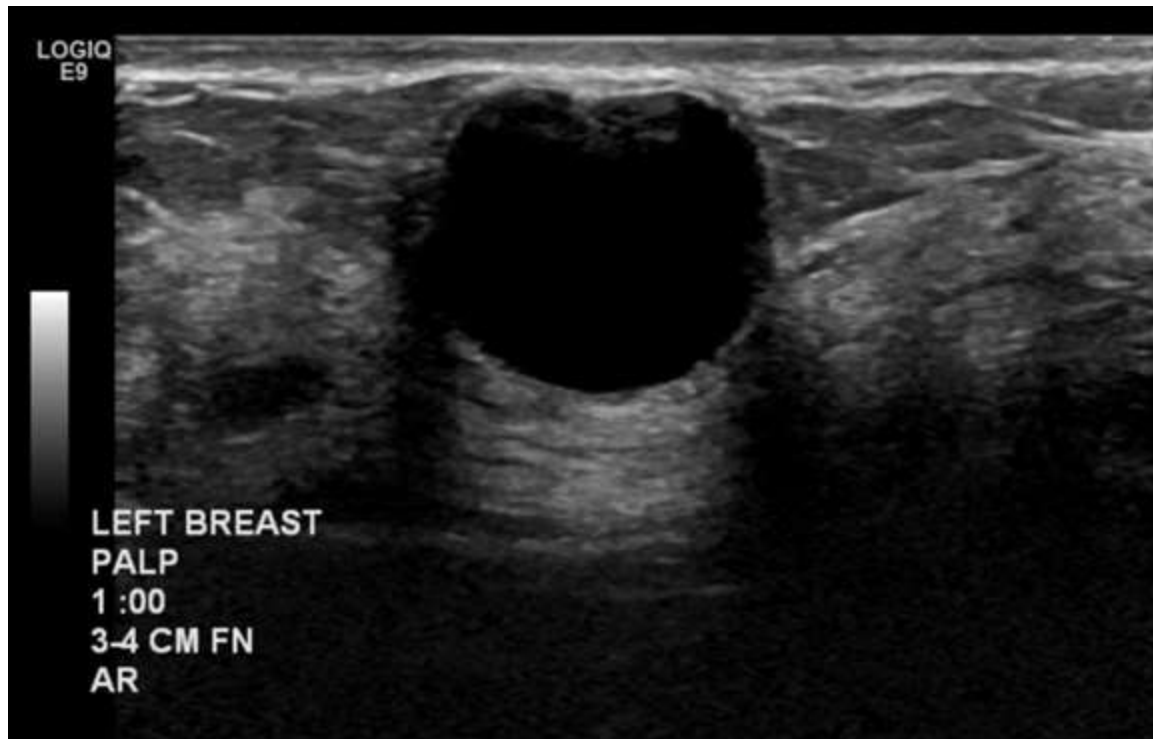
Characteristics for high probability of benign mass

- Ovoid
- Sharply marginated
- Well circumscribed
- Homogenous
- Wider than tall
- Through transmission
- Markedly hyperechoic

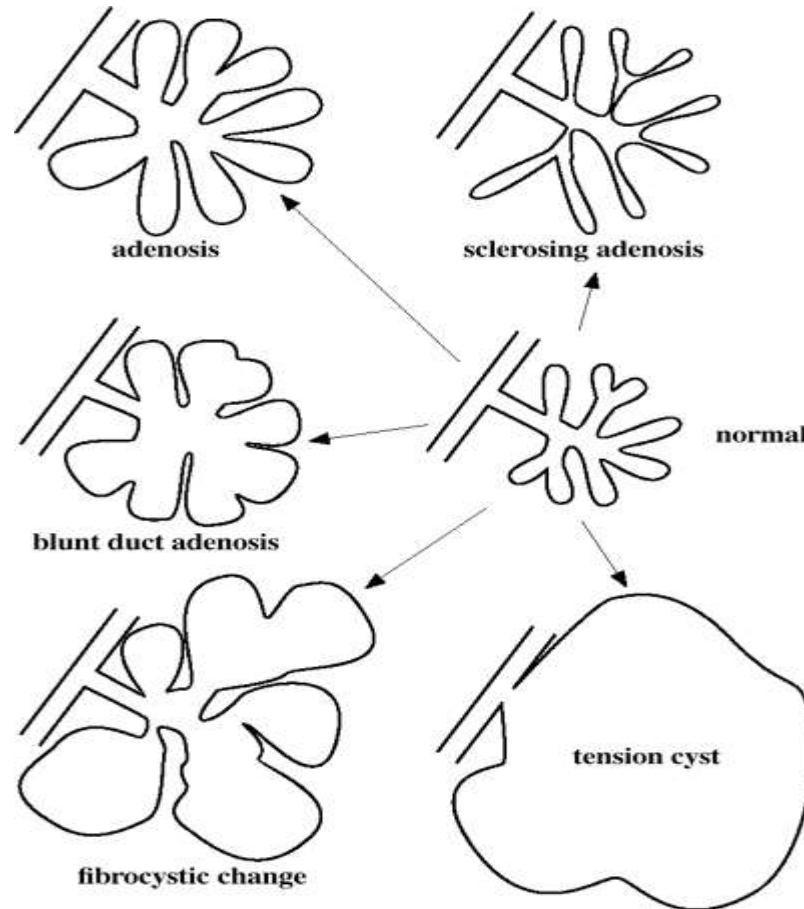
Specificity

- Well circumscribed and marginated: 10% malignant.
- Wider than tall : 30% could be malignant.
- Through transmission: 36% could be malignant.

Examples of Benign masses: Breast cyst



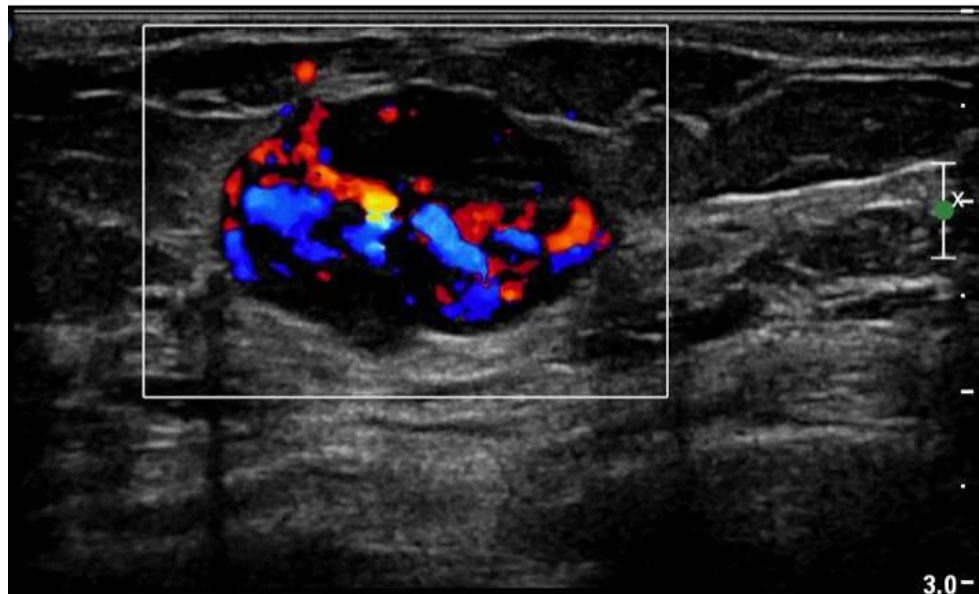
Physiology of breast cyst with adenosis



Be Careful



Solid mass with cystic appearance



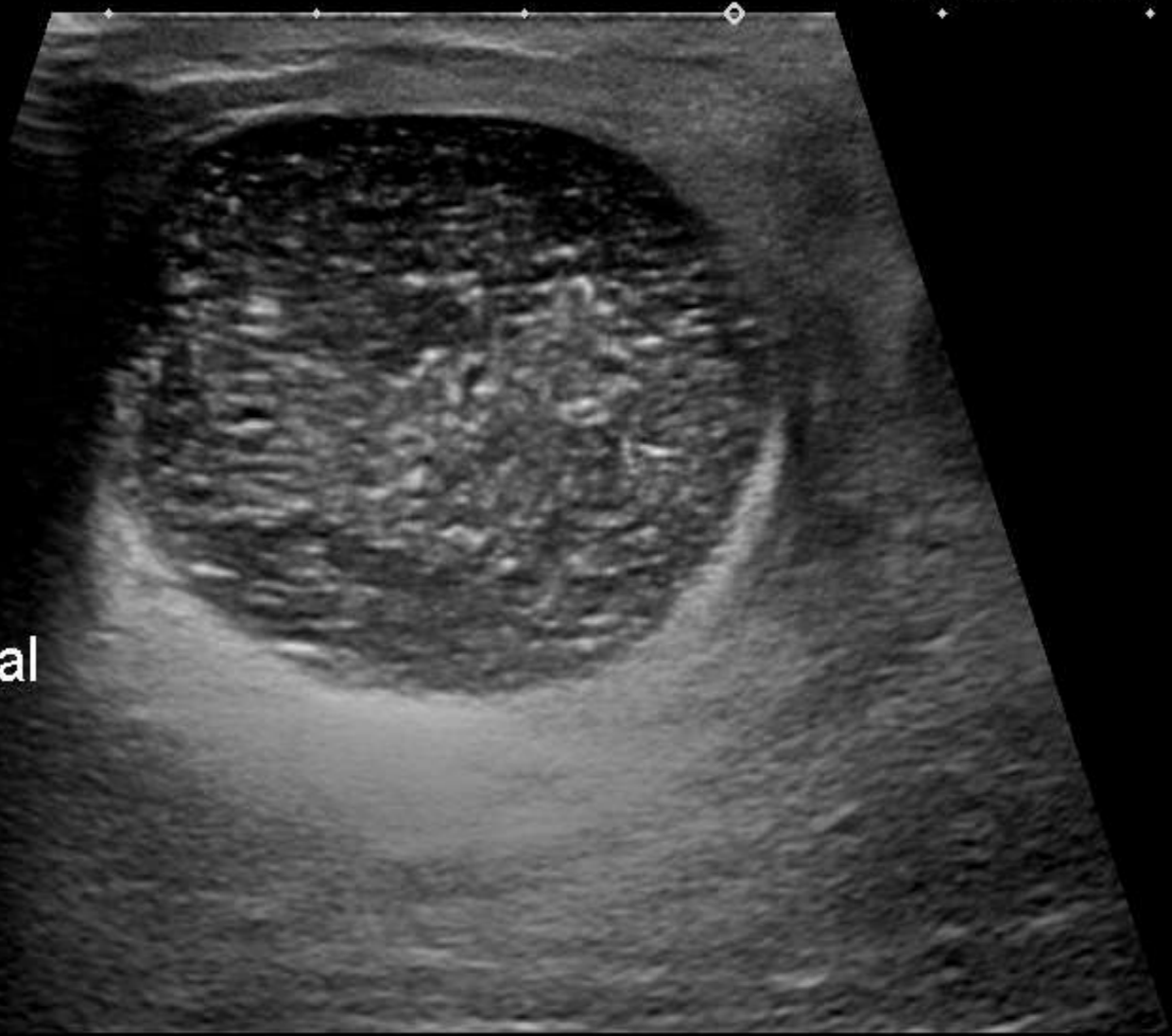
0
1
2
3
4
4.5

T

PALP

Lt Breast
3:00

R/A
Anti-Radial



18L7
diffT13.0
26 fps
Qscan
G:91
DR:70



Precision APure+

T

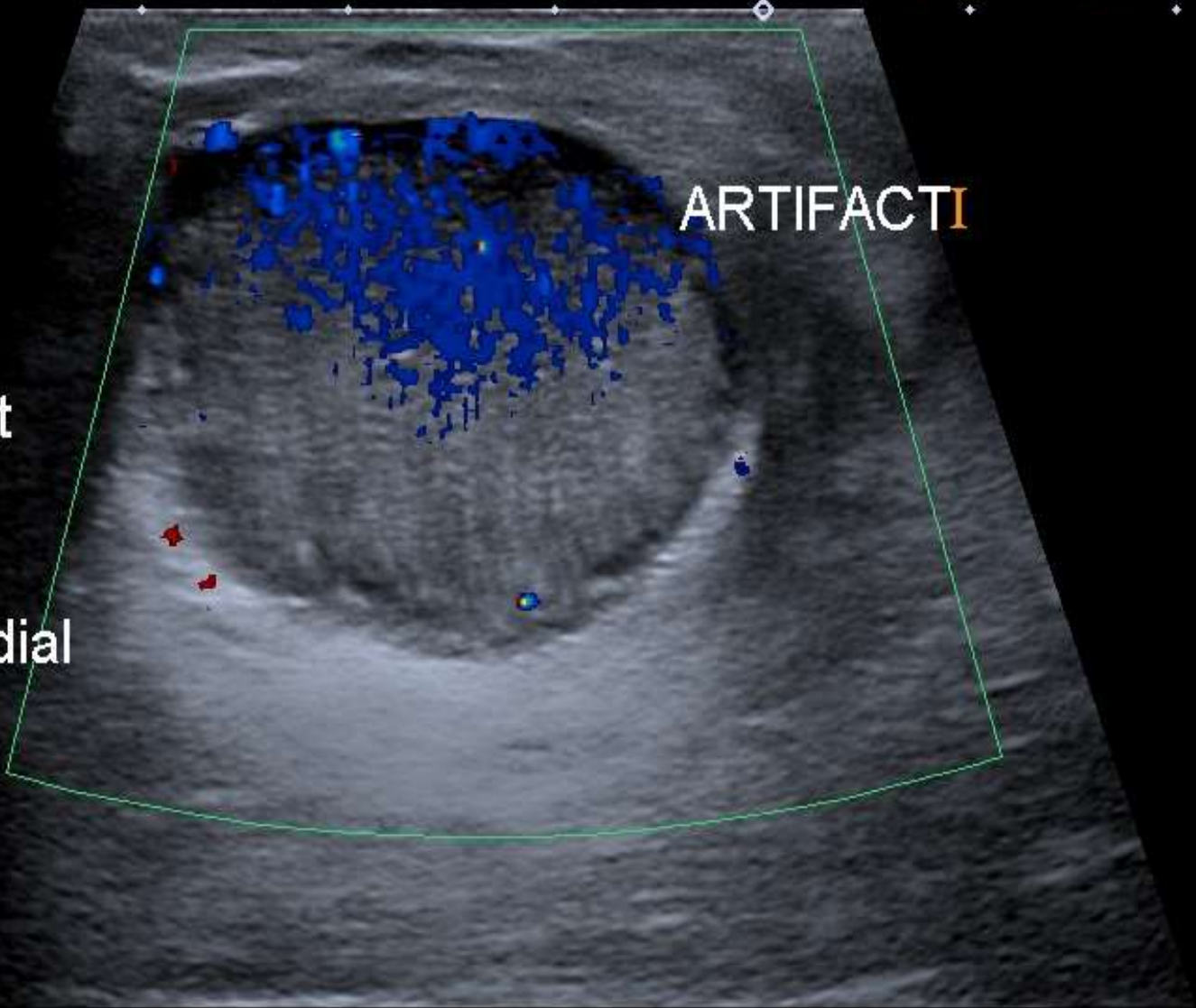
ARTIFACT

PALP

Lt Breast
3:00

R/A
Anti-Radial

- 0
- 1
- 2
- 3
- 4
- 4.5



1
diffT
7
QS
C
DF
CF
CO
1

FR 19

B

0- Frq 11.0
Gn 37
- S/A 3/2
- Map F/0
D 4.0
▲ DR 69
1- AO% 100

LOGIQ
E9



CYST ASPIRATION

LEFT BREAST

3:00

RETROAREOLAR

2-

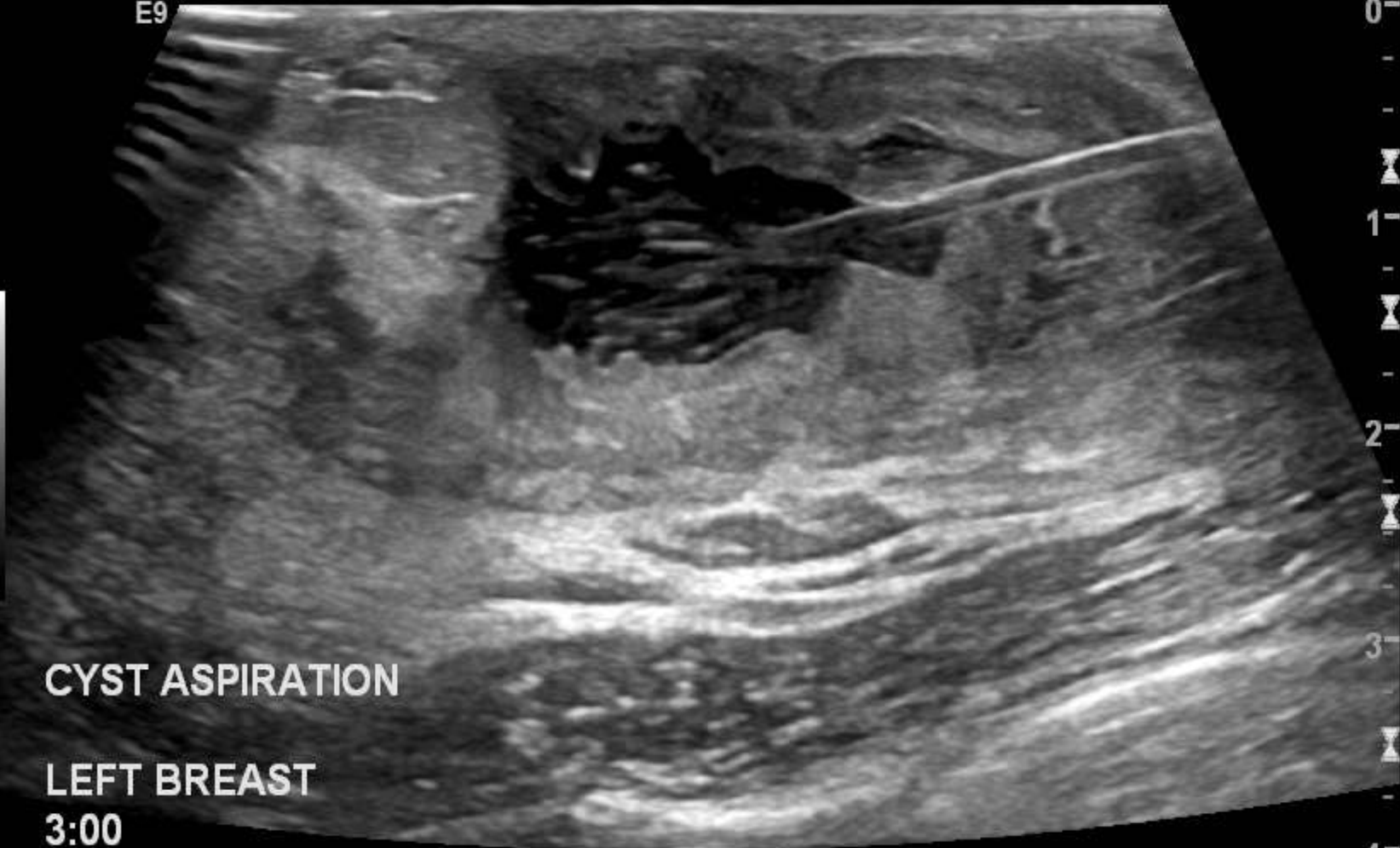
3-

4-

B

0-	Frq	11.0
	Gn	37
-	S/A	3/2
-	Map	F/0
Δ	D	4.0
Δ	DR	69
1-	AO%	100

LOGIQ
E9



CYST ASPIRATION

LEFT BREAST

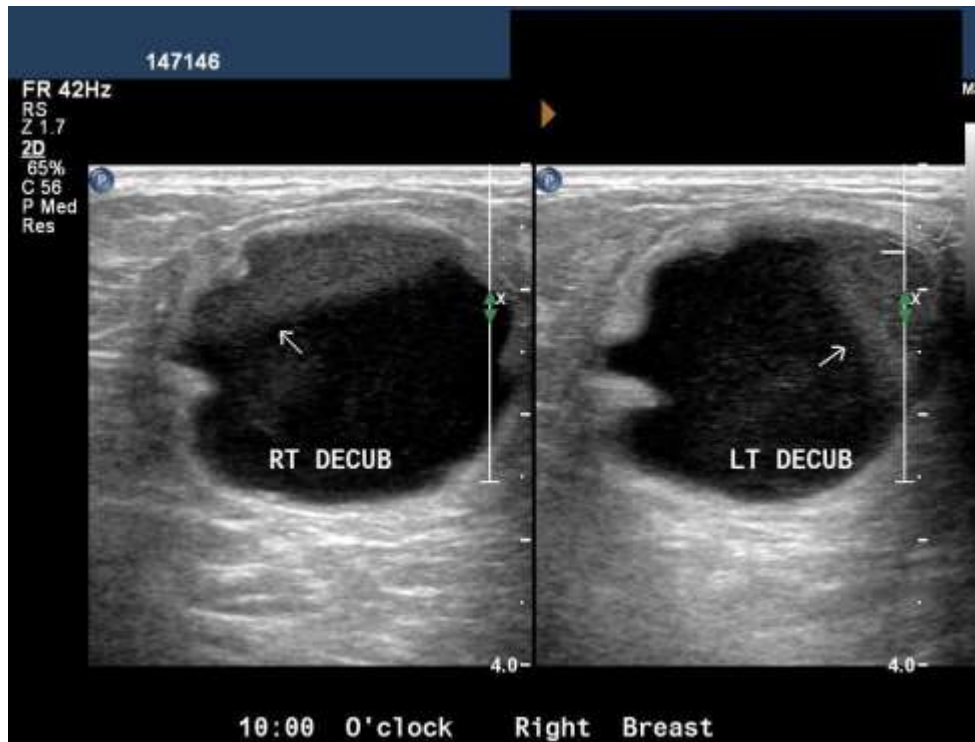
3:00

RETROAREOLAR

DR.SHULTZ

2-
3-
4-

Galactocele



Breast abscess



Breast abscess with doppler



FR 48Hz
RS

2D
72%
C 68
P Med
Gen

M4

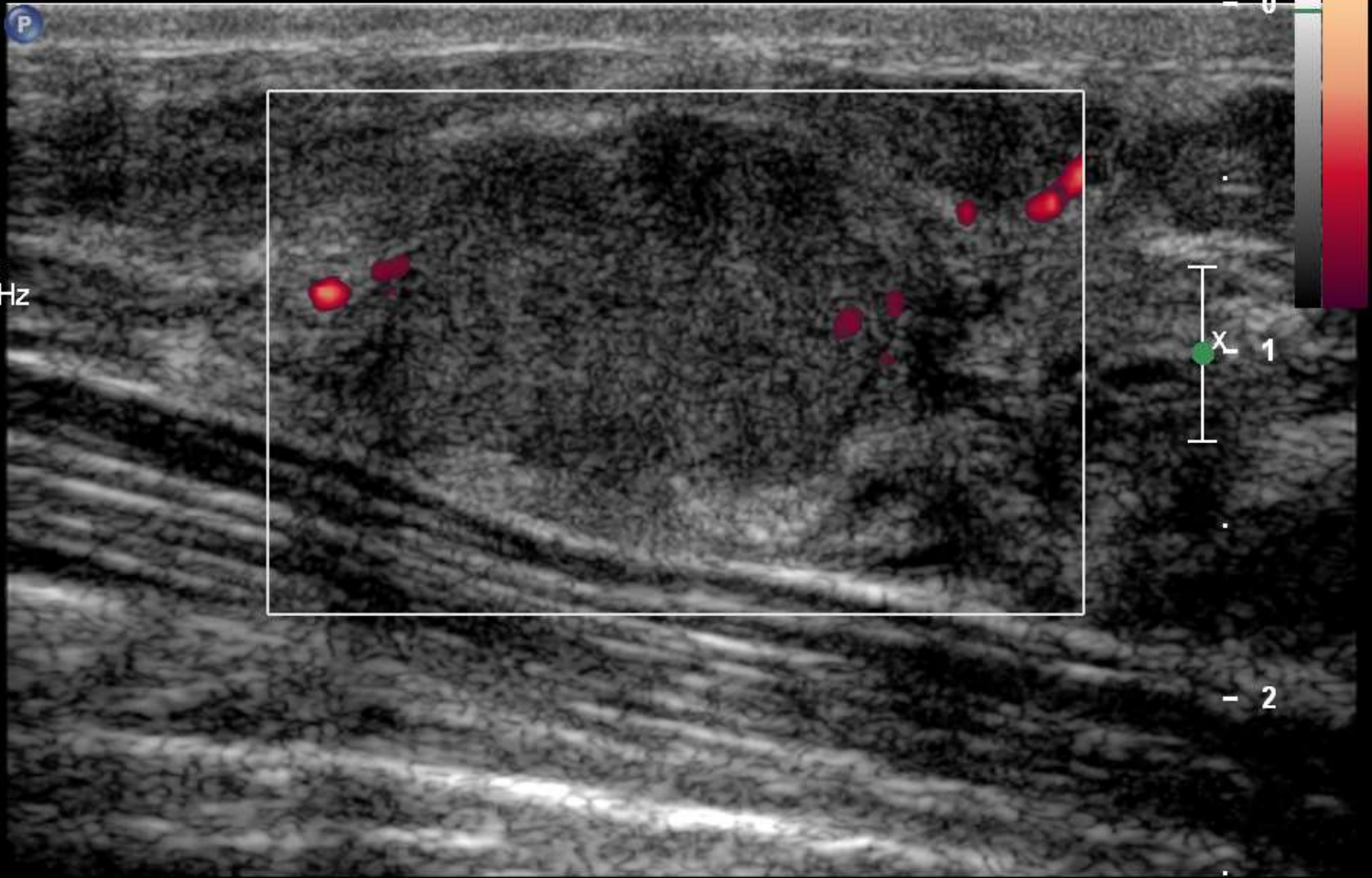


Right 10:00 5CM Rad

PR 1512
P1

2D
75%
C 62
P Med
Gen

CPA
82%
500Hz
WF 42Hz
Low



Right 10:00 5CM Rad

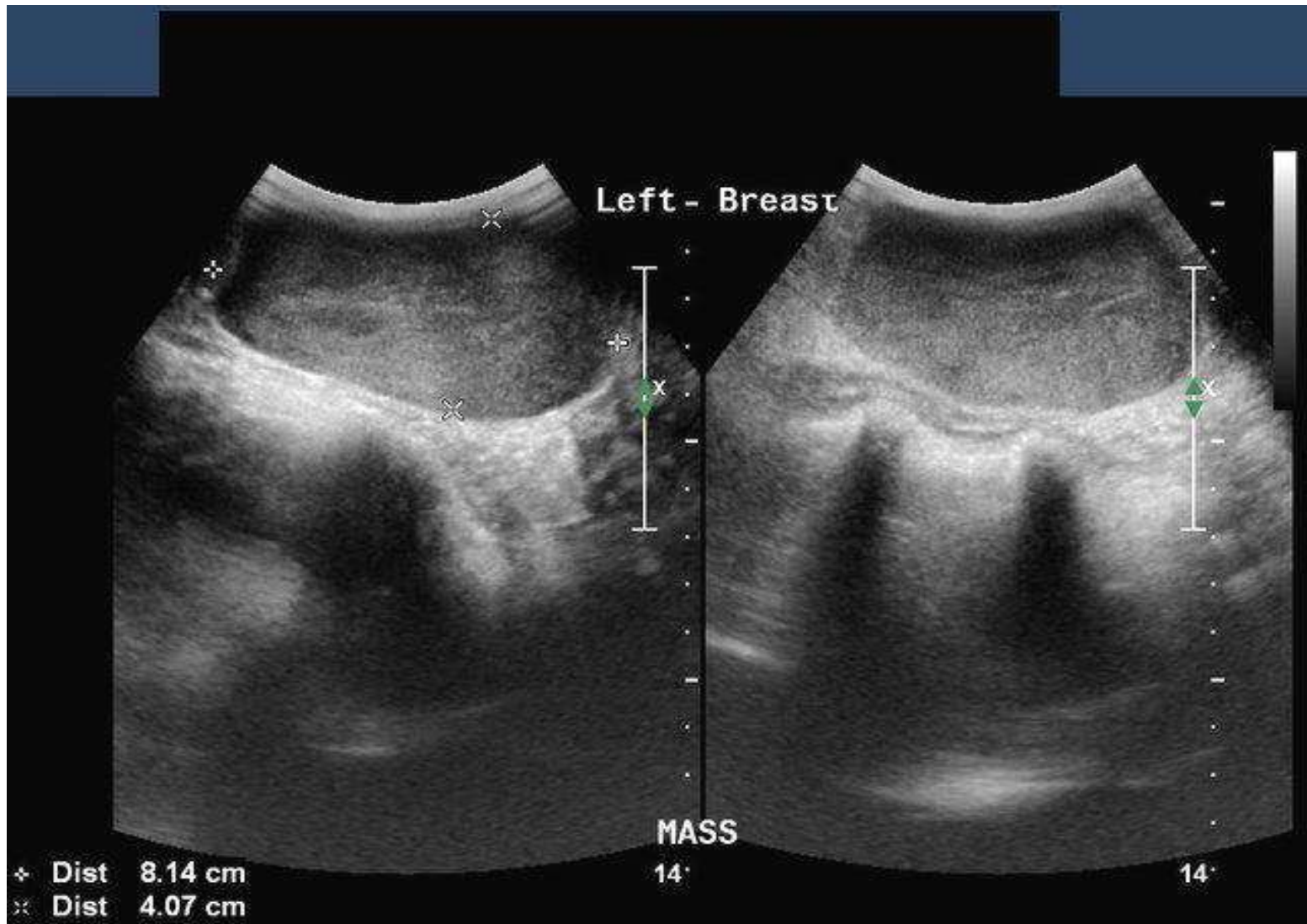
Left - Breast

MASS

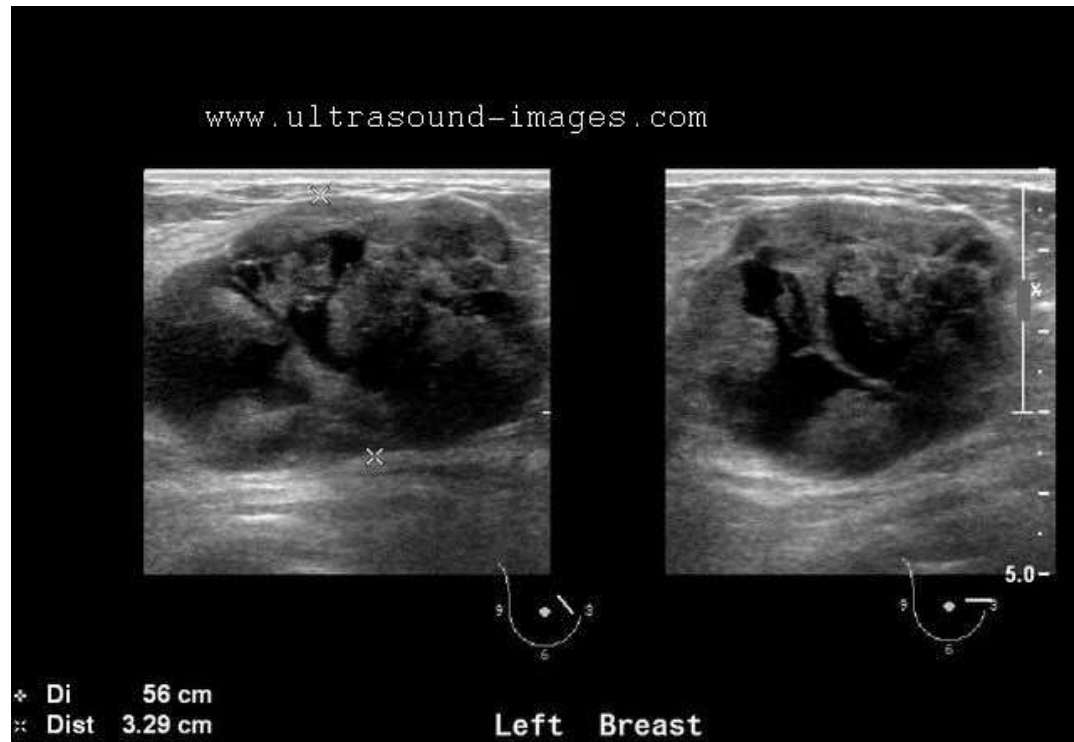
14'

14'

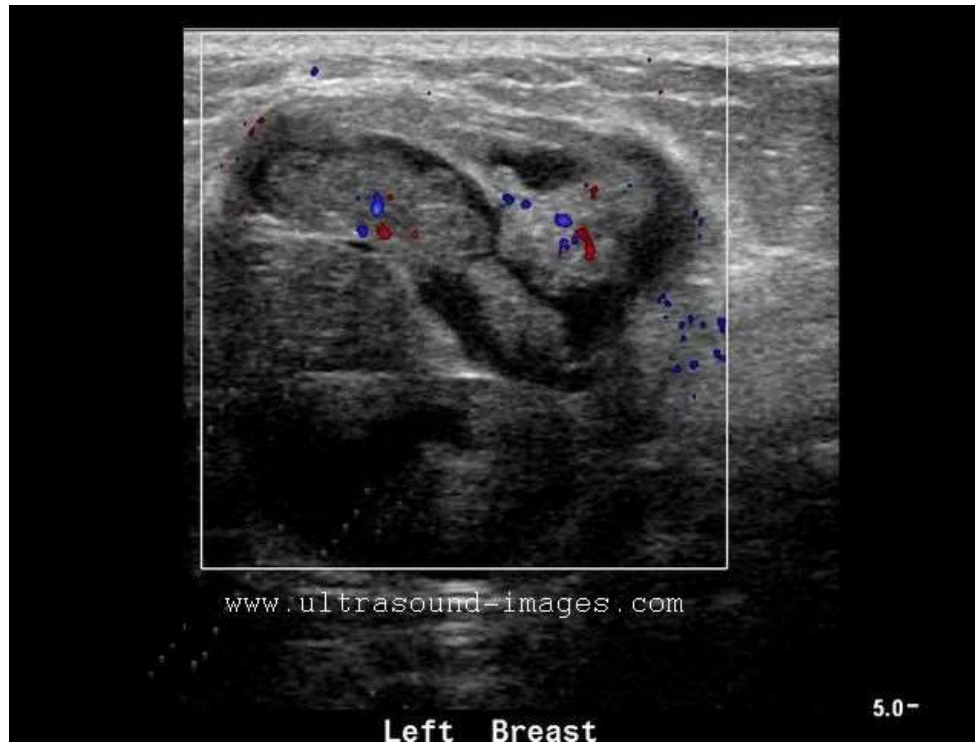
+ Dist 8.14 cm
x Dist 4.07 cm



Phylloides tumor



Phylloides tumor



High probability for Malignancy

- Irregular mass
- Spiculated or angular margins
- Marked hypo-echogenicity
- Taller than wide
- Presence of calcification
- Duct extension

Malignant masses

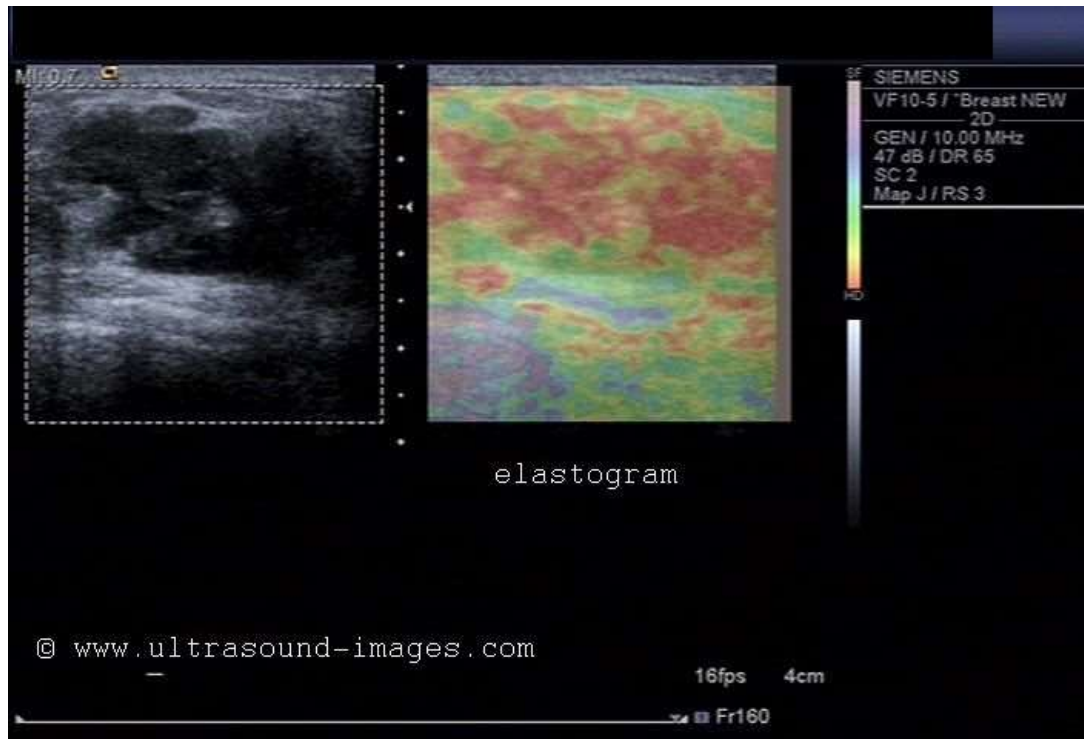




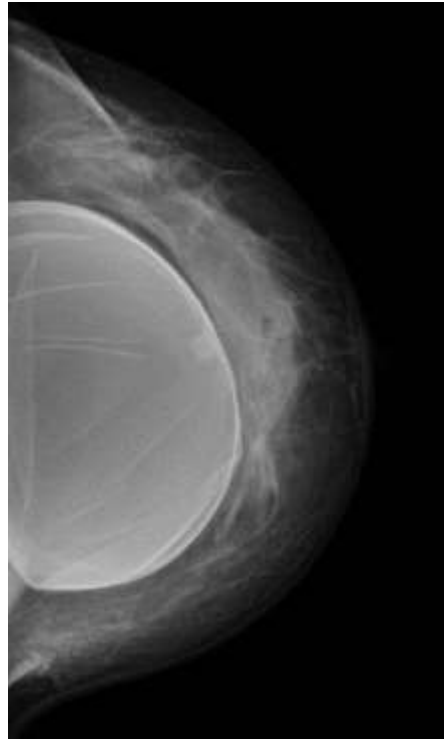
Breast Carcinoma with Doppler



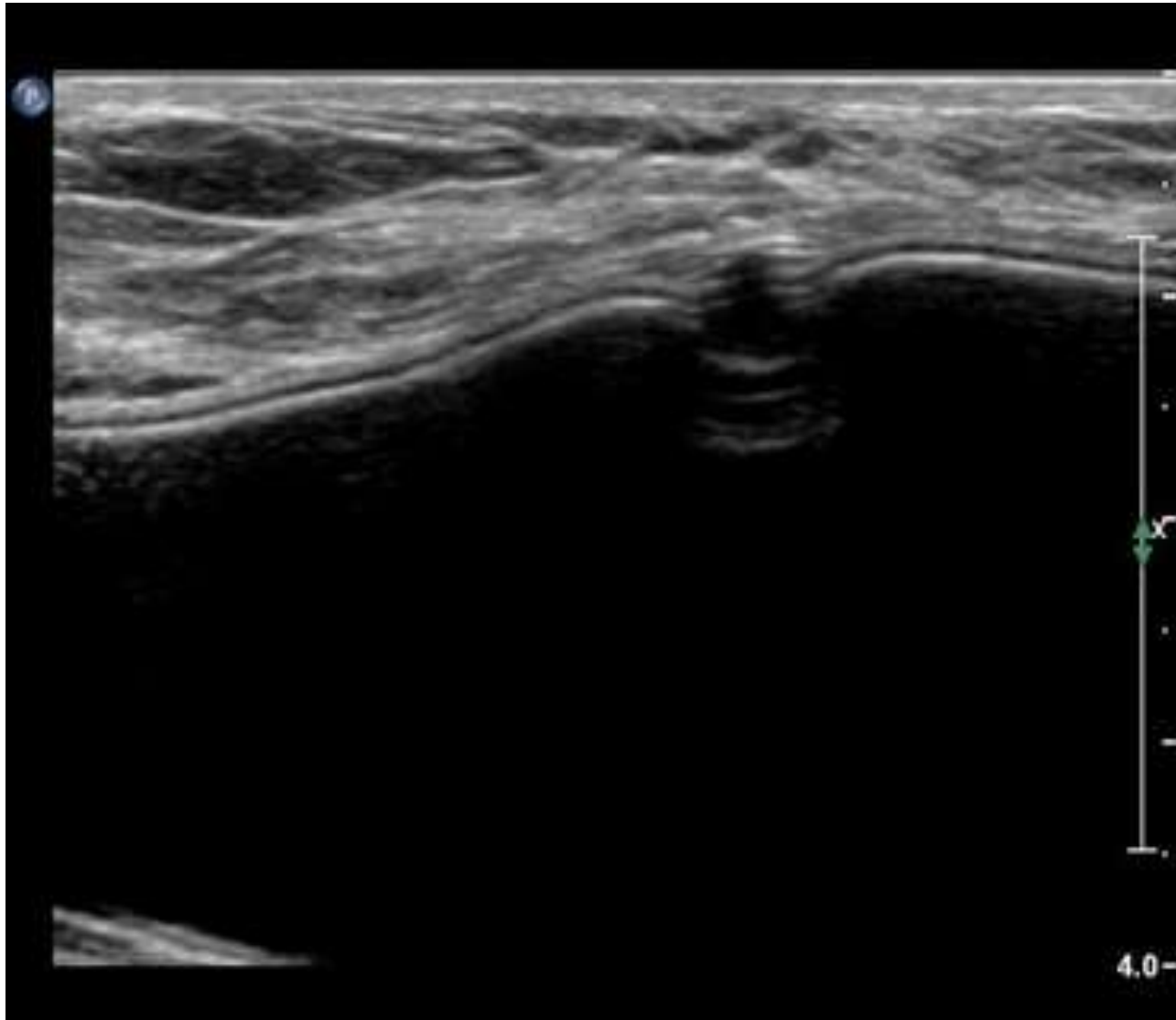
Breast Carcinoma



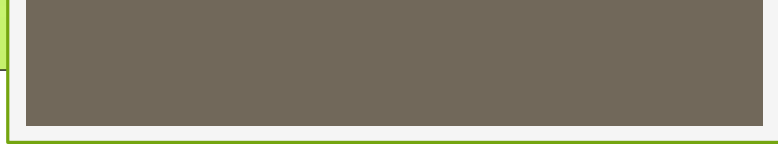
Breast Implant



Breast Ultrasound



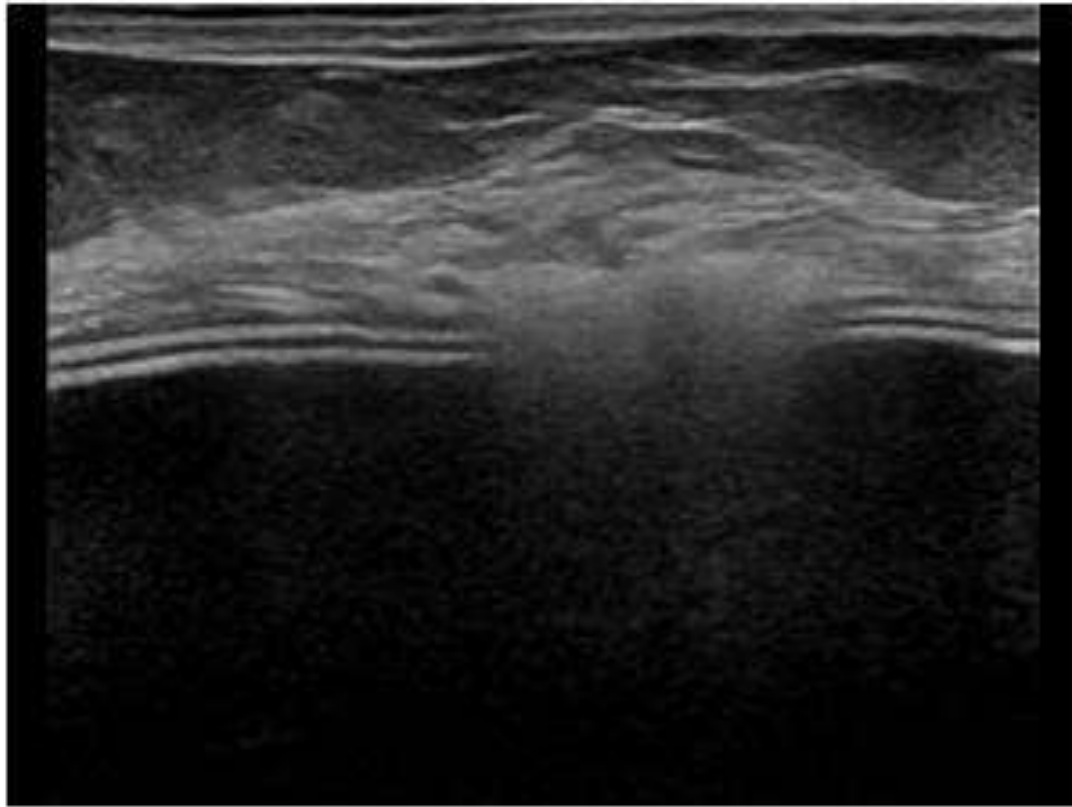
LMLO

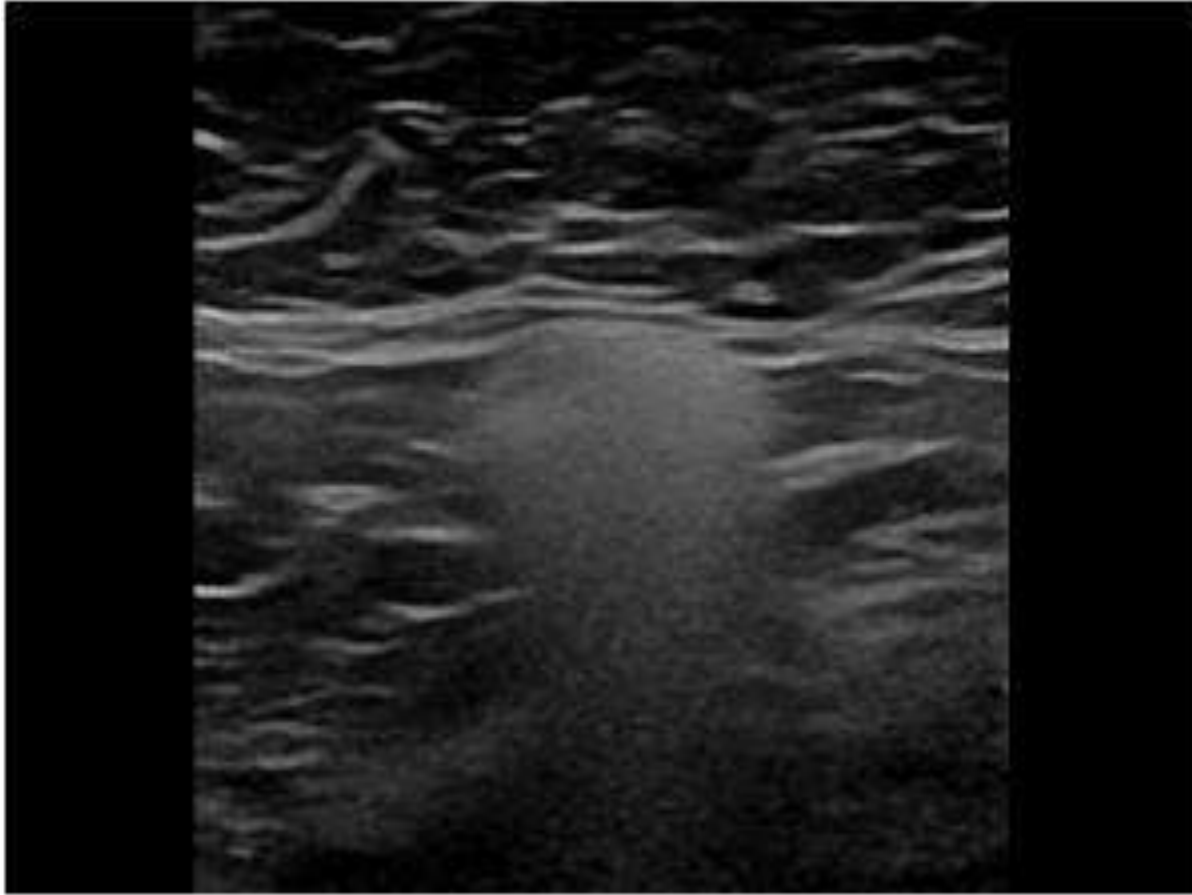


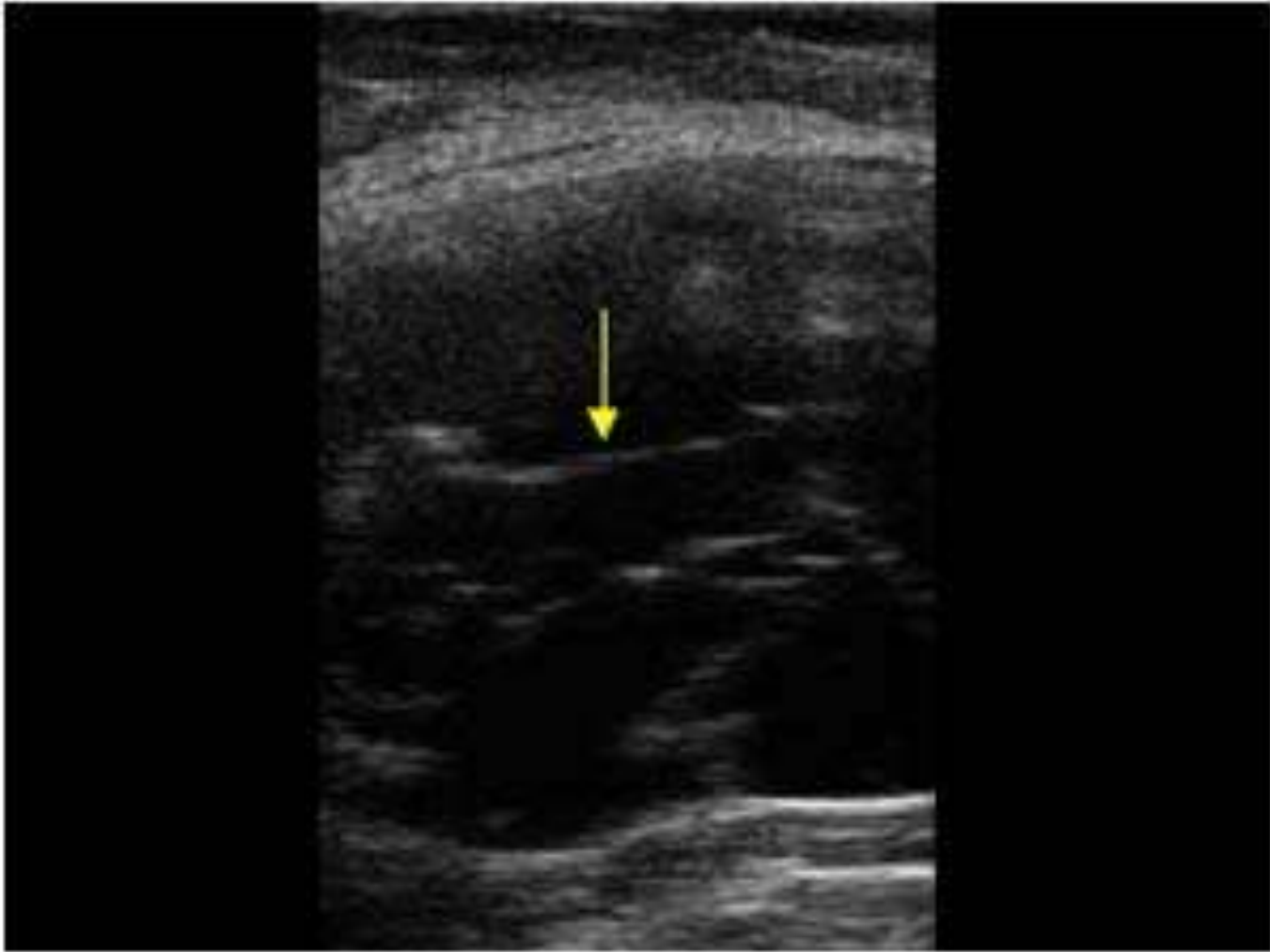
Snow storm appearance

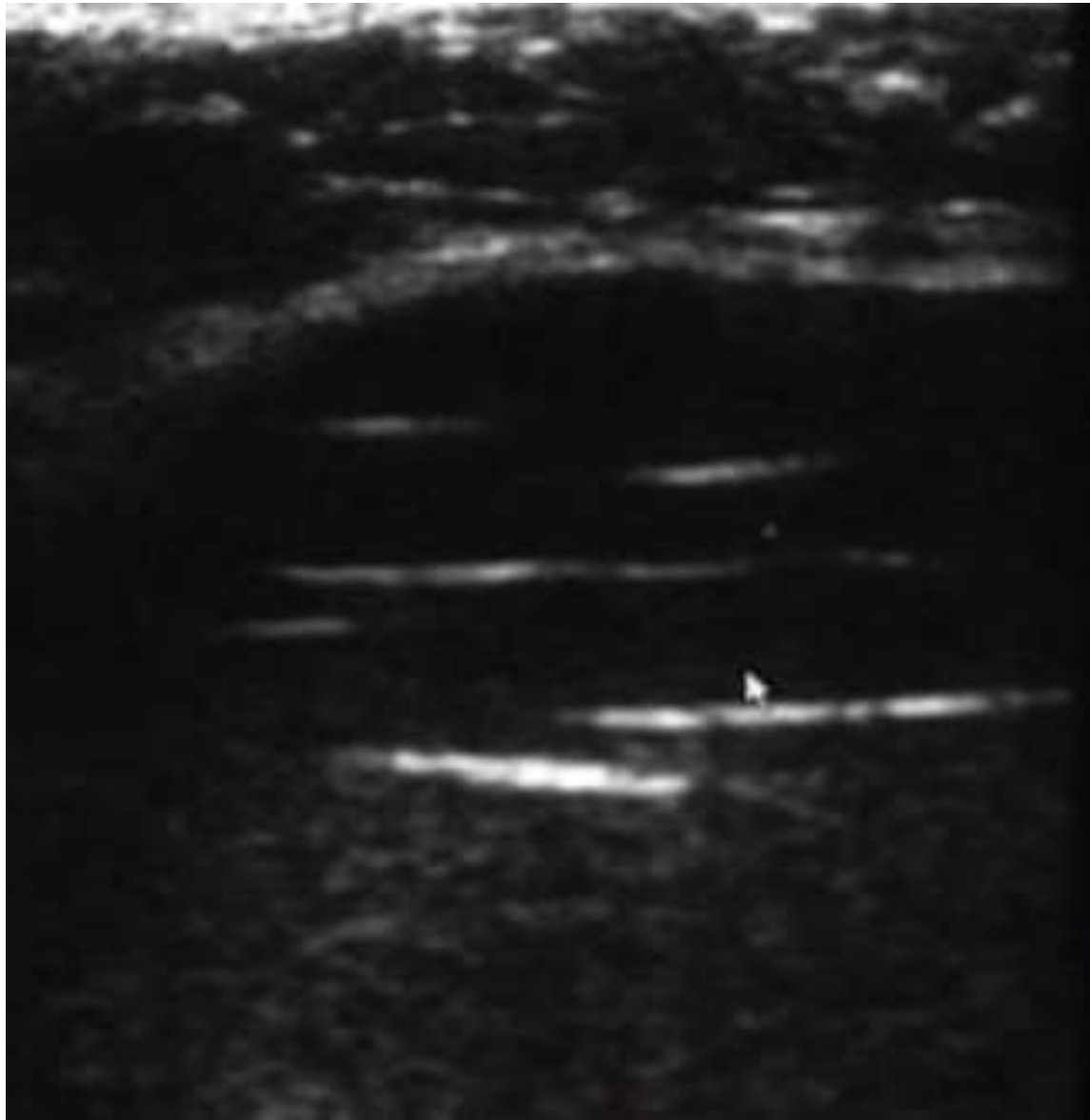


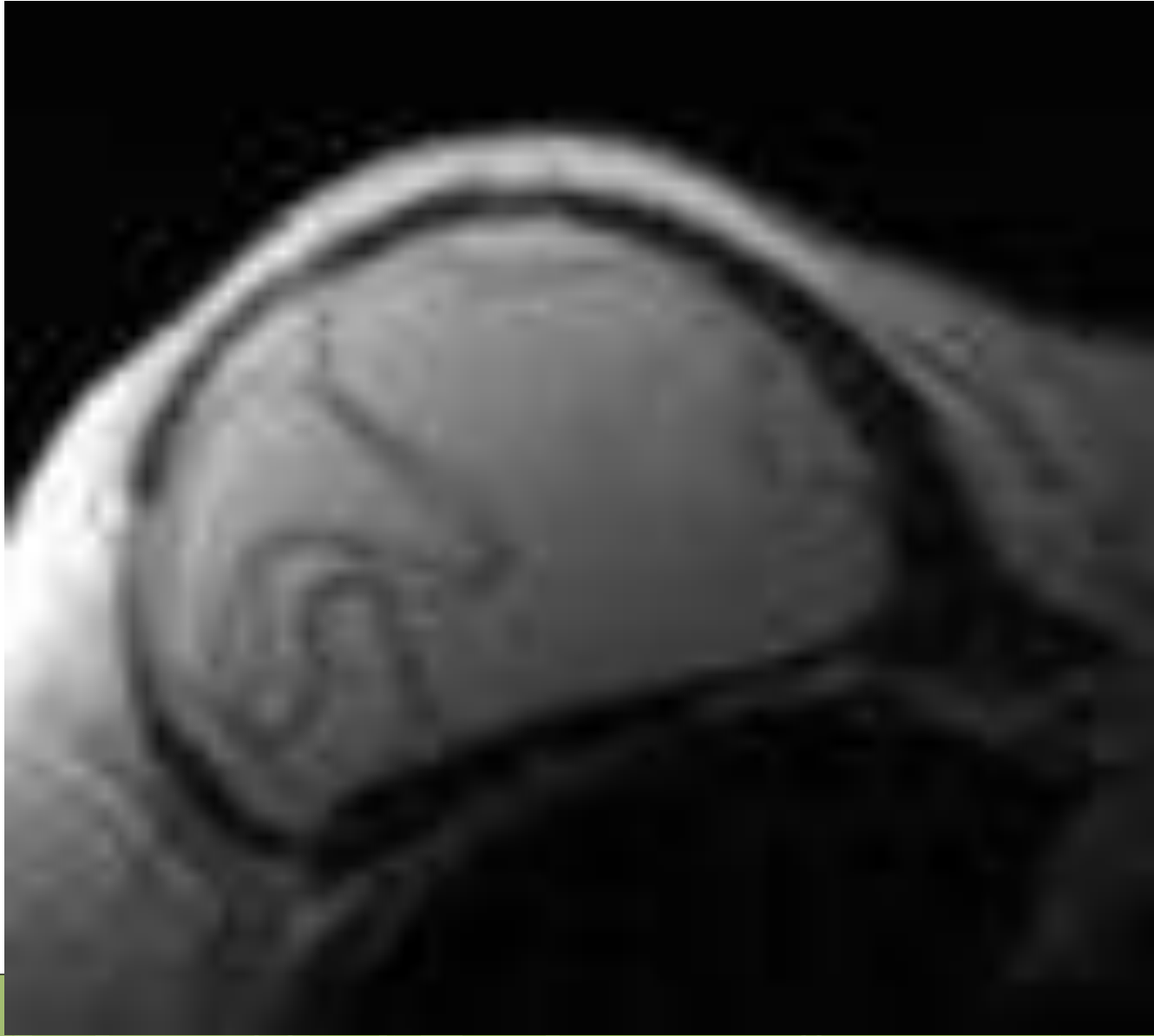
Role of ultrasound in Breast implant











Ultrasound staging of the Breast CA: Features of benign lymph nodes

1. Kidney shaped
2. Less than 1cm in short axis
3. Smooth rim like cortex less than 3mm
4. Fatty hilum
5. Hilar flow

Features of malignancy

- Cortical thickness
- Cortical bulging
- Round shape
- Loss of fatty hilum
- Loss of hilar flow

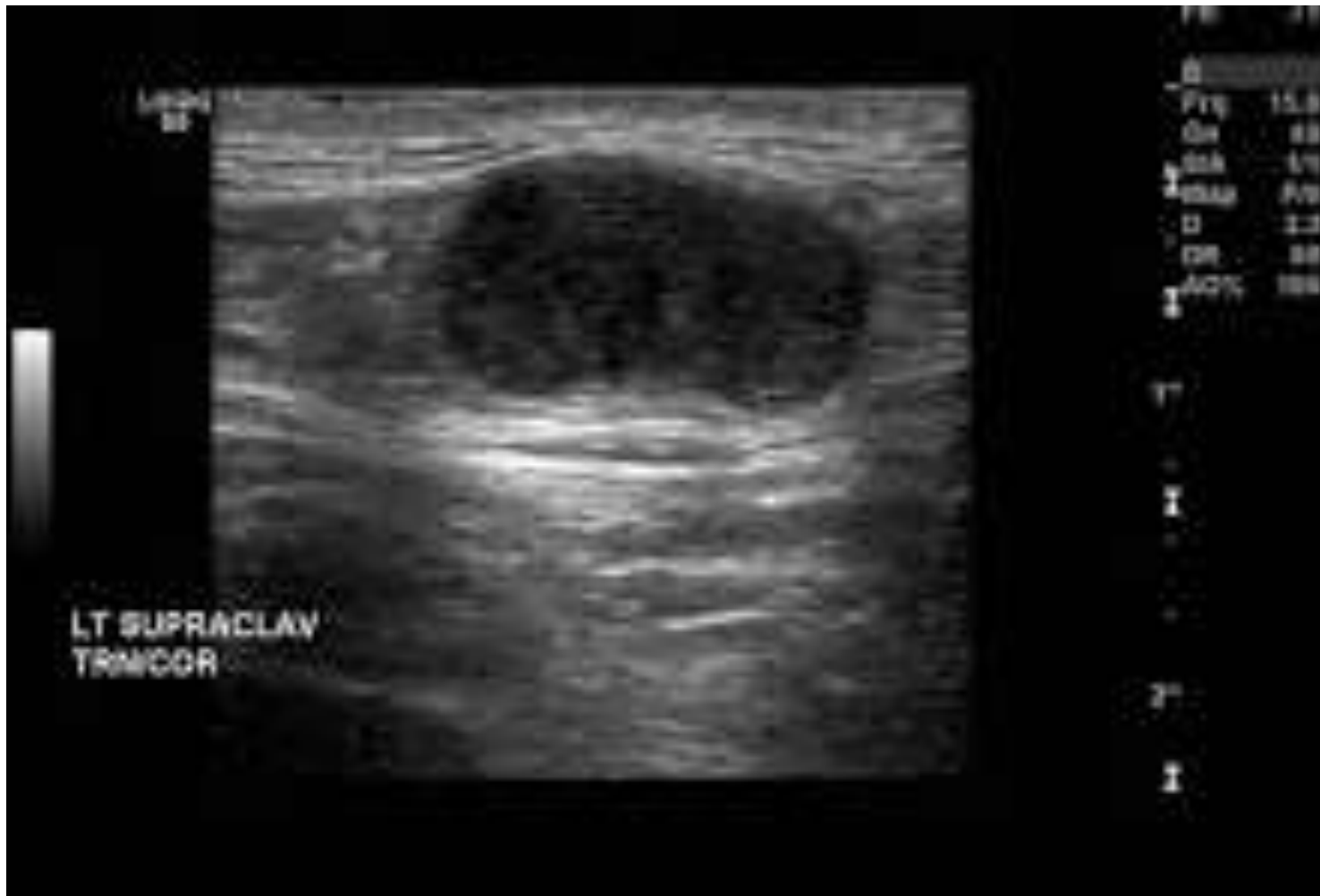
Benign lymph node on US



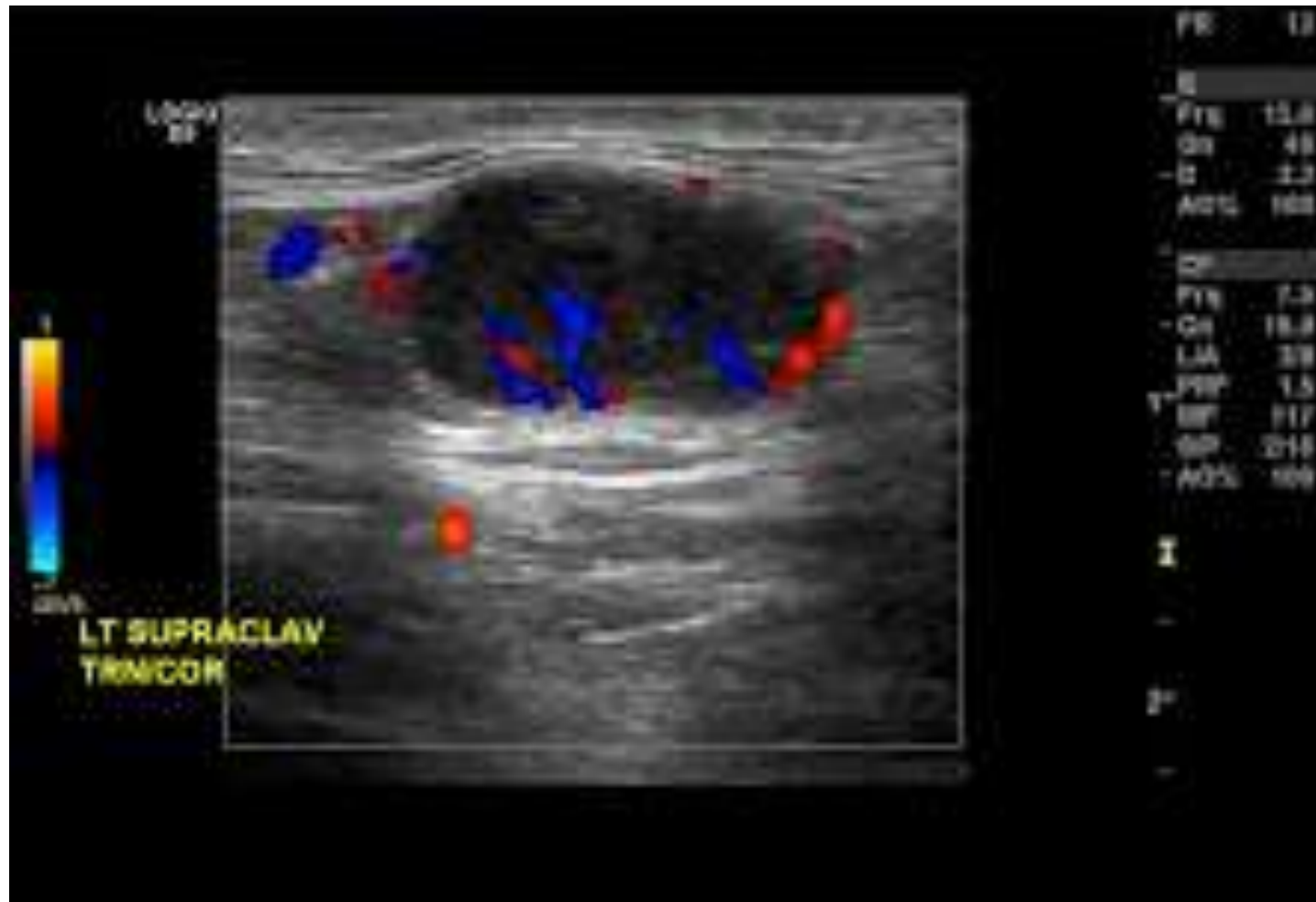
Normal hilar flow



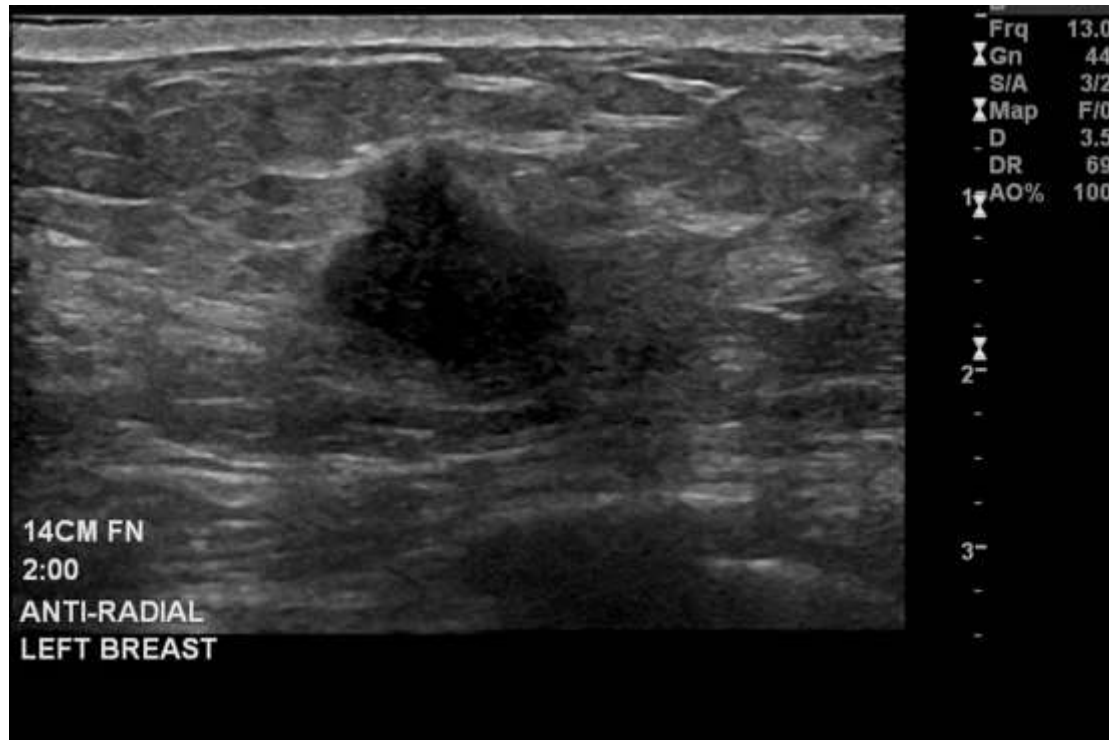
Metastatic node

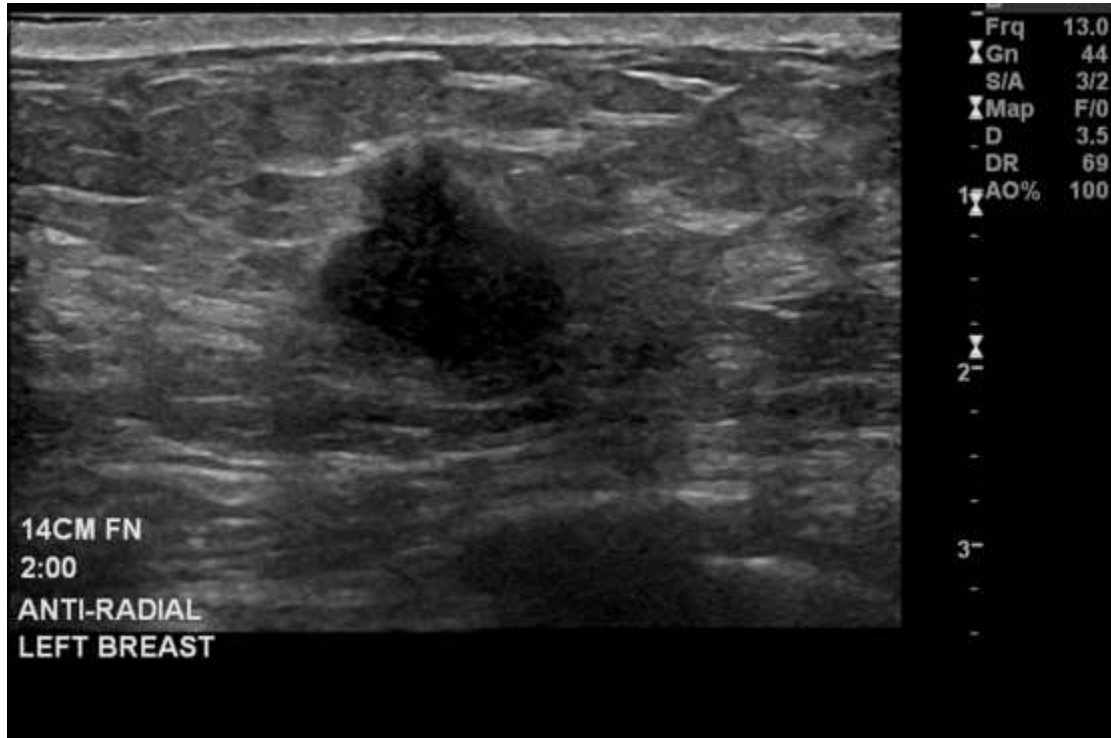


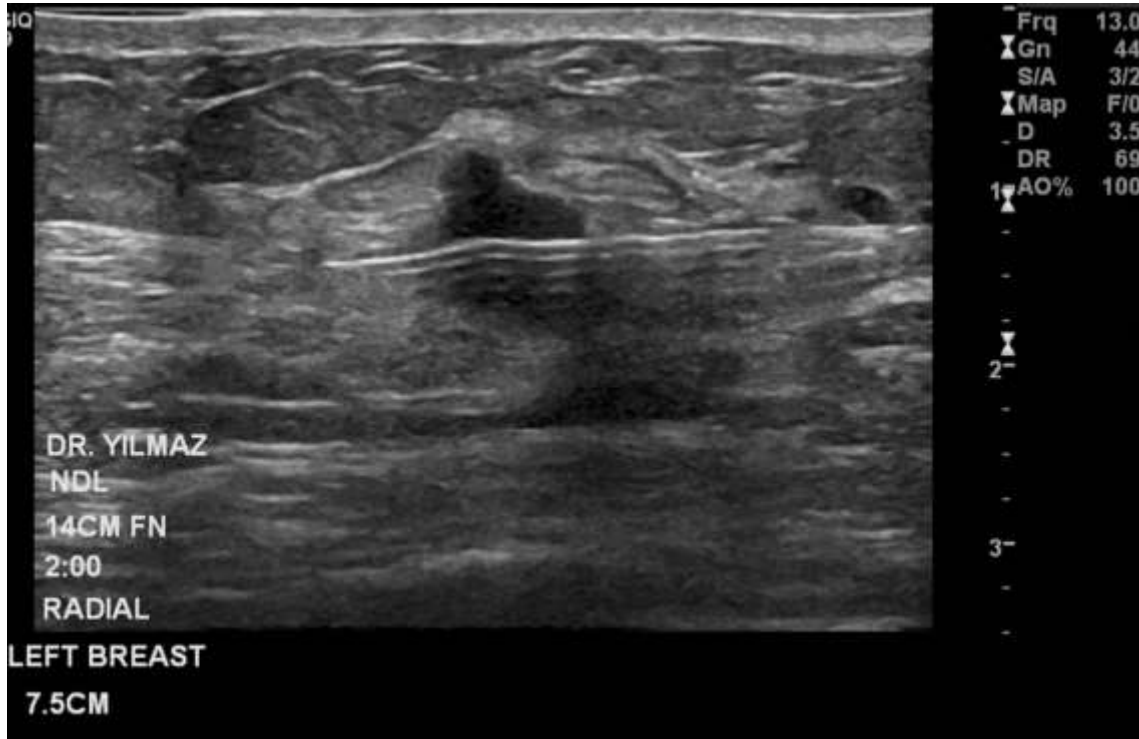
Metastatic node

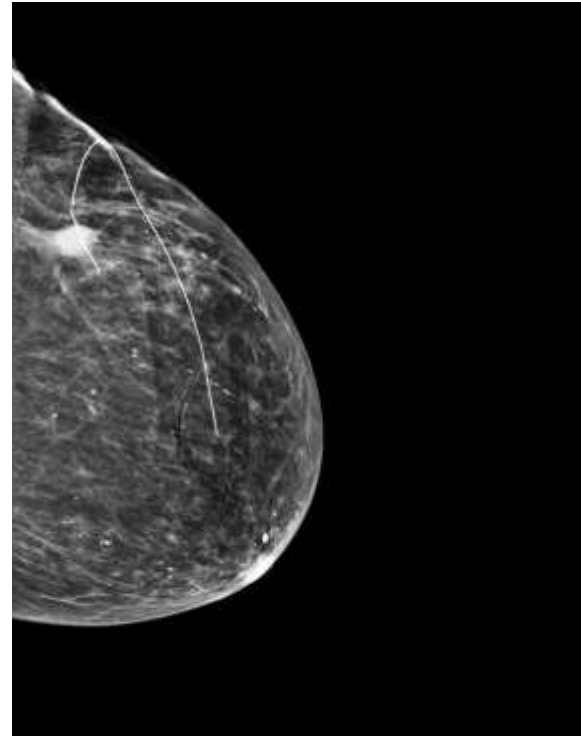
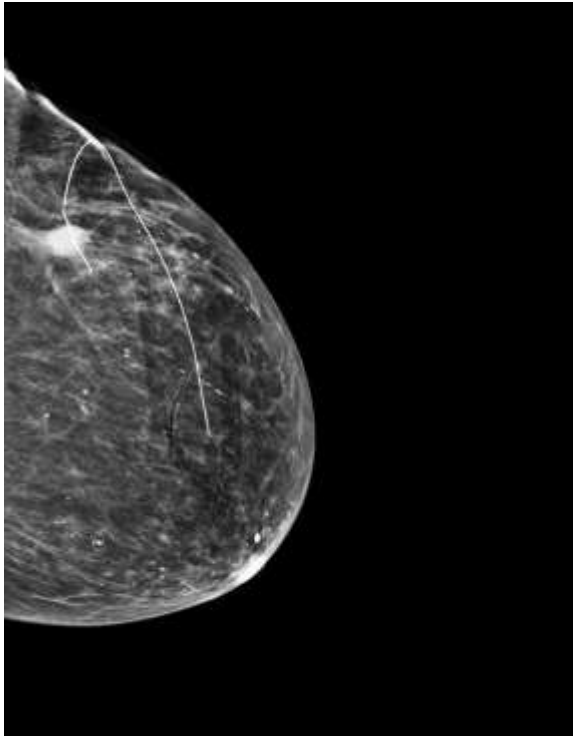
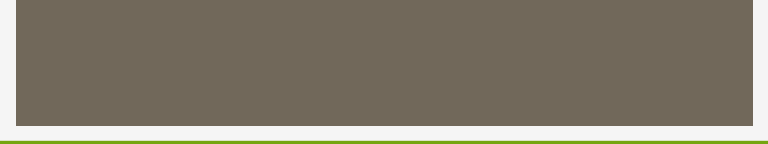


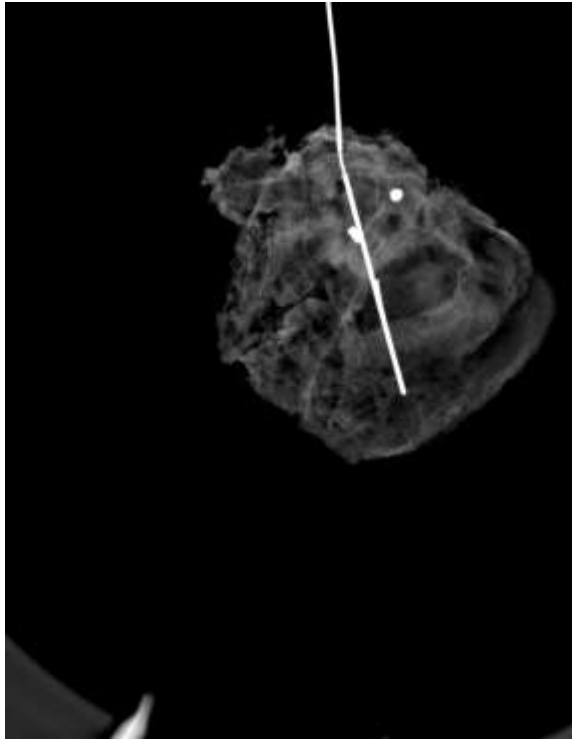
Ultrasound guided needle localization

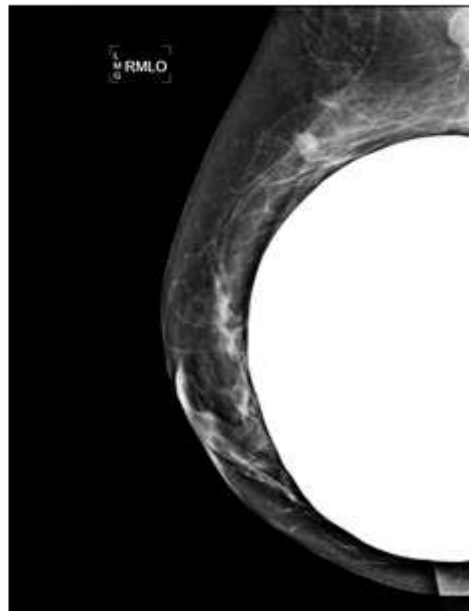
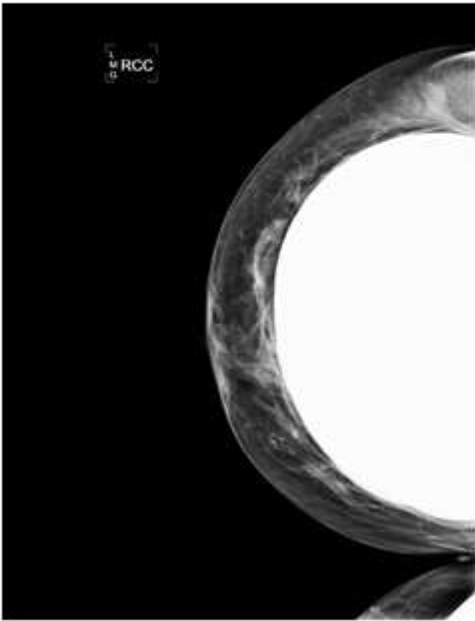








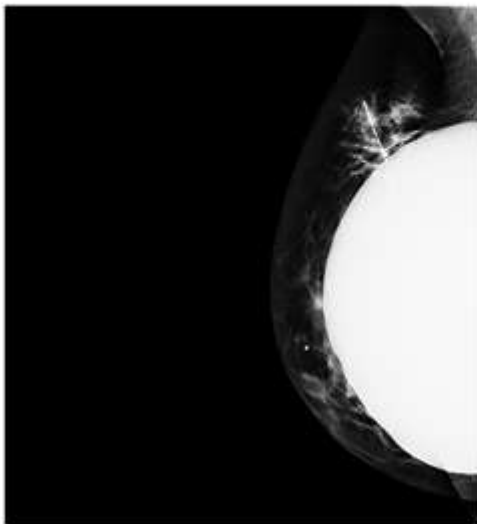




BNL with USG



BNL with USG



Role of USG

- Secondary screening process
- Further characterization of mammographic or MR findings
- Diagnostic for implant rupture
- Diagnostic for cyst vs solid mass
- Benign vs malignant masses
- Follow up for probably benign masses
- First line for palpable masses under 30 years
- Follow up for assessment of treatment response in benign or malignant etiologies.

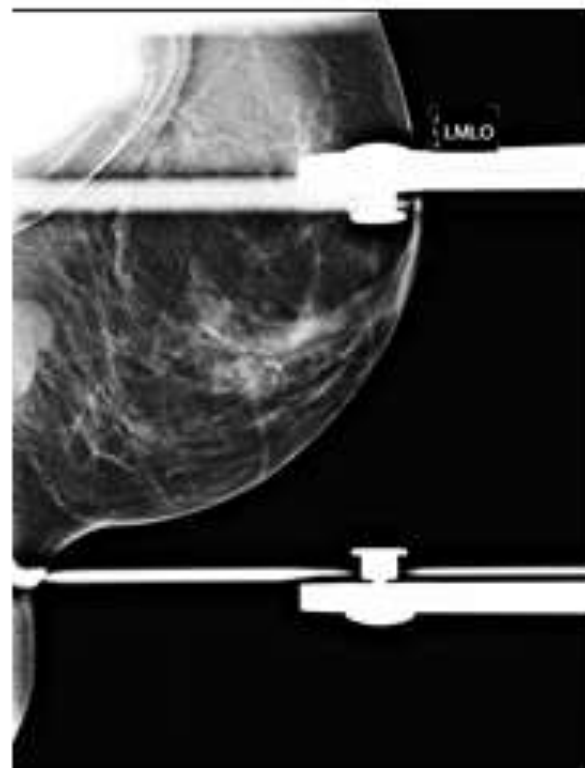
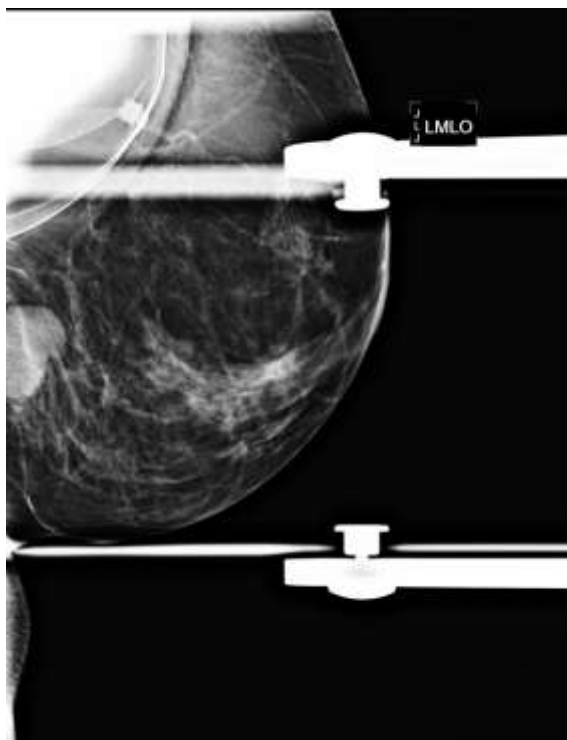
Role of USG

- Therapeutic aspiration of symptomatic cysts
- Therapeutic aspiration of breast abscess
- Ultrasound guided wire localization
- Ultrasound guided biopsies
- Ultrasound guided placement of fiducial markers for radiation

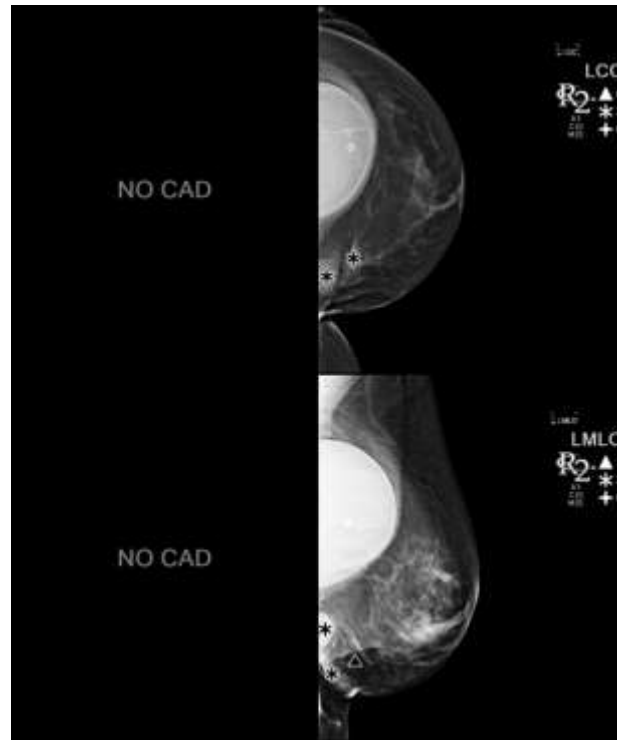
Case 1: Mass in the inferomedial left breast

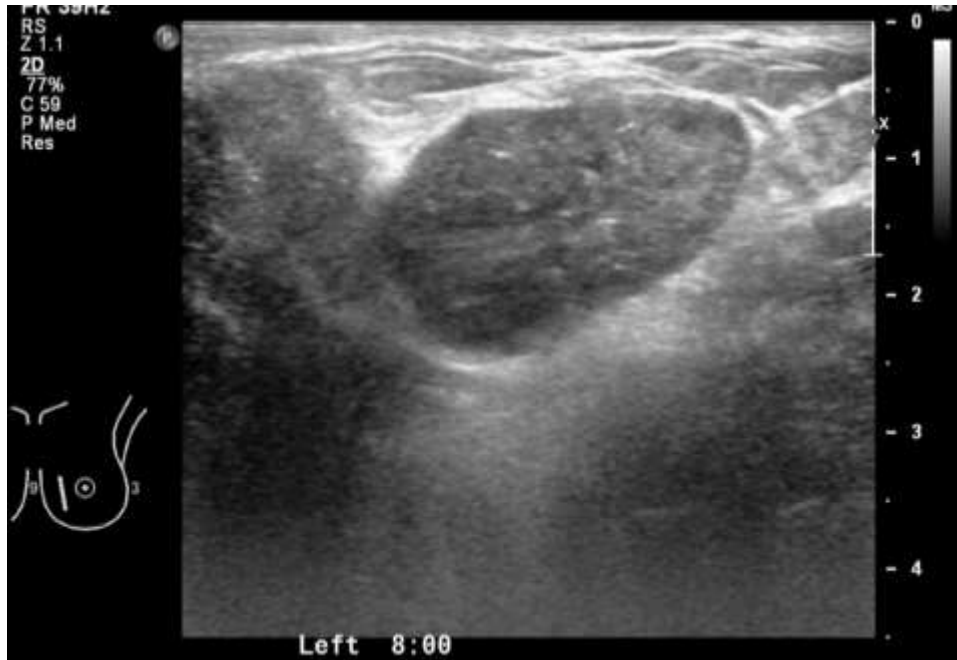


Spots

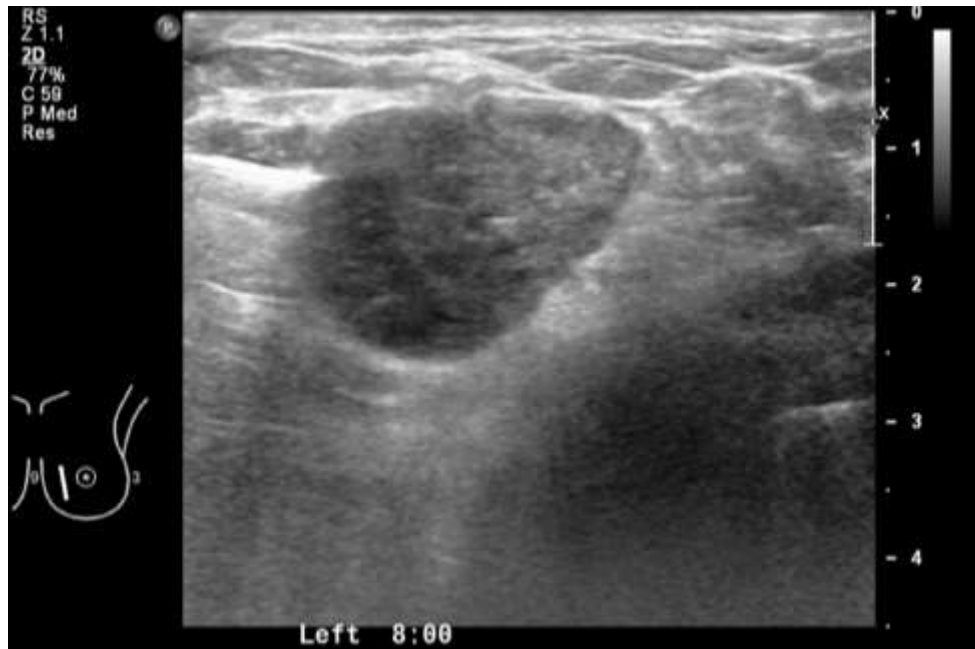


CAD





USG



Case 2: 42 F with palpable findings



FR 4Hz

P1

2D

72%

C 56

P Med

Res

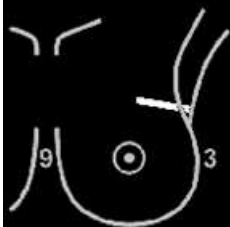
CF

82%

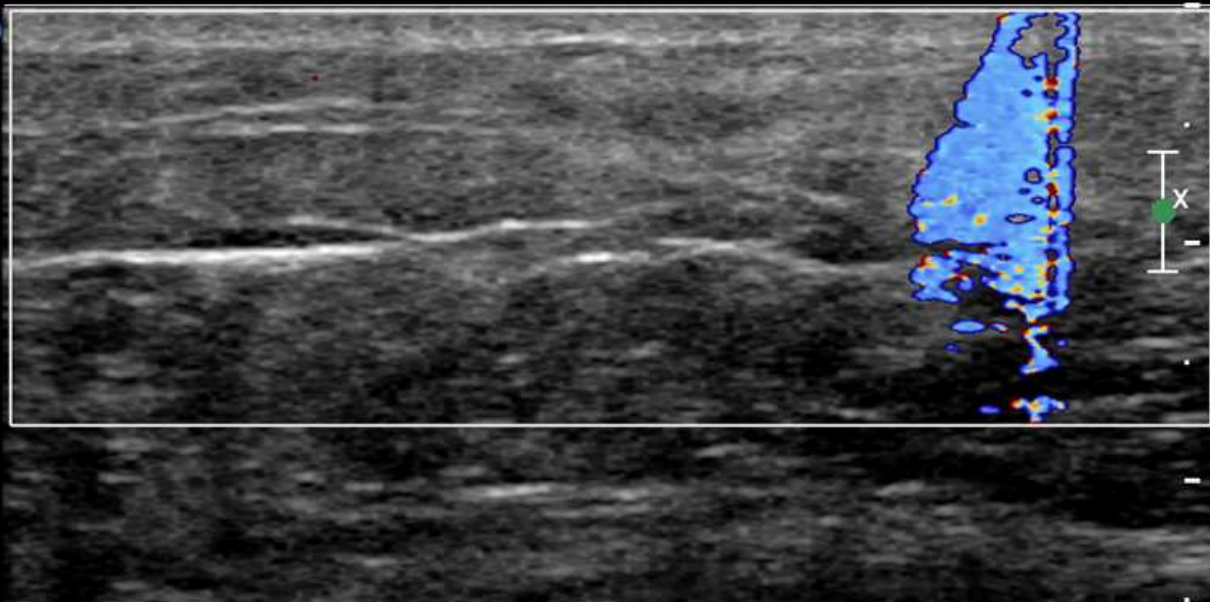
500Hz

WF 27Hz

Low



P



M3 M3

+3.3

-3.3

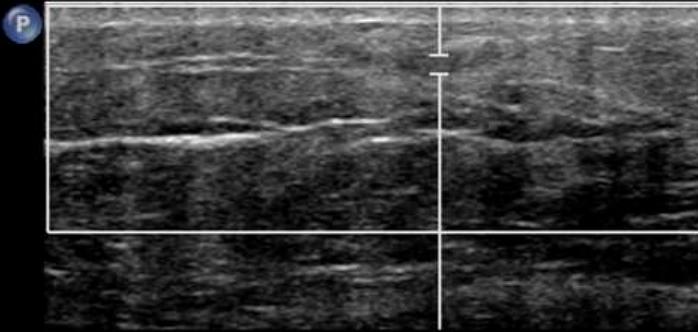
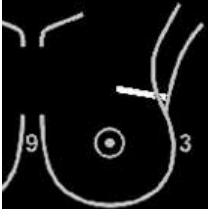
cm/s

Left 2:00

FR 8Hz
P1

2D
70%
C 56
P Med
Res

CPA
80%
500Hz
WF 40Hz
Low



PW
40%
WF 40Hz
SV 1.5mm
M3
6.0MHz
0.5cm

M3 M3



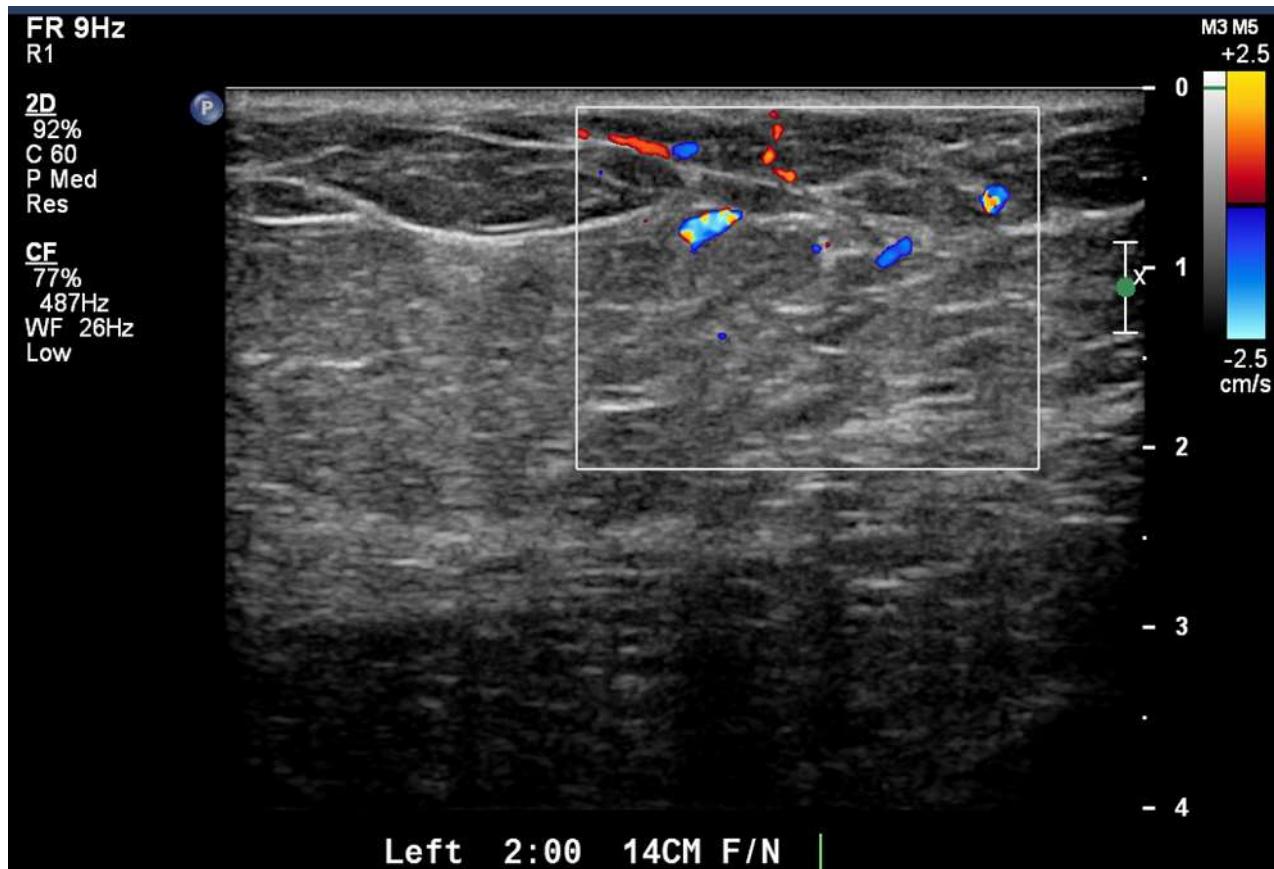
-
-10
-
- cm/s
-
-10
-



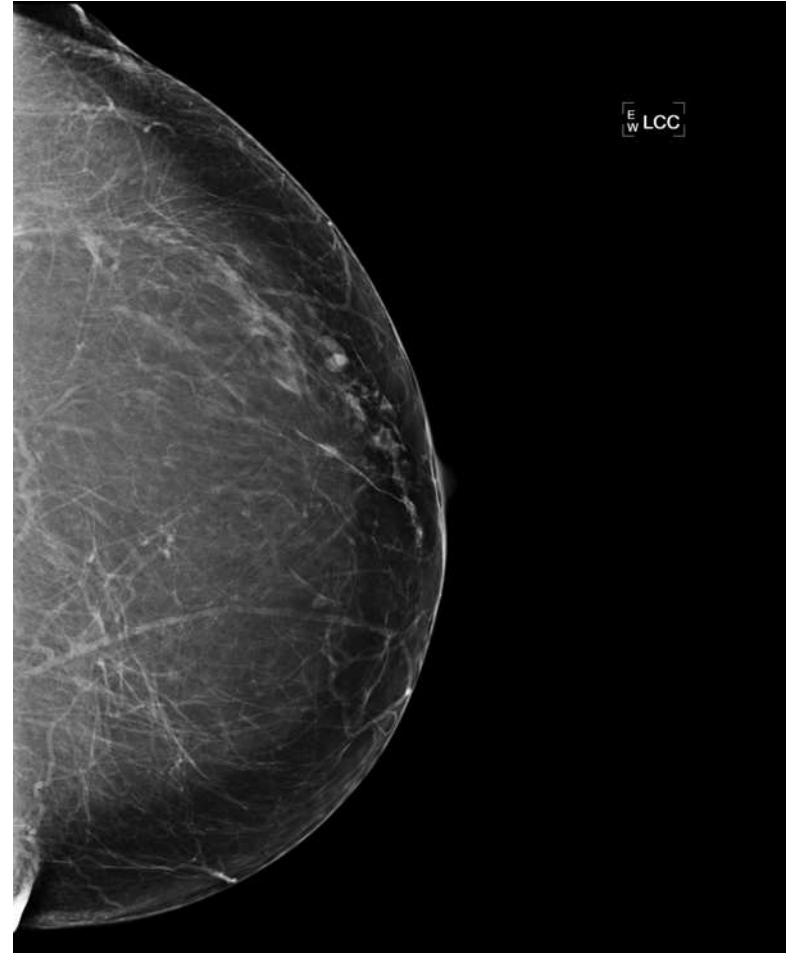
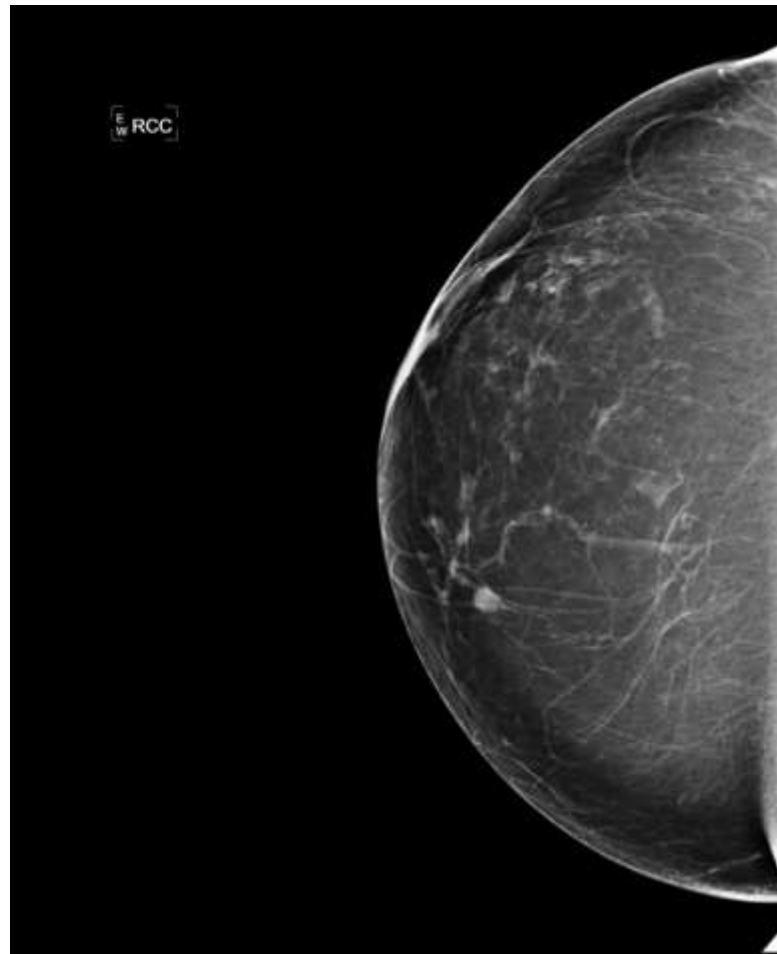
Left 2:00

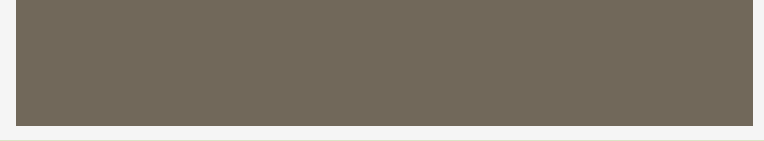
6.6sec

Mondor's Disease



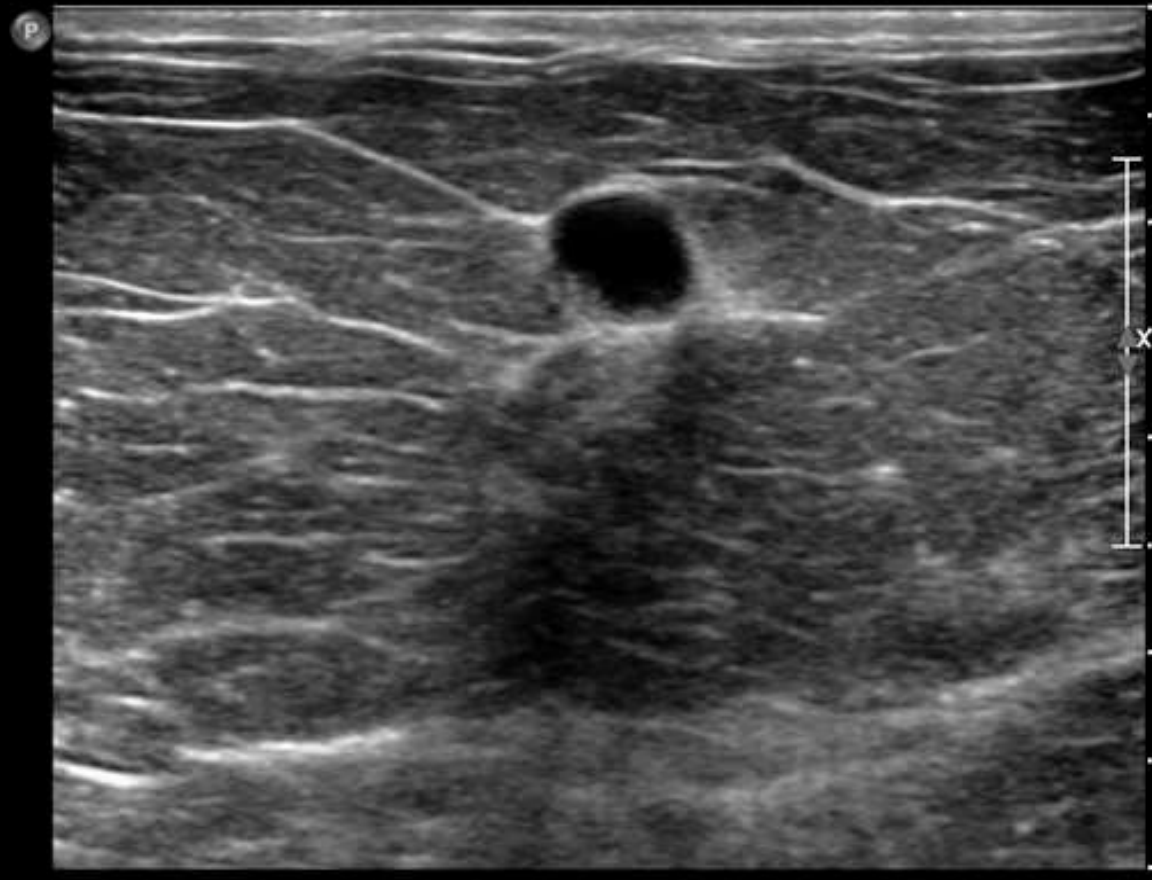
Case 3: Small mass at Rt 3'o clock





FR 42Hz
RS

2D
62%
C 58
P Med
Res
TAC1



M3

Right Breast 3:00 Long 3 CM F/N

PR 512
R1

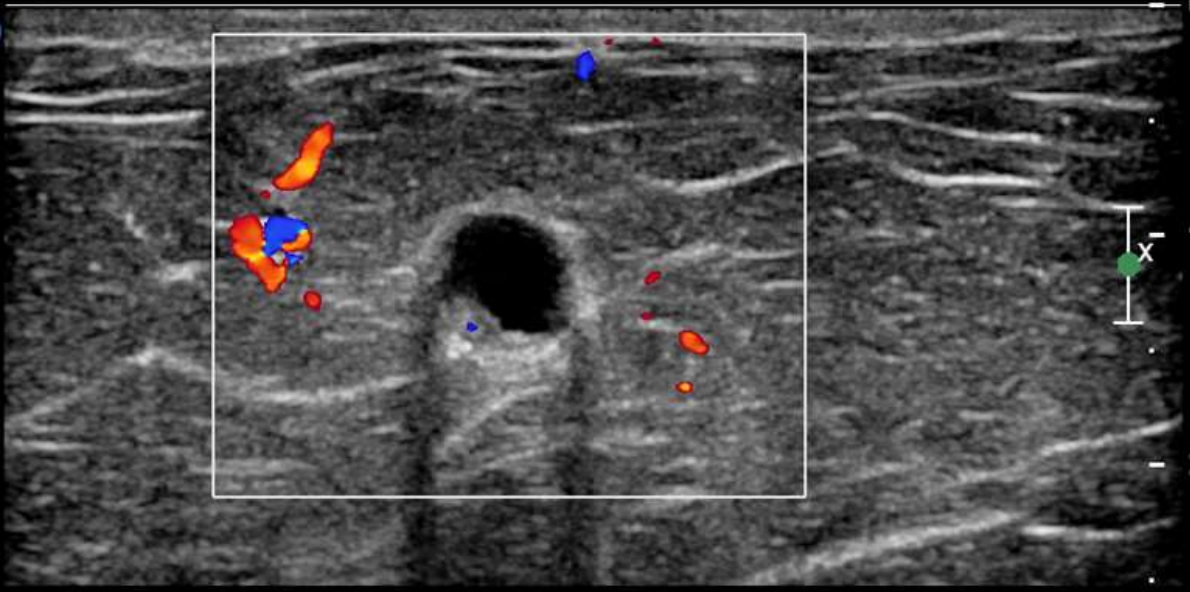
2D

85%
C 60
P Med
Res
TAC1

CF

77%
487Hz
WF 26Hz
Low

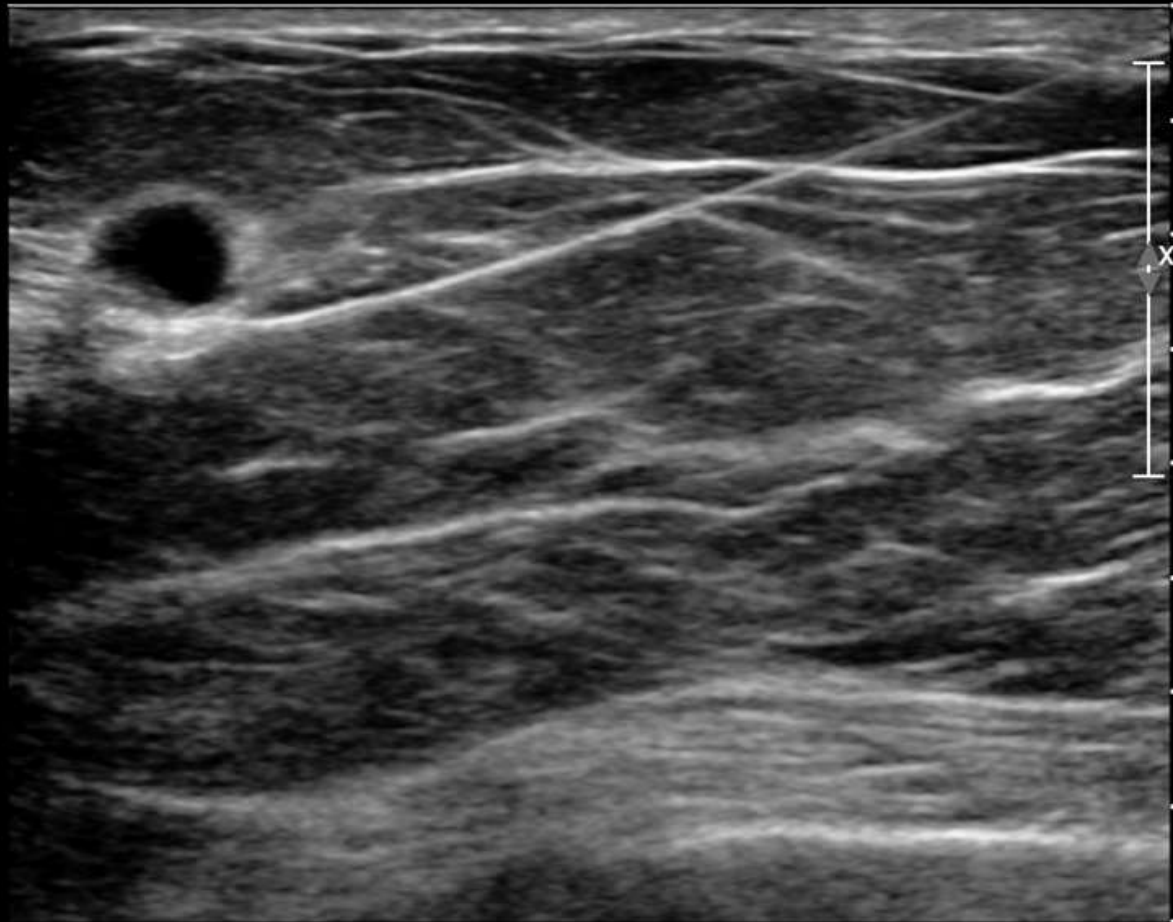
P



Right Breast 3:00 Rad 3 CM F/N

FR 42HZ
RS

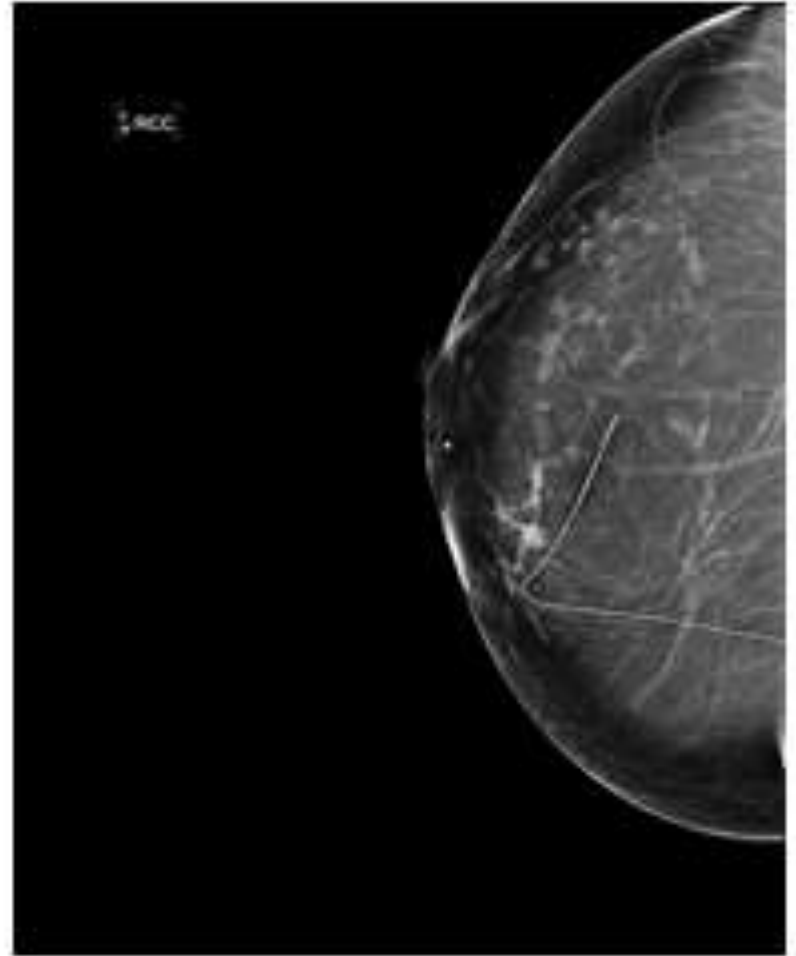
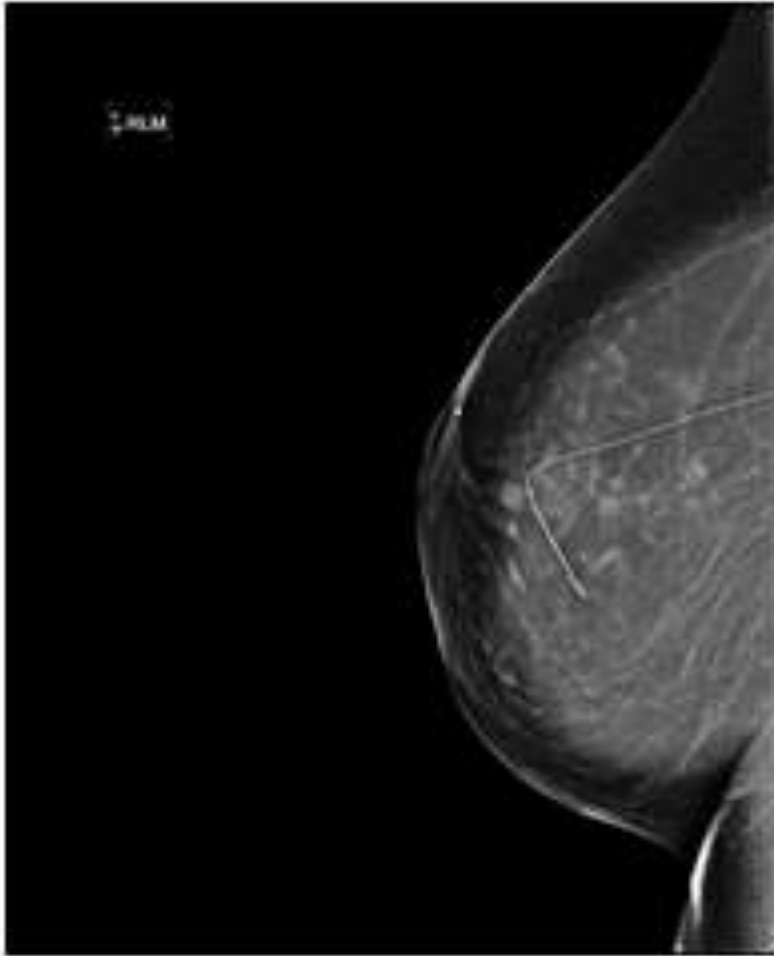
2D
57%
C 58
P Med
Res



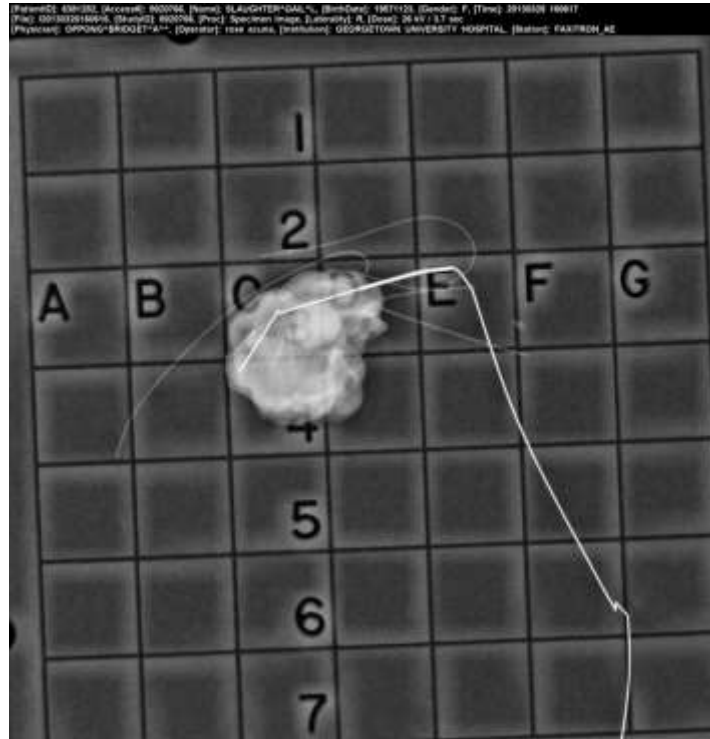
MS
0
1
2
3
4

Right 3:00 Rad 4 CM F/N

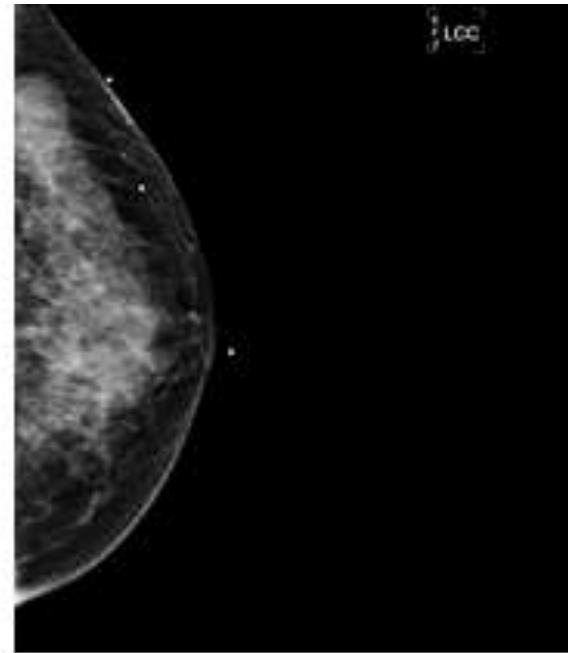
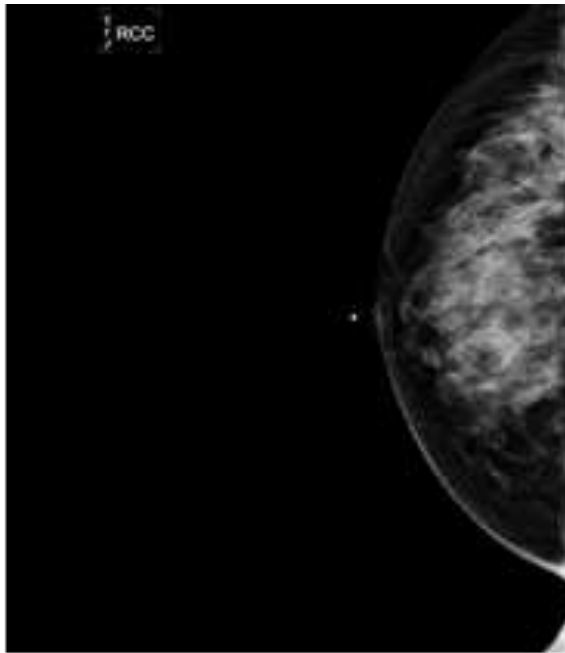
Intraductal papilloma

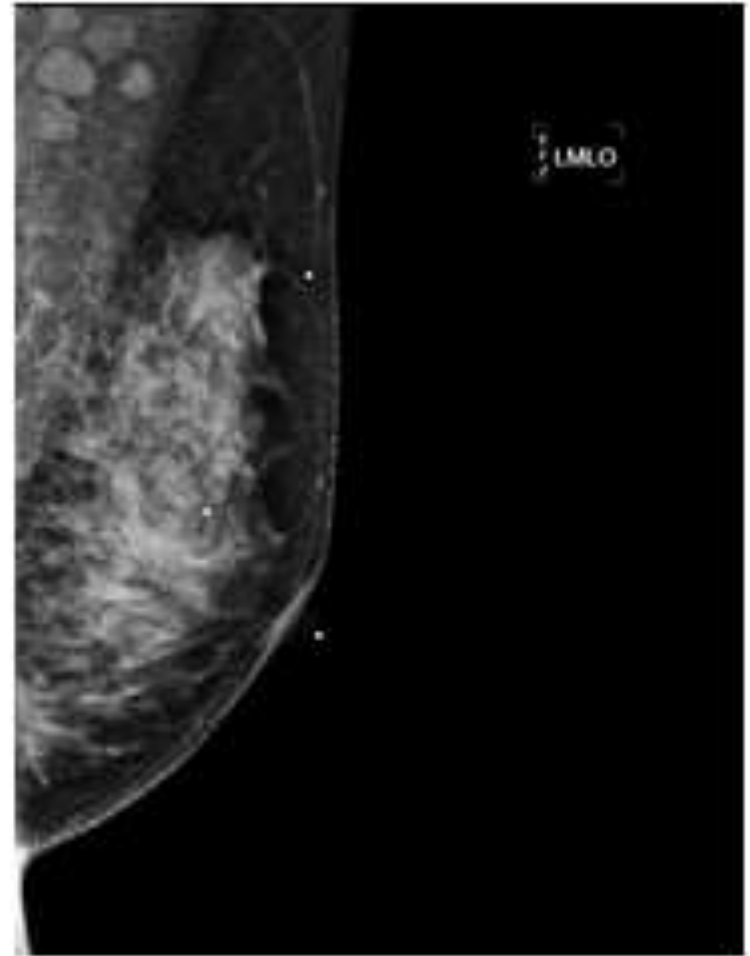
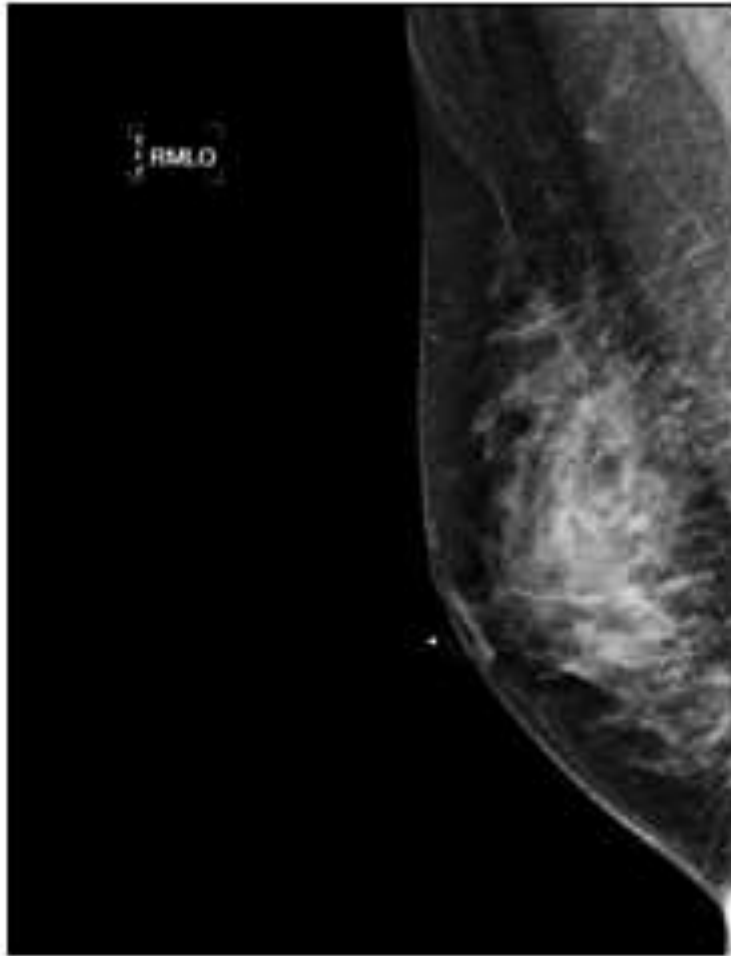


Specimen Radiograph



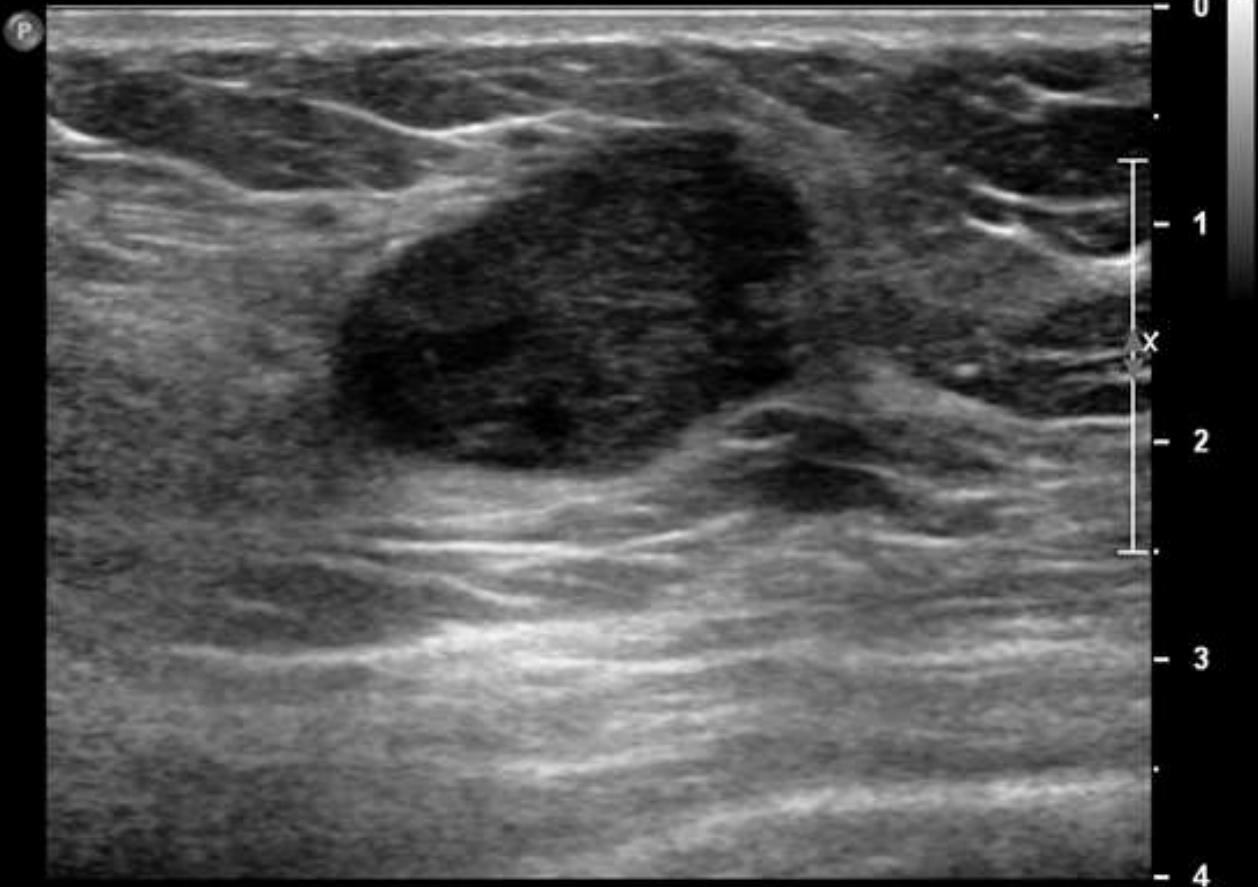
Case 4: 54 F with mass at left 2'o klok position





FR 42Hz
RS

2D
63%
C 58
P Med
Res
TAC1

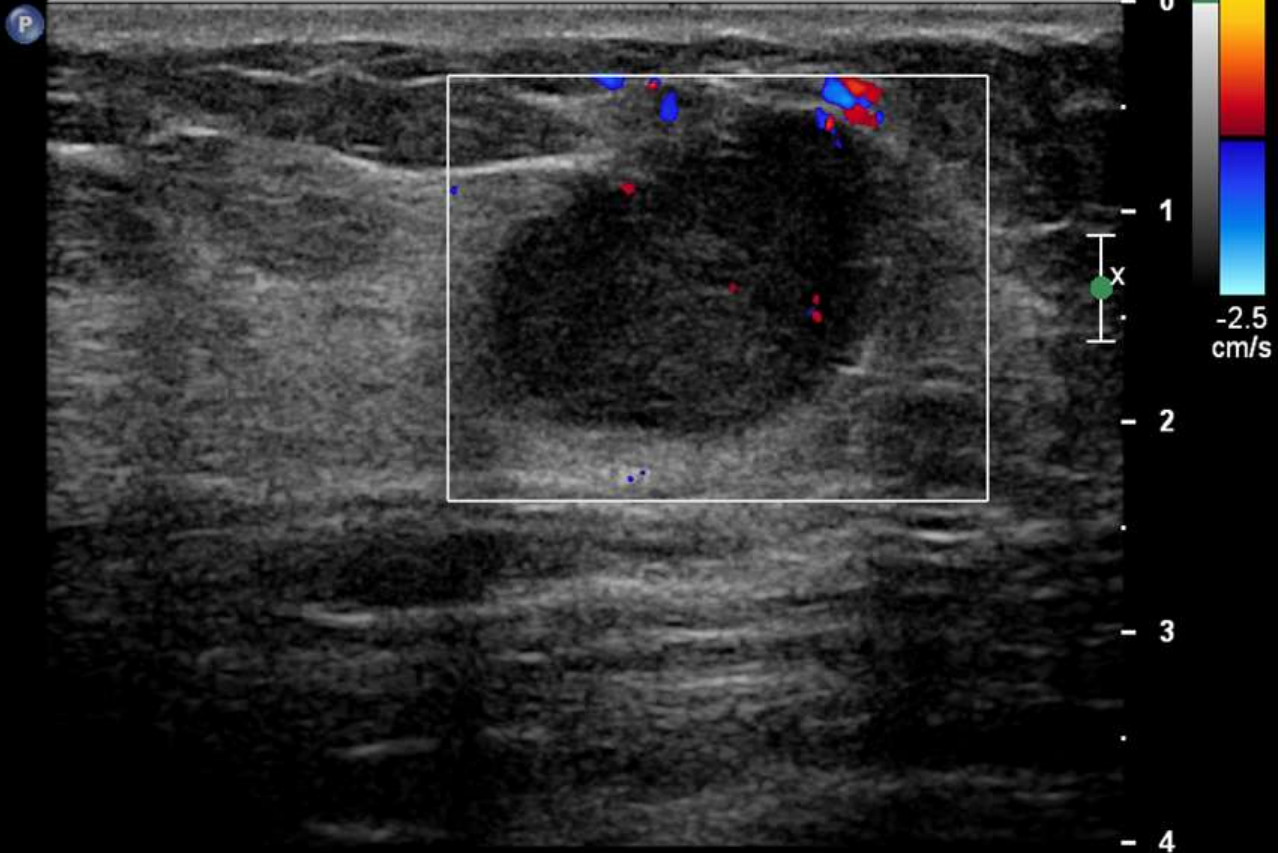


M3

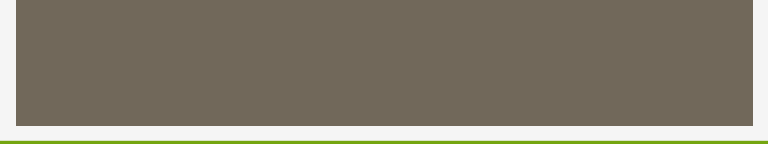
Left Breast 1:00 Rad 7 CM F/N

FR 9Hz
R1

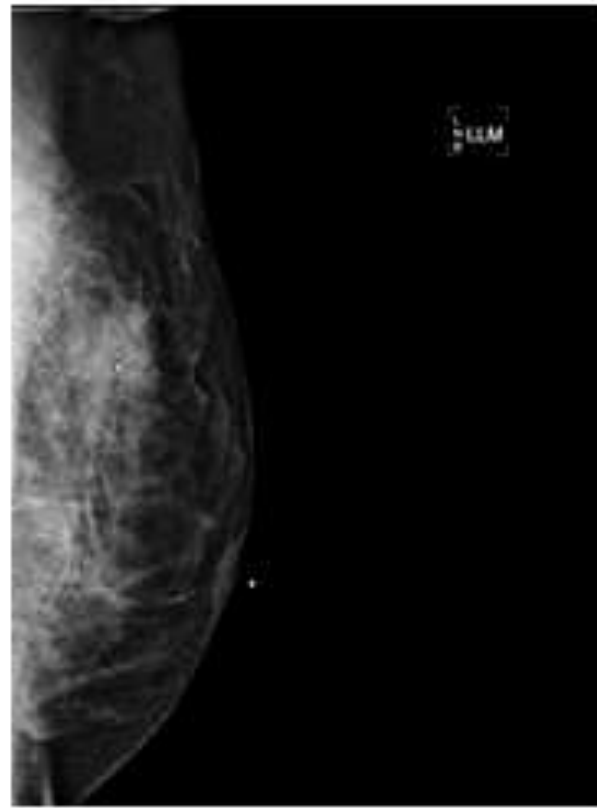
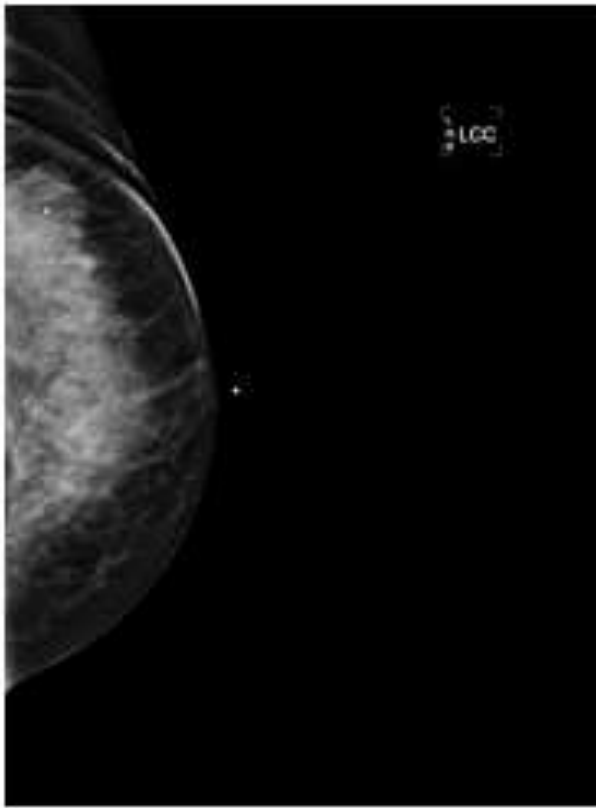
2D
88%
C 60
P Med
Res
TAC1
CF
77%
487Hz
WF 26Hz
Low



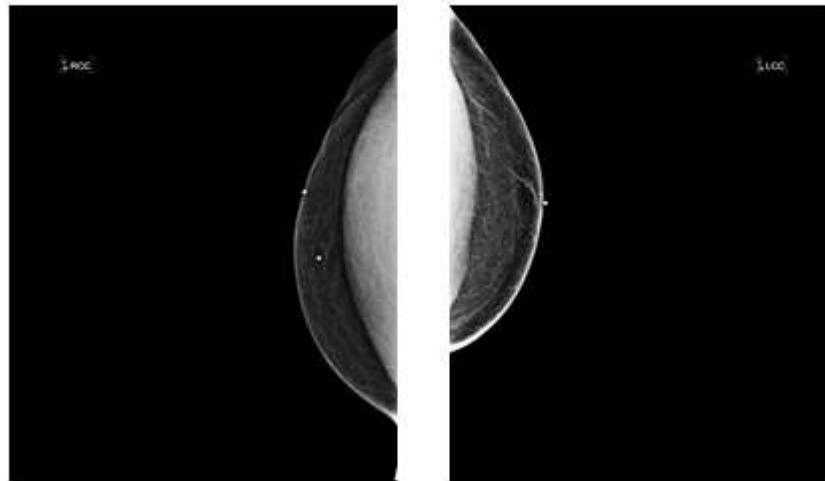
Left Breast 1:00 Rad 7 CM F/N

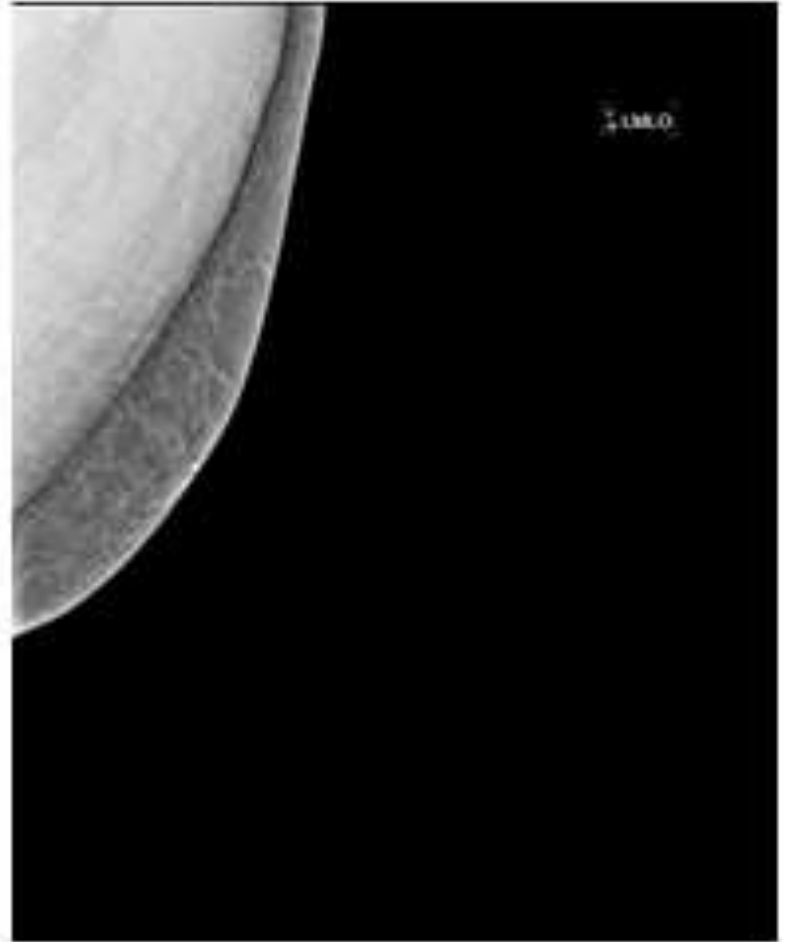
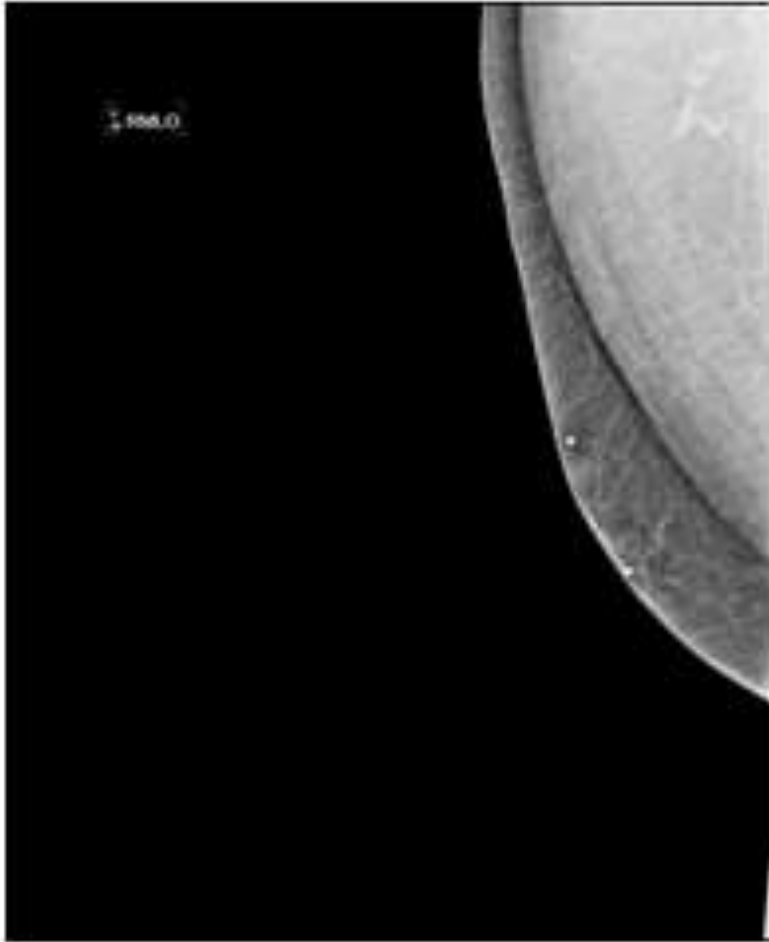


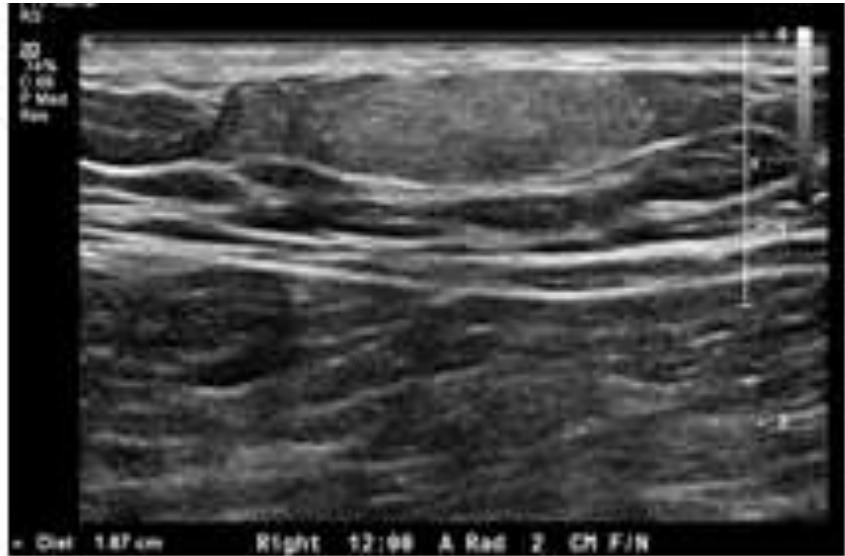
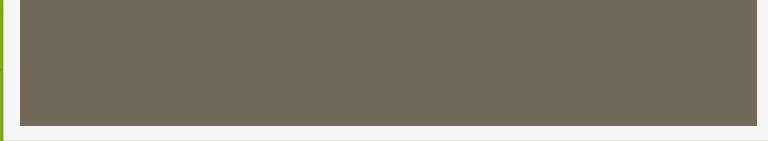
Invasive ductal carcinoma



Case:5 50y male with palpable findings







Lipoma

Case 6: 45 year old with palpable at left 12'oclock



LOGIQ
E9

CHI		
0-	Frq	12.0
-	Gn	33
∞	S/A	3/2
-	Map	F/0
	D	4.5
1-	DR	69
-	AO%	100

LEFT BREAST
AREA OF PALP
5- 6:00
5-7 CMNP
RADIAL



4-

FR 4

CHI

Frq 12.0

Gn 33

D 6.0

AO% 100

CF

Frq 6.3

2-Gn 17.0

L/A 3/8

PRF 0.8

WF 89

S/P 1/12

AO% 100



6-

LOGIQ
E9



**LEFT BREAST
AREA OF PALP
2- 3:00
4-8 CMNP
RADIAL**

Benign Fat Necrosis

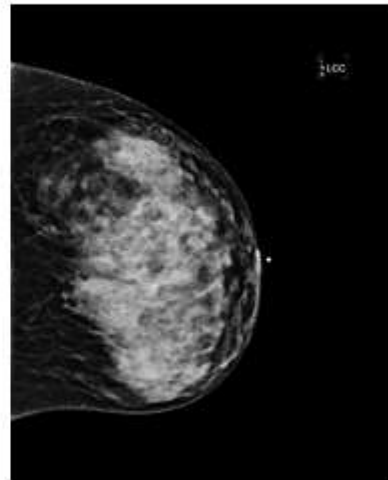
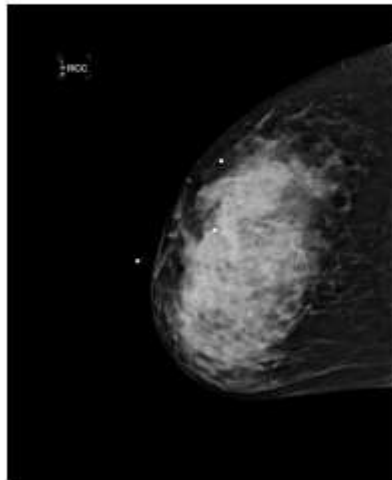
Last piece of puzzle

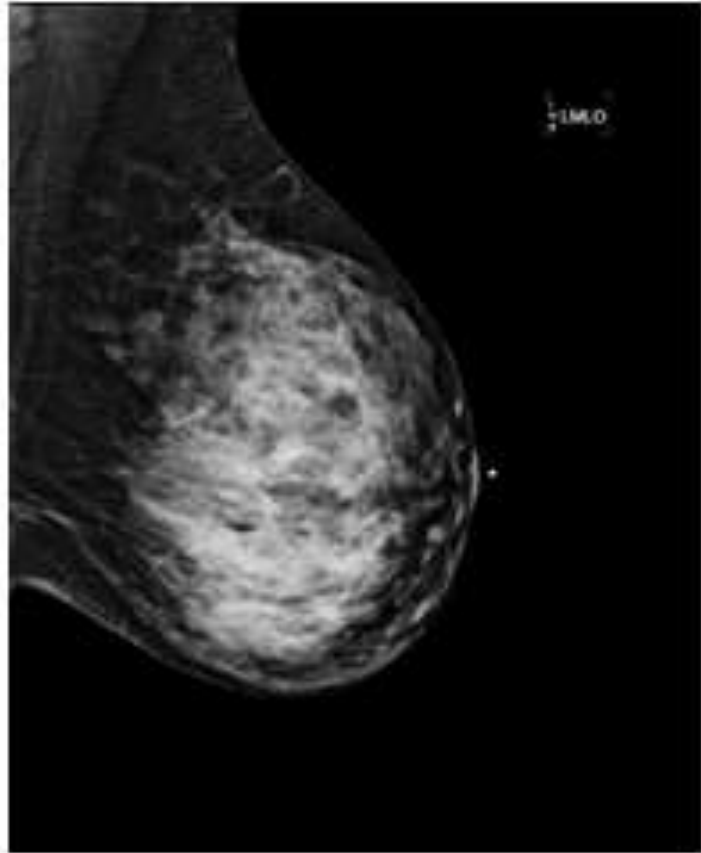
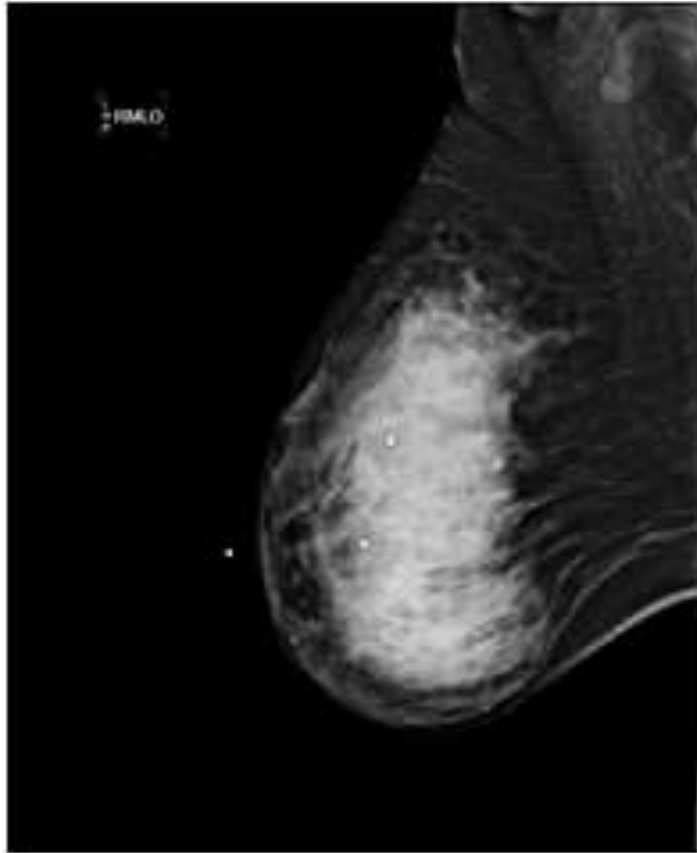


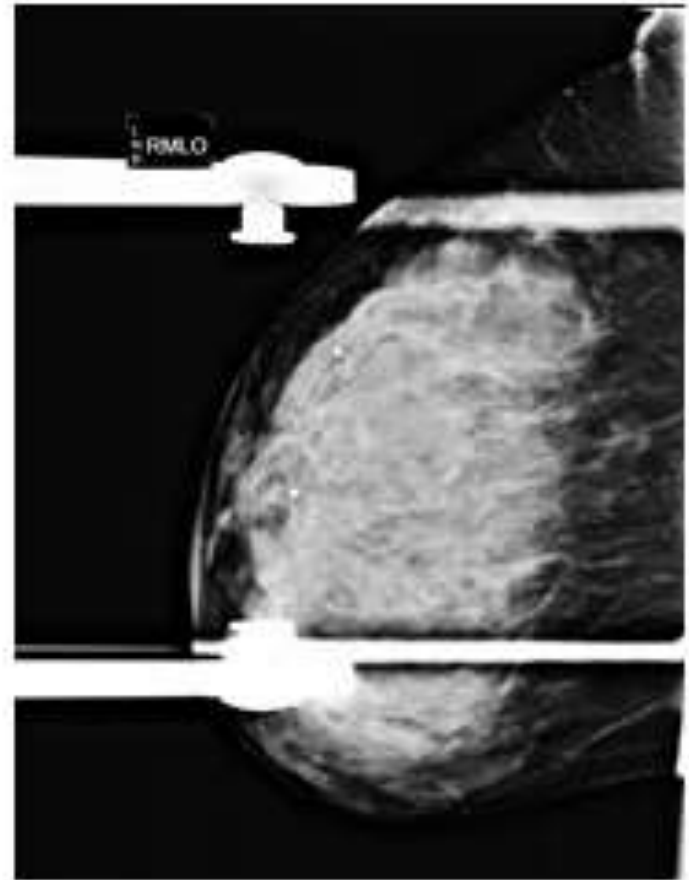
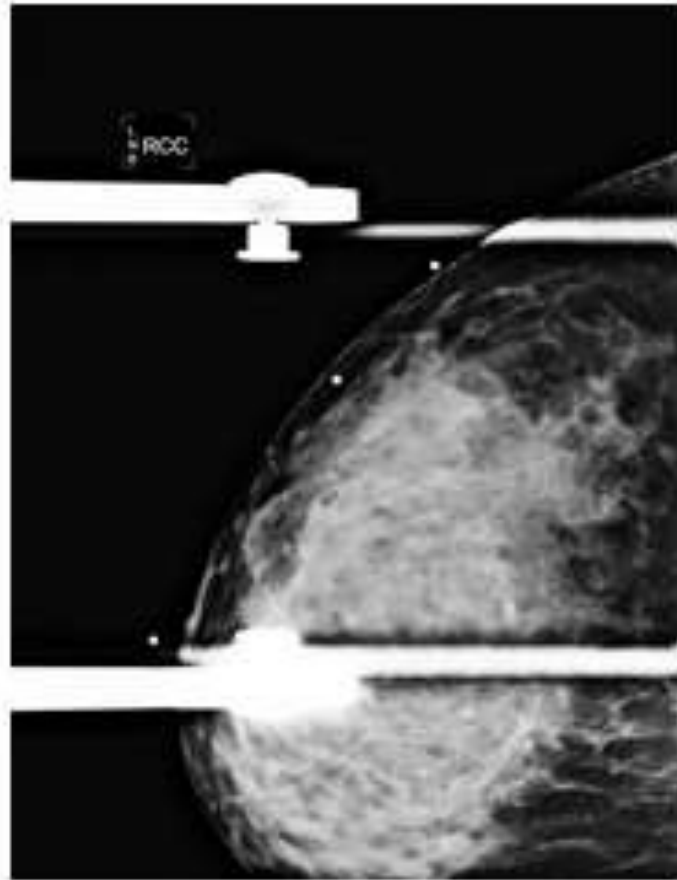
History

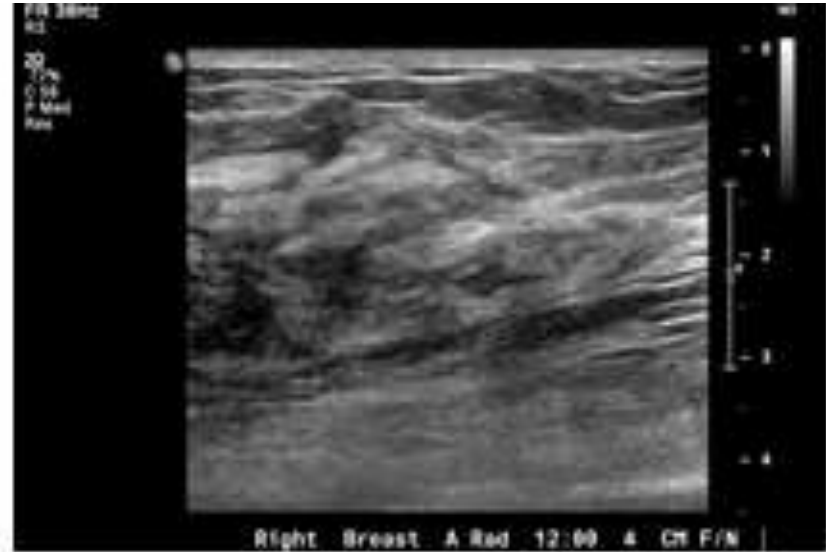
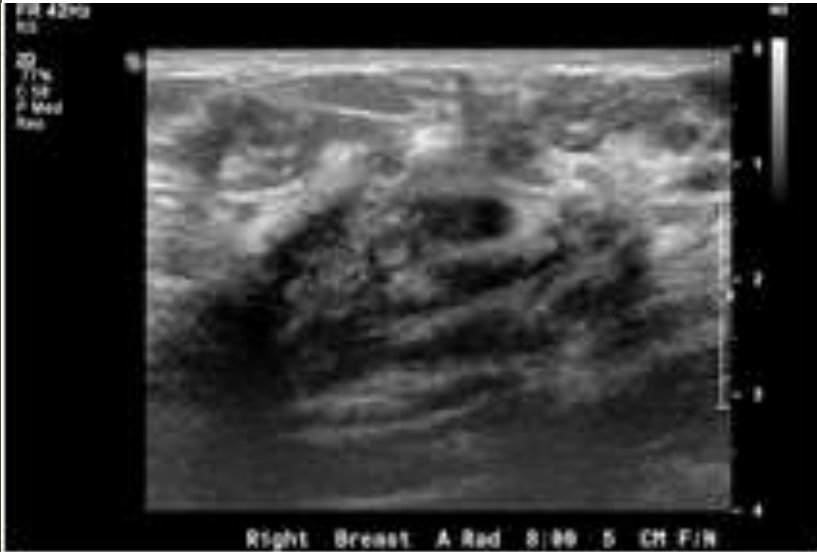
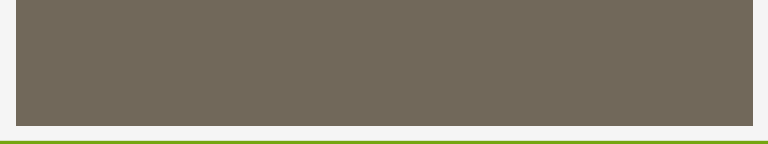
- 50 year old female presented with palpable findings in the right breast at 10'o clock position. Strong family history of breast cancer

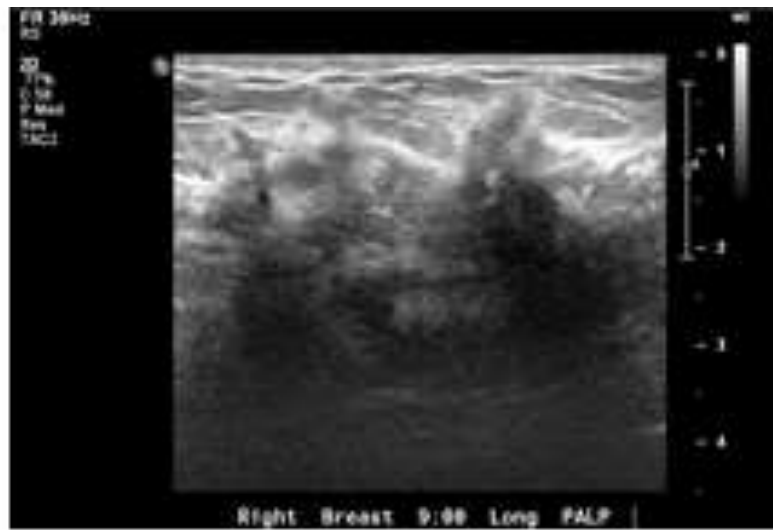
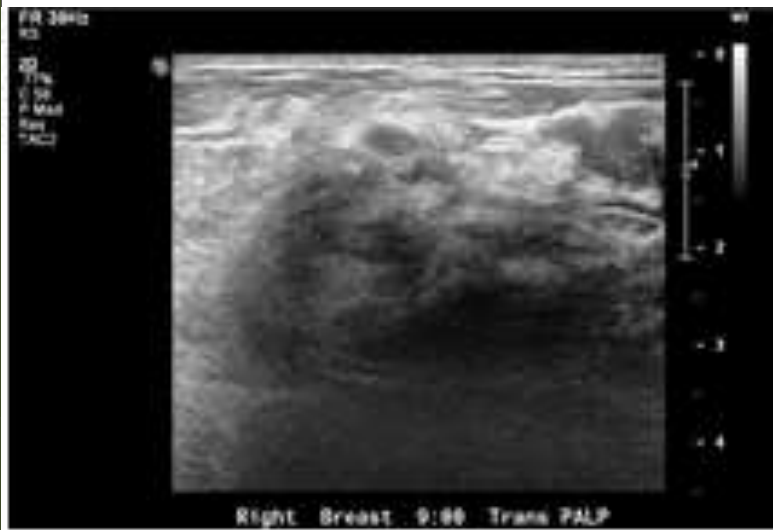
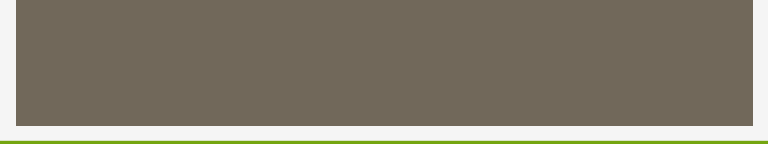
Case 1: 50y female with palpable mass at right 10 o'clock position

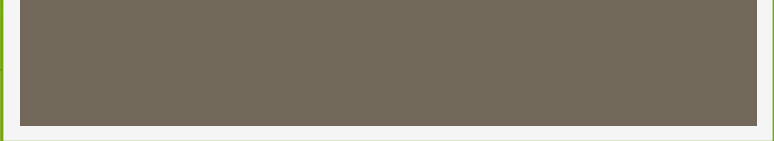






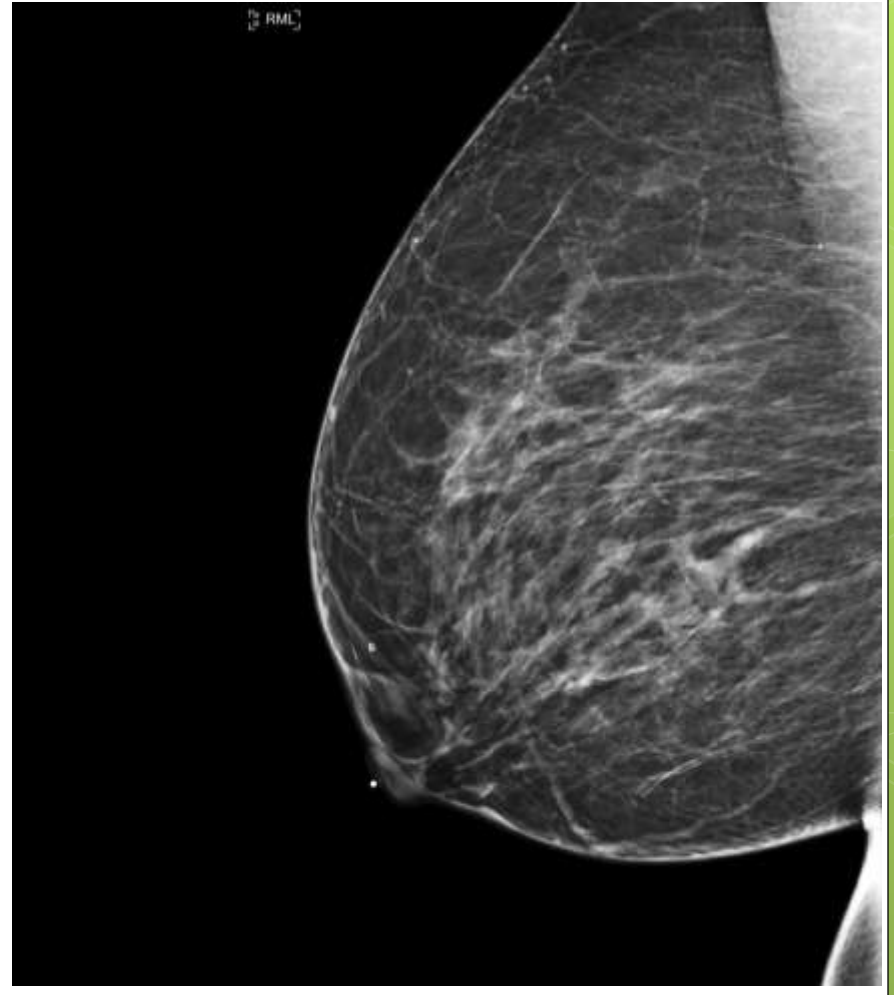
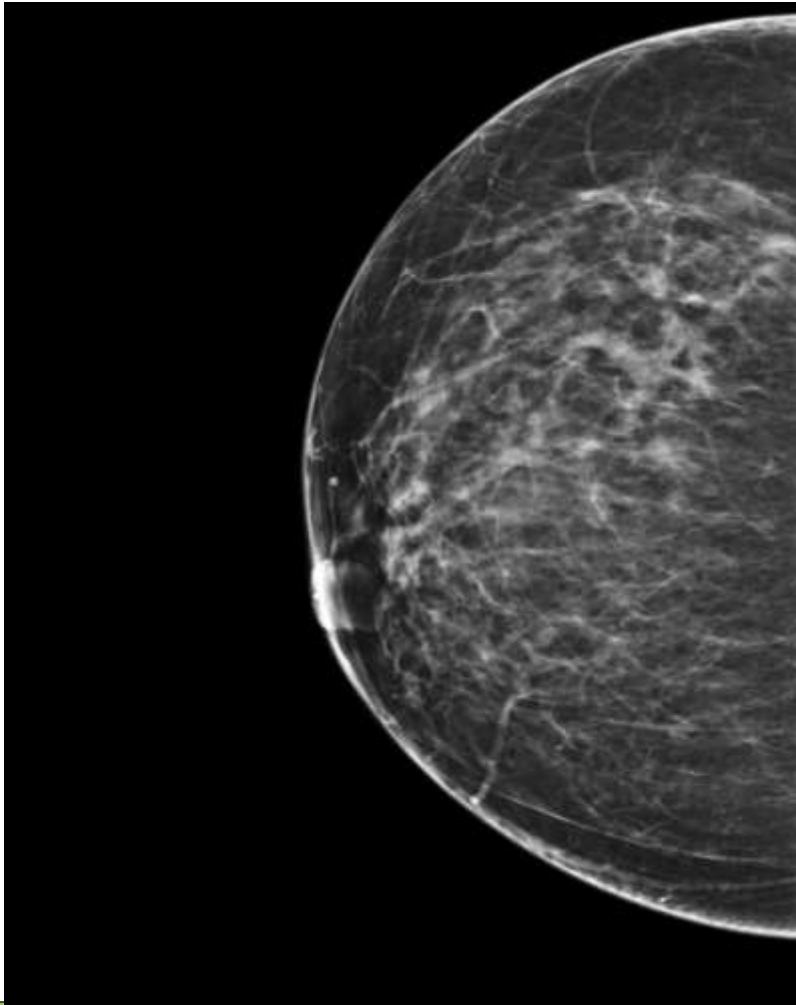


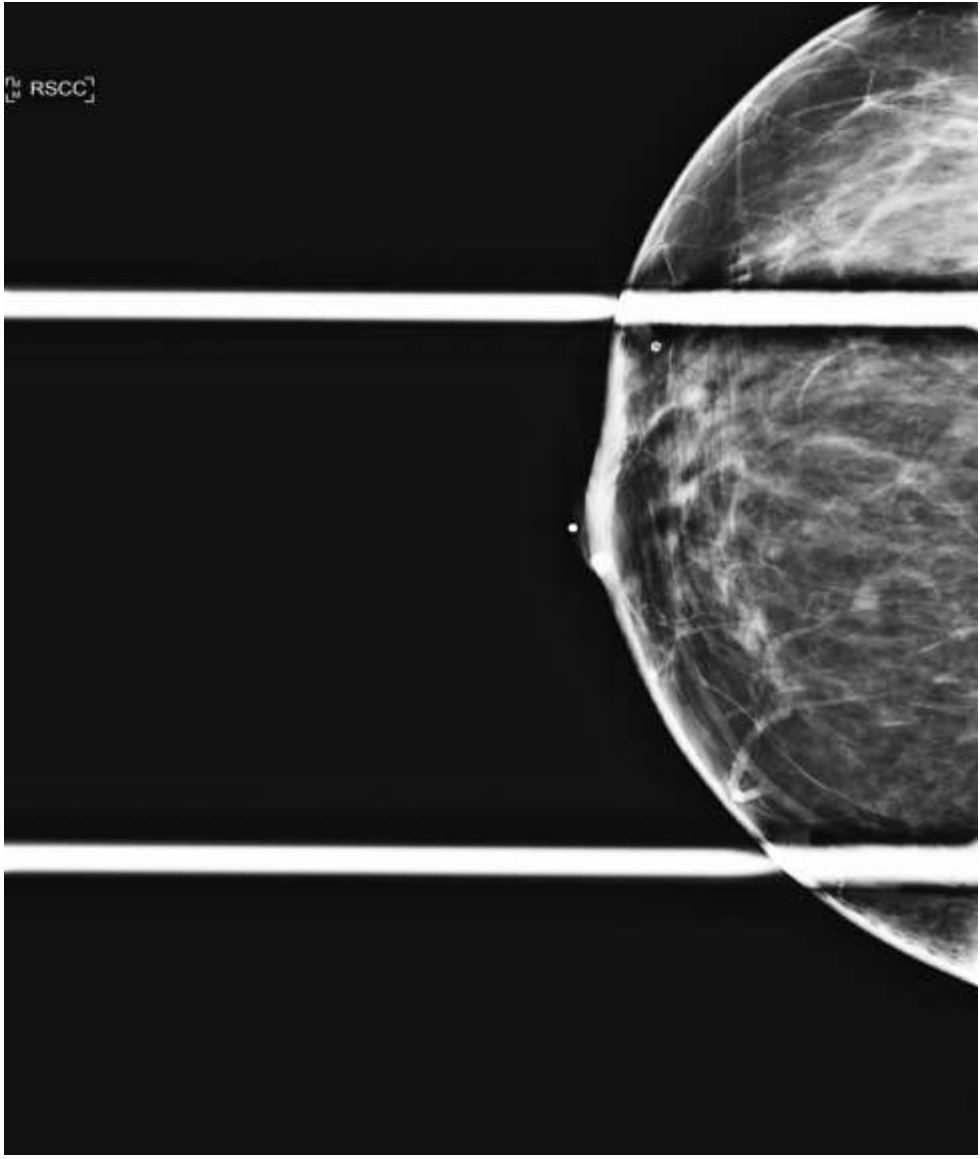






Case 2 :Presented with right nipple discharge

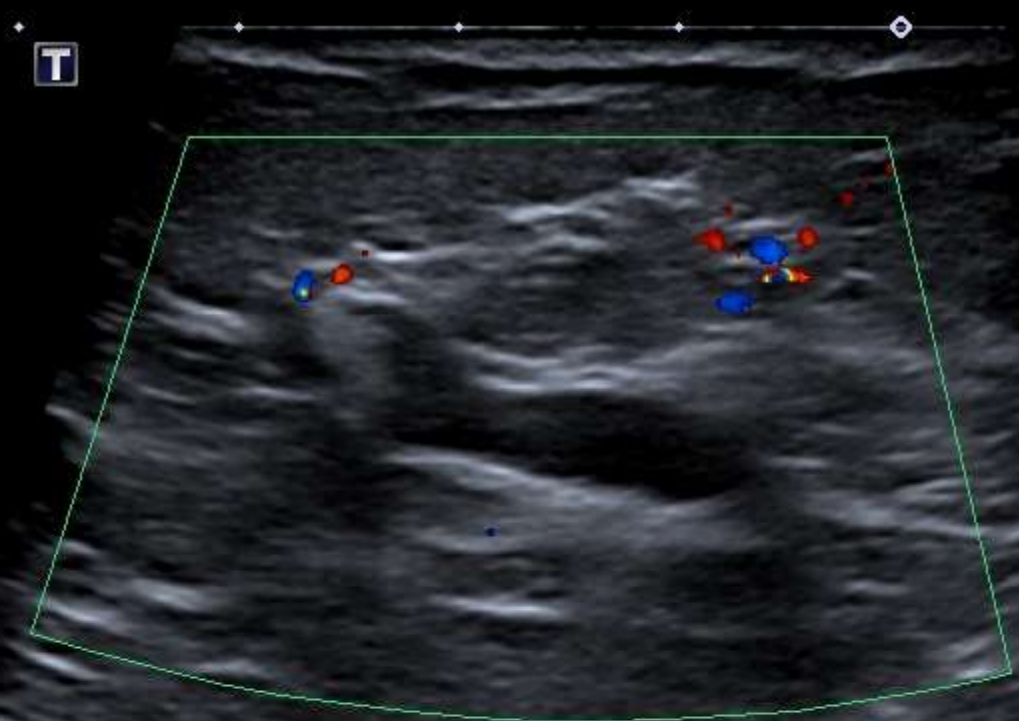




5.4
5.4
cm/s

Precision APure+

0
1
2
3
4
4.5



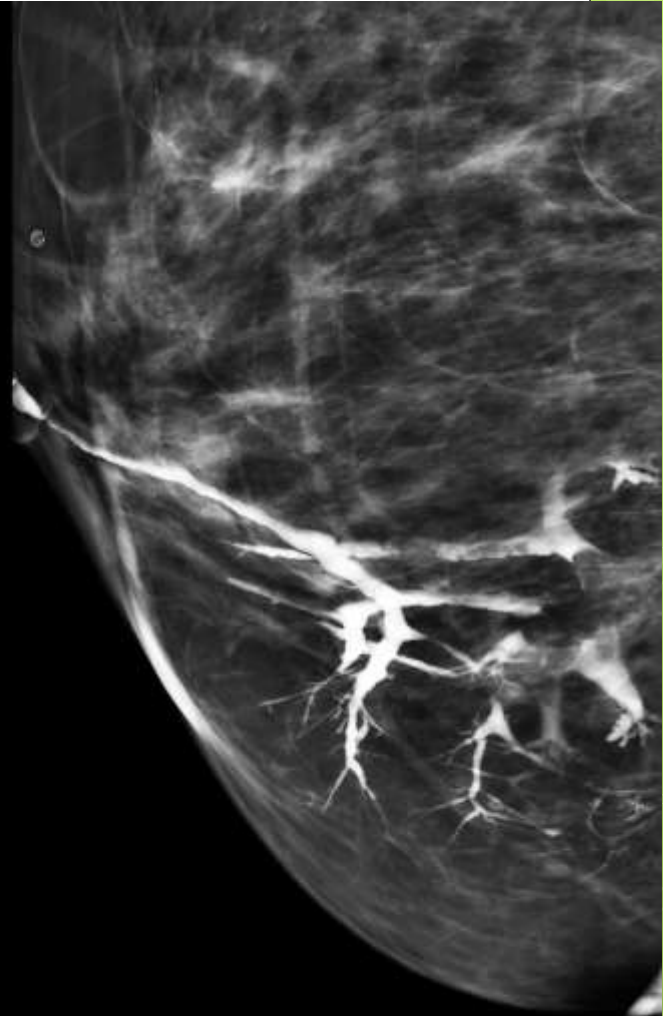
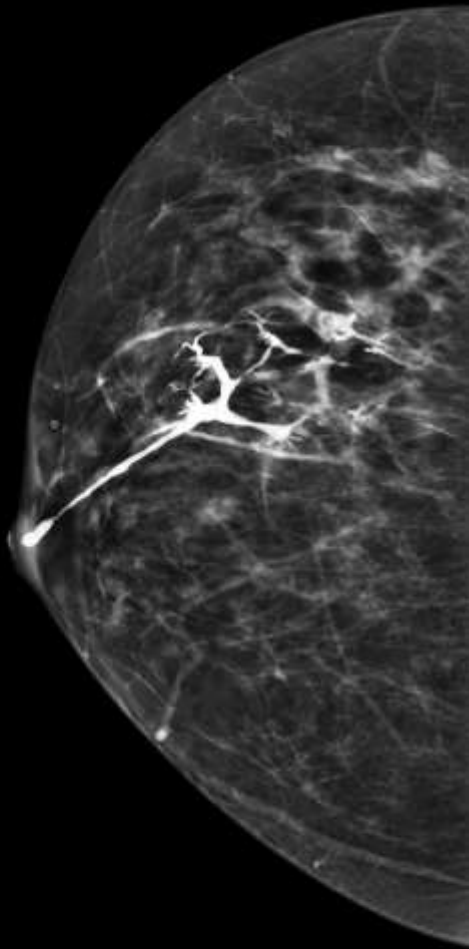
18L7
diffT13.0
8 fps
Qscan
G:78
DR:70
CF 6.1
CG:40
12.1k
F:4

Rt Breast

7:00

4-6 CMNP

Anti-Radial



Dist A 13.4 mm
Dist B 6.0 mm

T

Rt Breast
8:00
9 CM NP
RADIAL

18L7
diffT13.0
32 fps
Qscan
G:85
DR:70

0
1
2
3
4

138

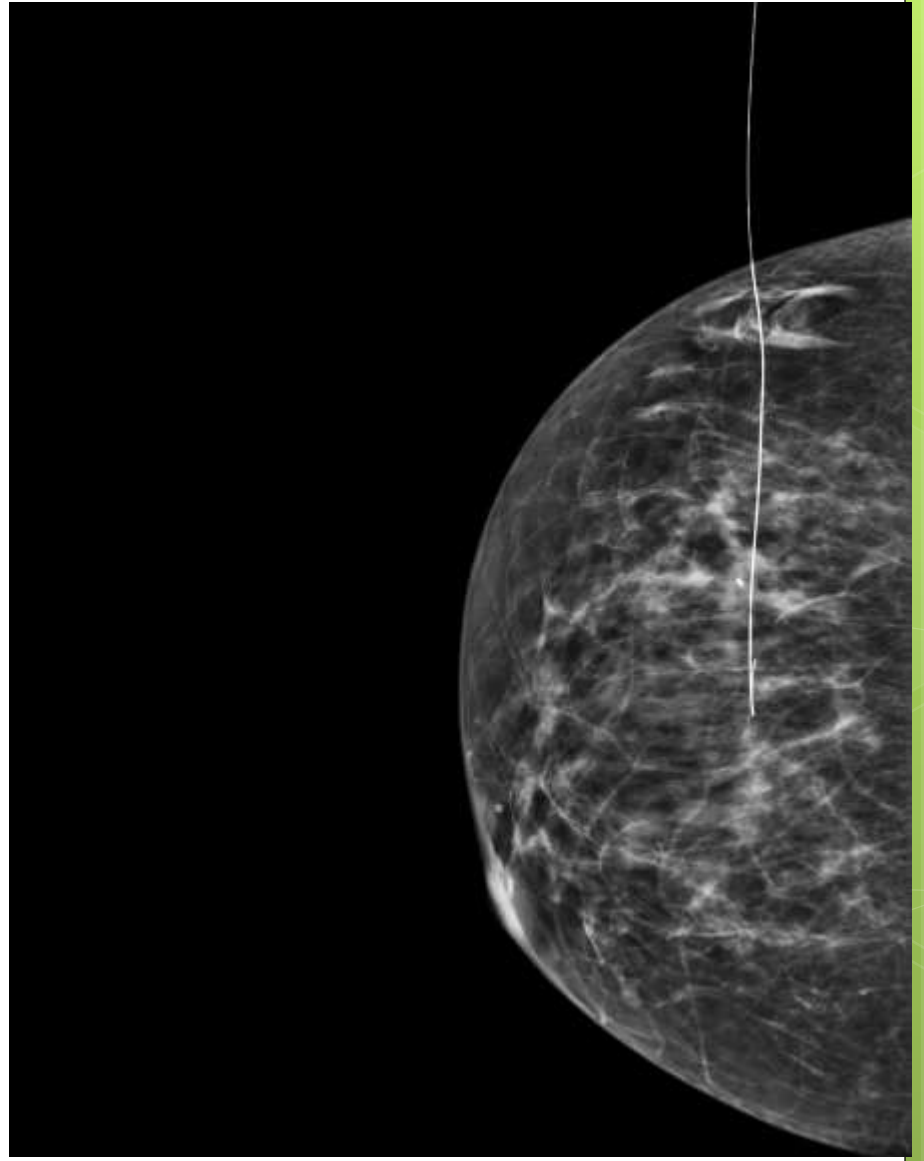
- ◊ 0
- +
- ◊
- BX 1
- ◊ 1
- Rt Breast
- ◊
- 8:00
- ◊ 2
- 7-9 CMNP
- ◊
-
- ◊ 3
- DR SHULTZ
- ◊
- 12 GA CELERO
- ◊ 4
-
- ◊ 4.5

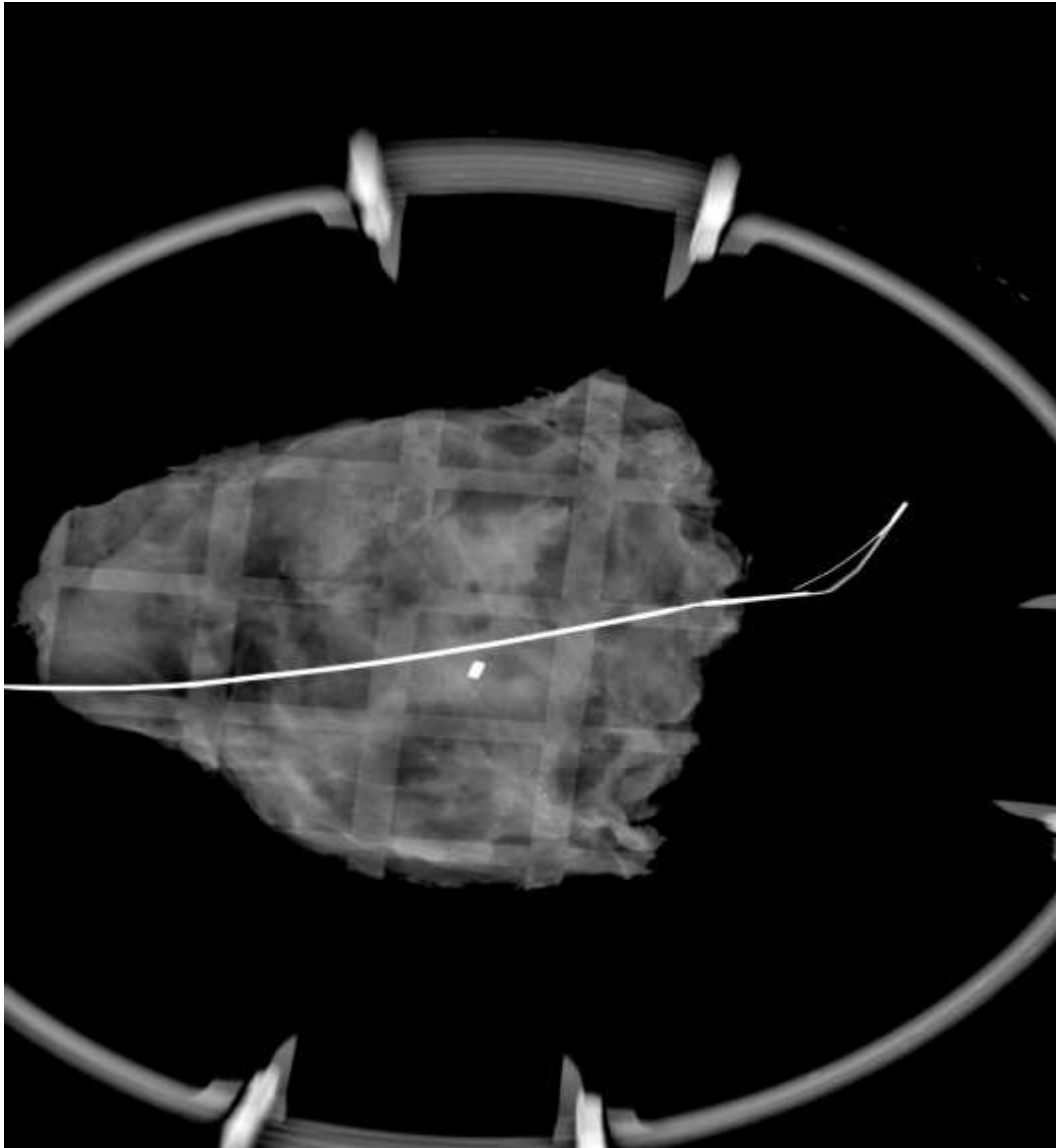
T



MIm
1.2
18L7
diffT13.0
26 fps
Qscan
G:85
DR:70

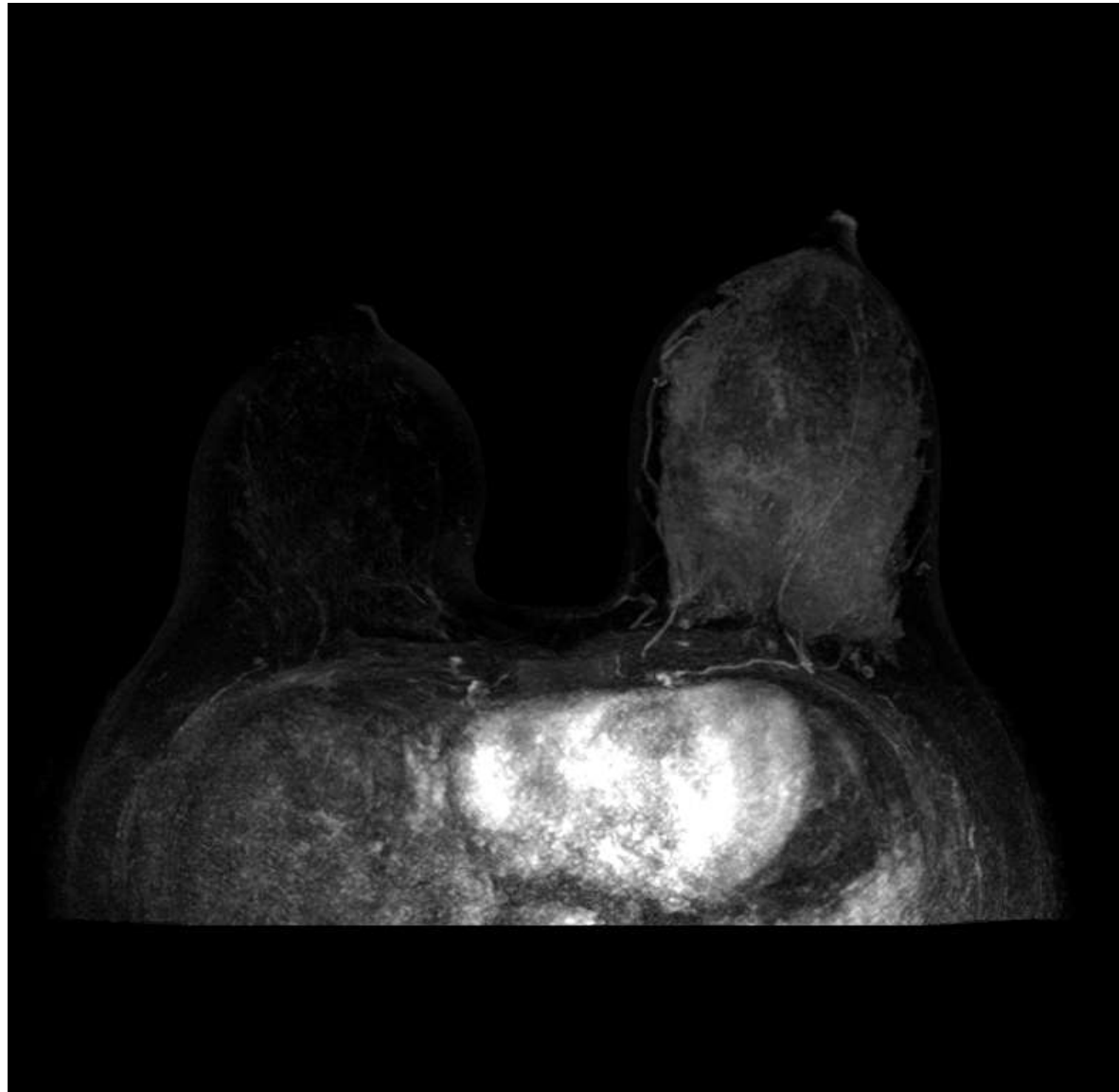
Needle LOC

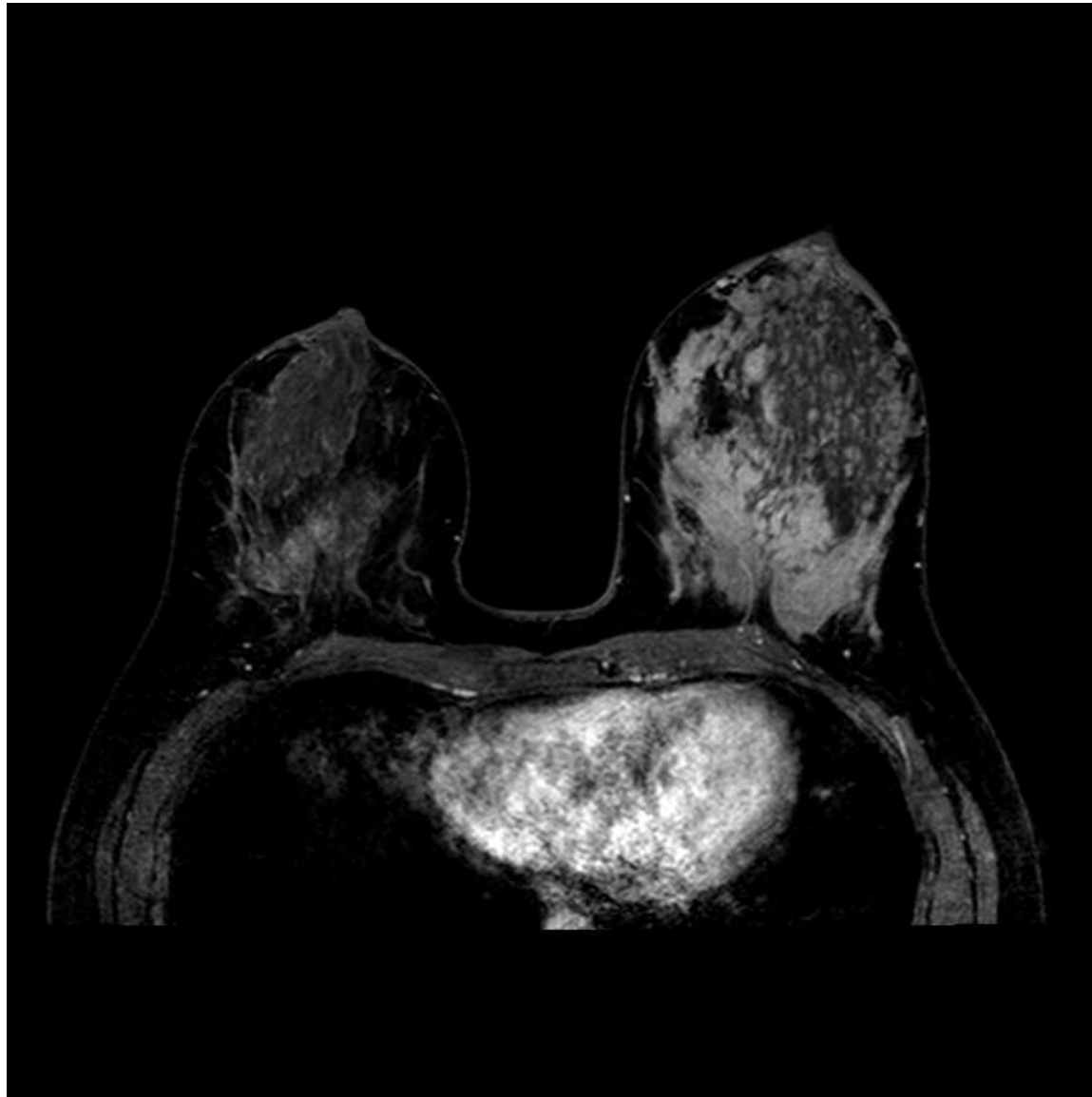


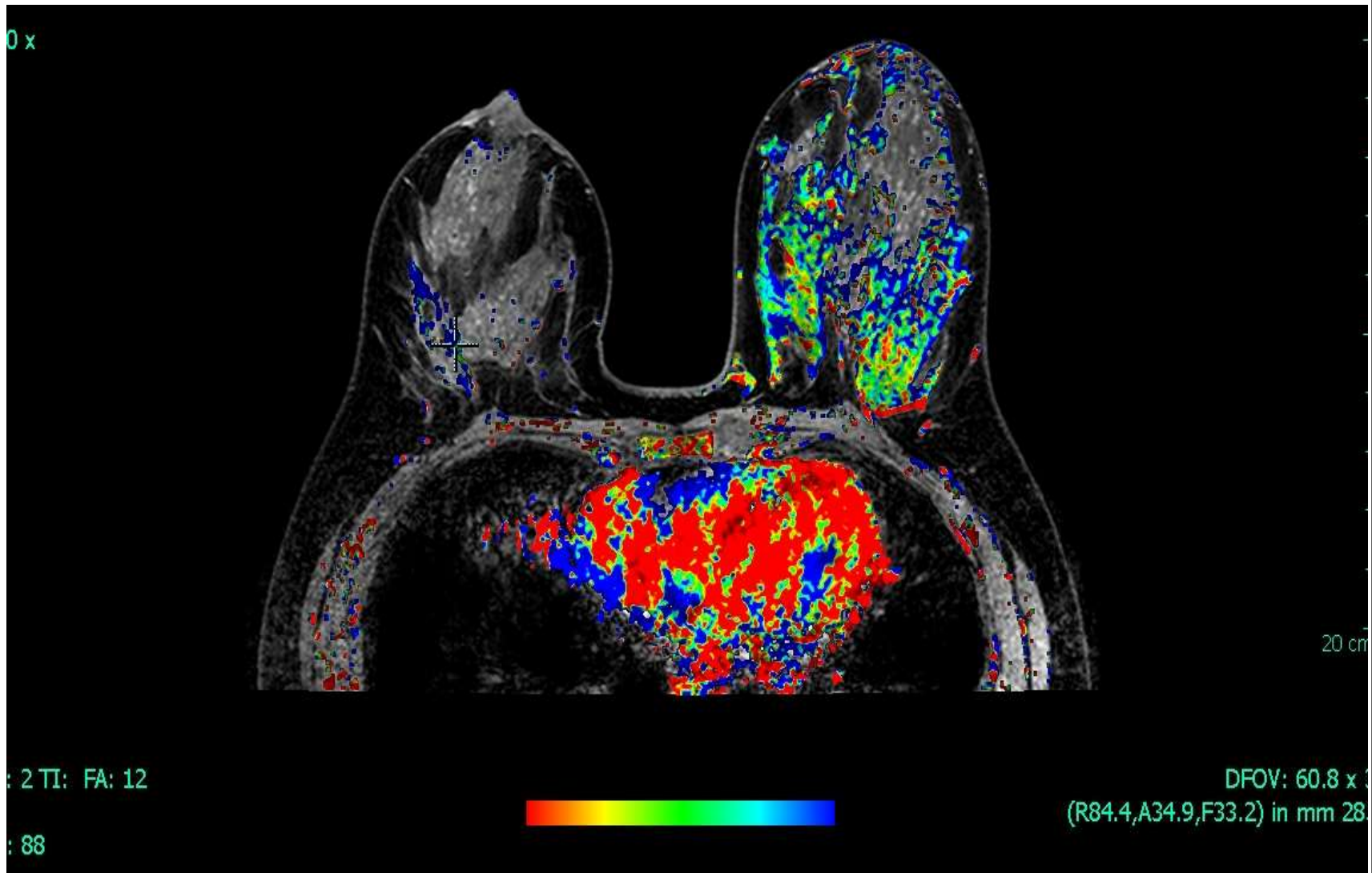
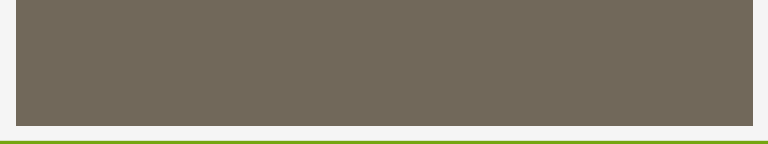


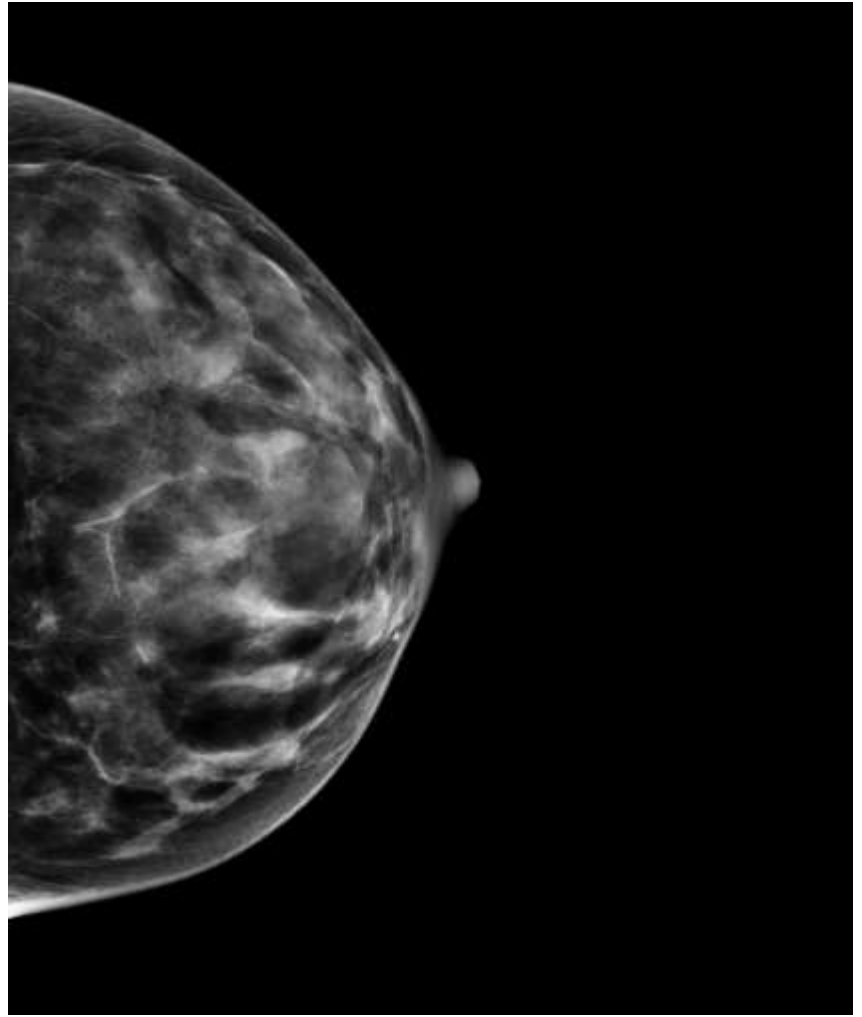
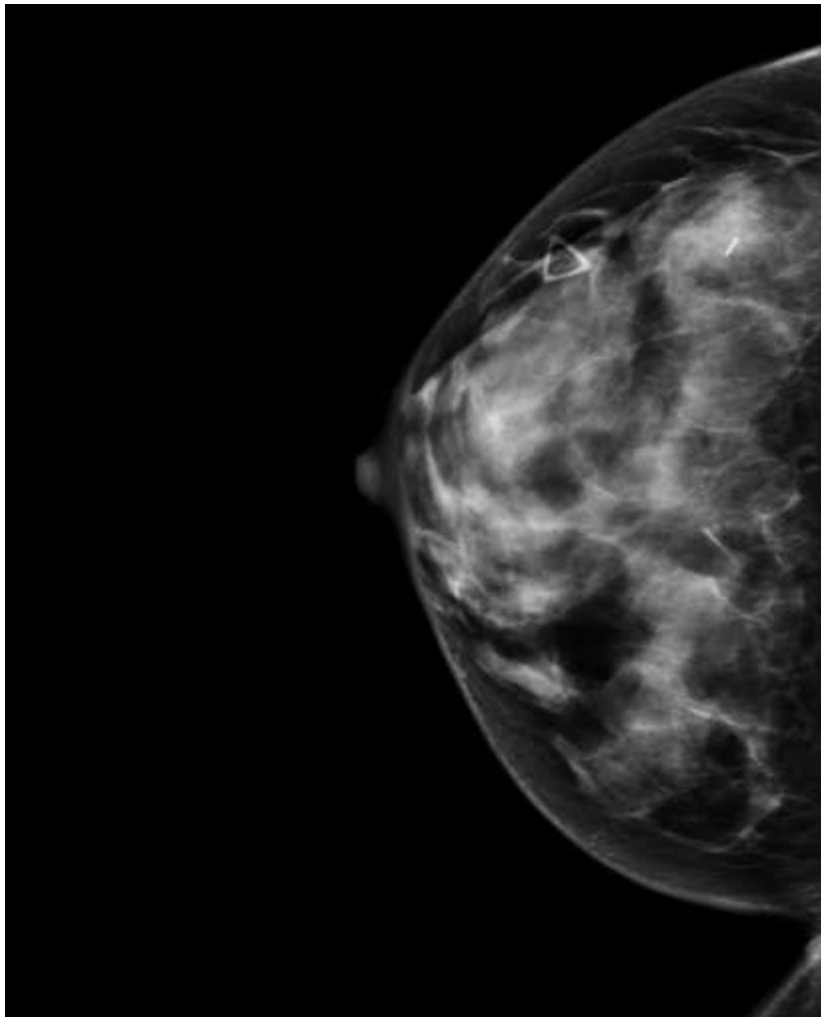
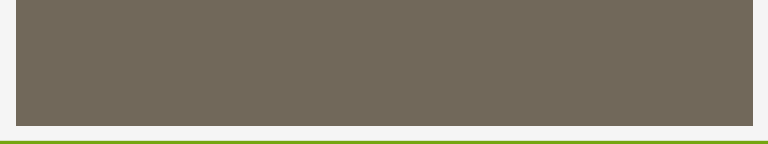
Case:3

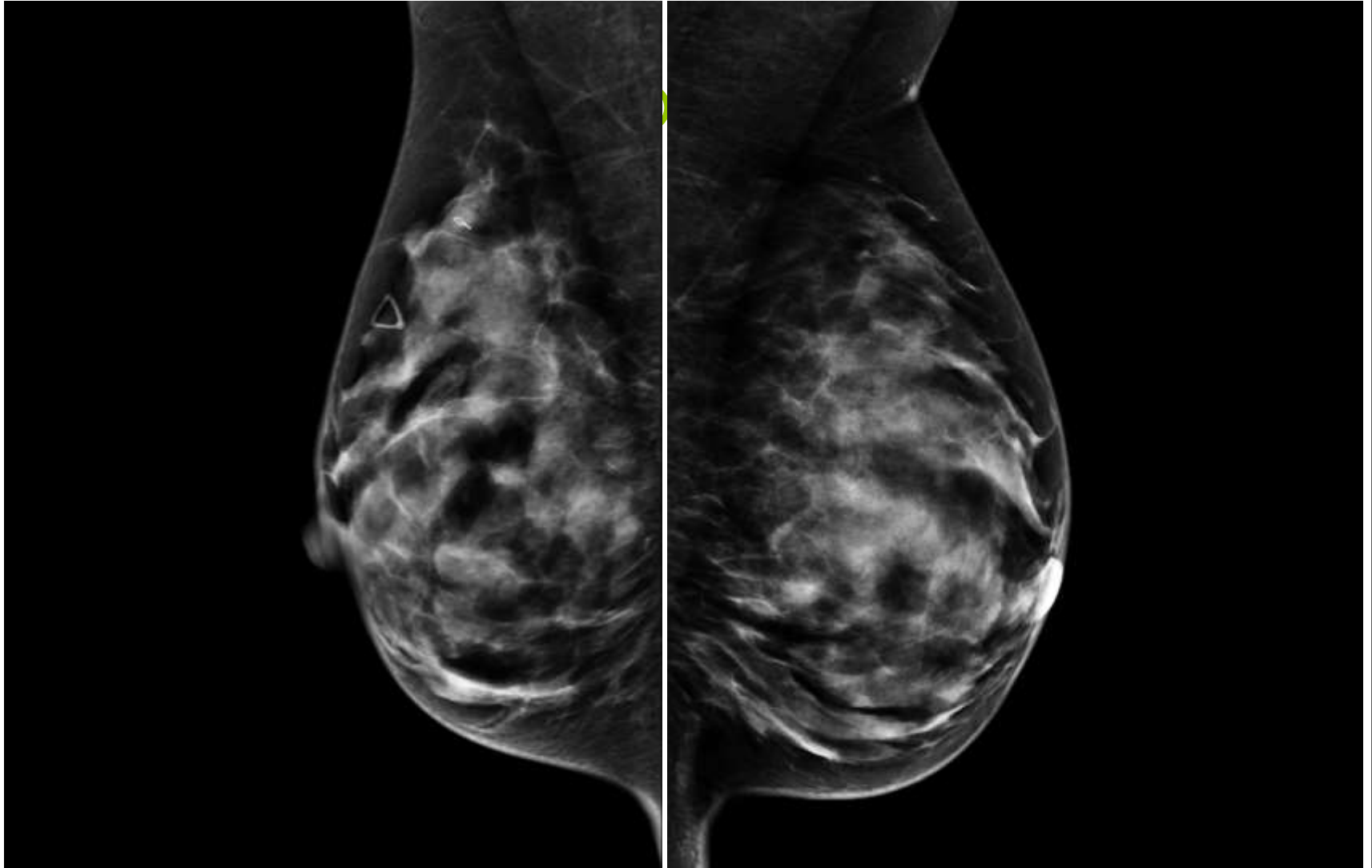
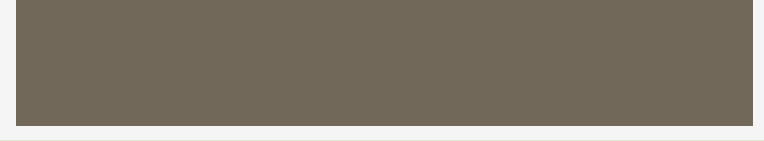
- 35 year old female with strong family history of breast cancer, presented with palpable findings in both breasts. Personal history of lymphoma post radiation to left chest wall 15 years ago, now in remission. Patient is currently breast feeding.











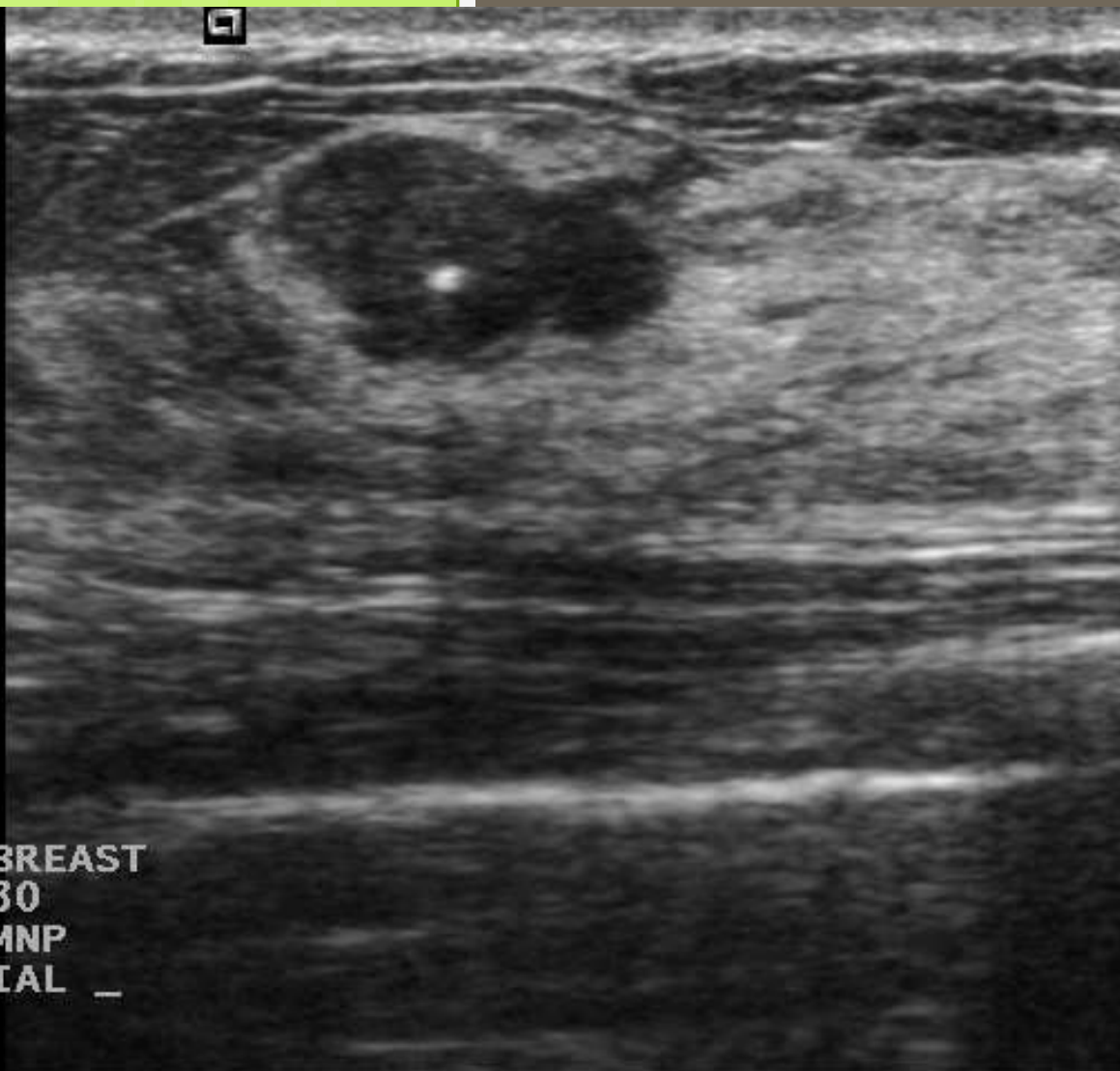
386884852
6/20/2011
1:25:39 PM

M: 0.6

VFX13-5
BREAST
14fps
MI:0.6

GEN/11.4 MHz
38dB/DR55
MapG/VEOff
RS3/SC3

RT BREAST
10 30
7 CMNP
RADIAL _



3.5cm
14fps

Fr22

SIEMENS

386884852
6/20/2011
1:09:19 PM

TIS: 0.9
TIB: 0.9

VFX13-5
BREAST
9fps
TIS:0.9/TIB:0.9

GEN/11.4 MHz
36dB/DR55
MapG/VEOff
RS3/SC3

PWR/7.3 MHz
Flow Gen
0dB/P3/RS5
PRF488/F2

LT BREAST
R/A
NIPPLE
ANTI_RADIAL _



3.5cm
9fps

Fr54

SIEMENS

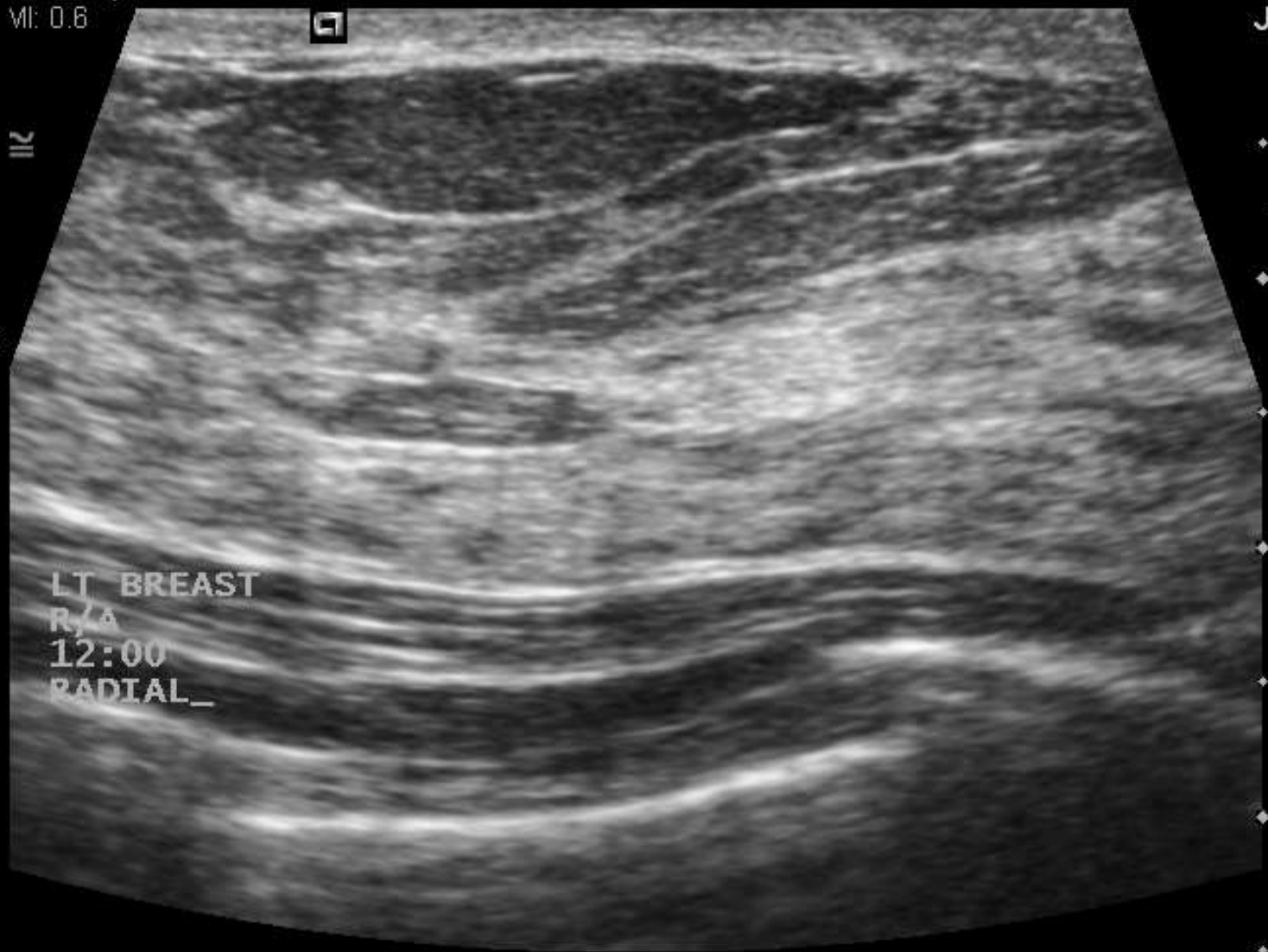
386884852
6/20/2011
1:12:08 PM

MI: 0.6

VFX13-5
BREAST
14fps
MI:0.6

GEN/11.4 MHz
38dB/DR55
MapG/VEOff
RS3/SC3

LT BREAST
R/A
12:00
RADIAL_



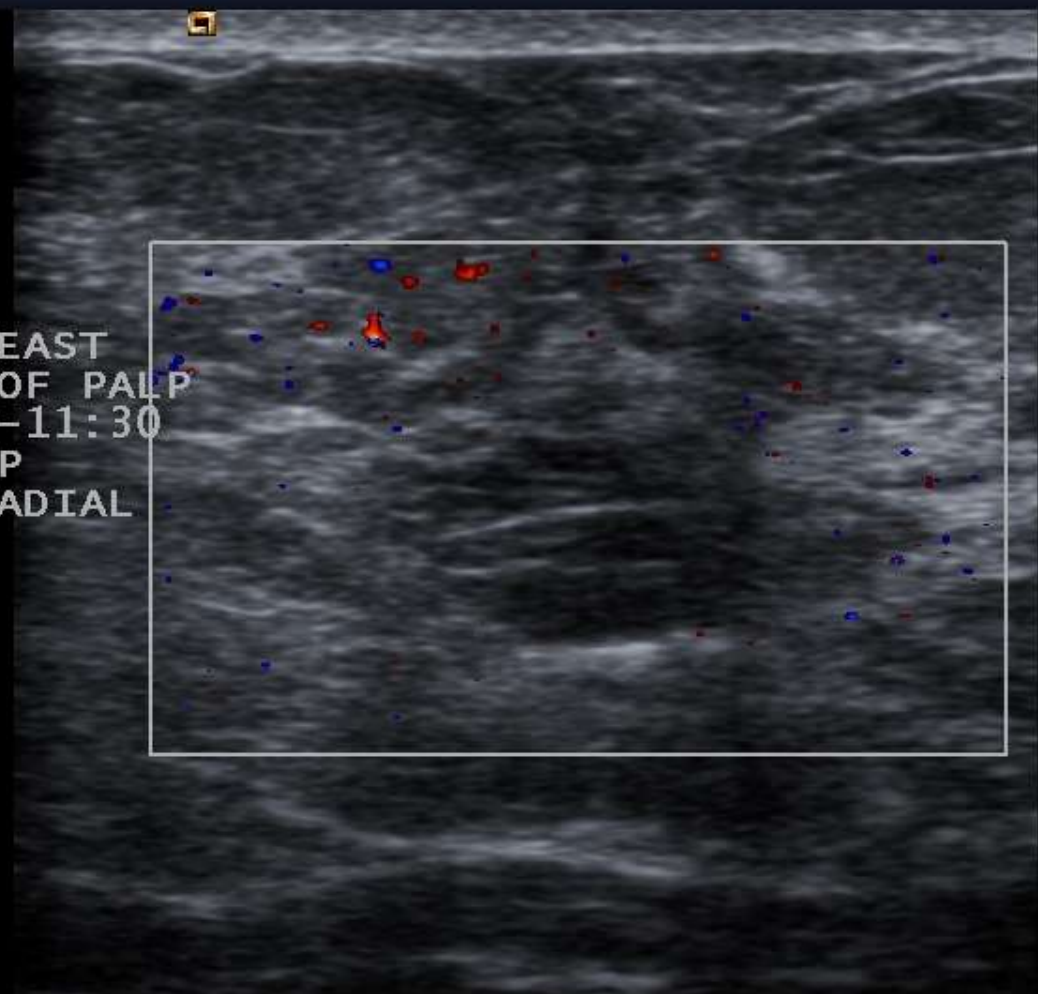
3.5cm
14fps

Fr146

SIEMENS

TIS: 1.0
TIB: 1.0

IR



LT BREAST
AREA OF PALP
9:30-11:30
9CMNP
ANTIRADIAL

PT IS BREAST FEEDING

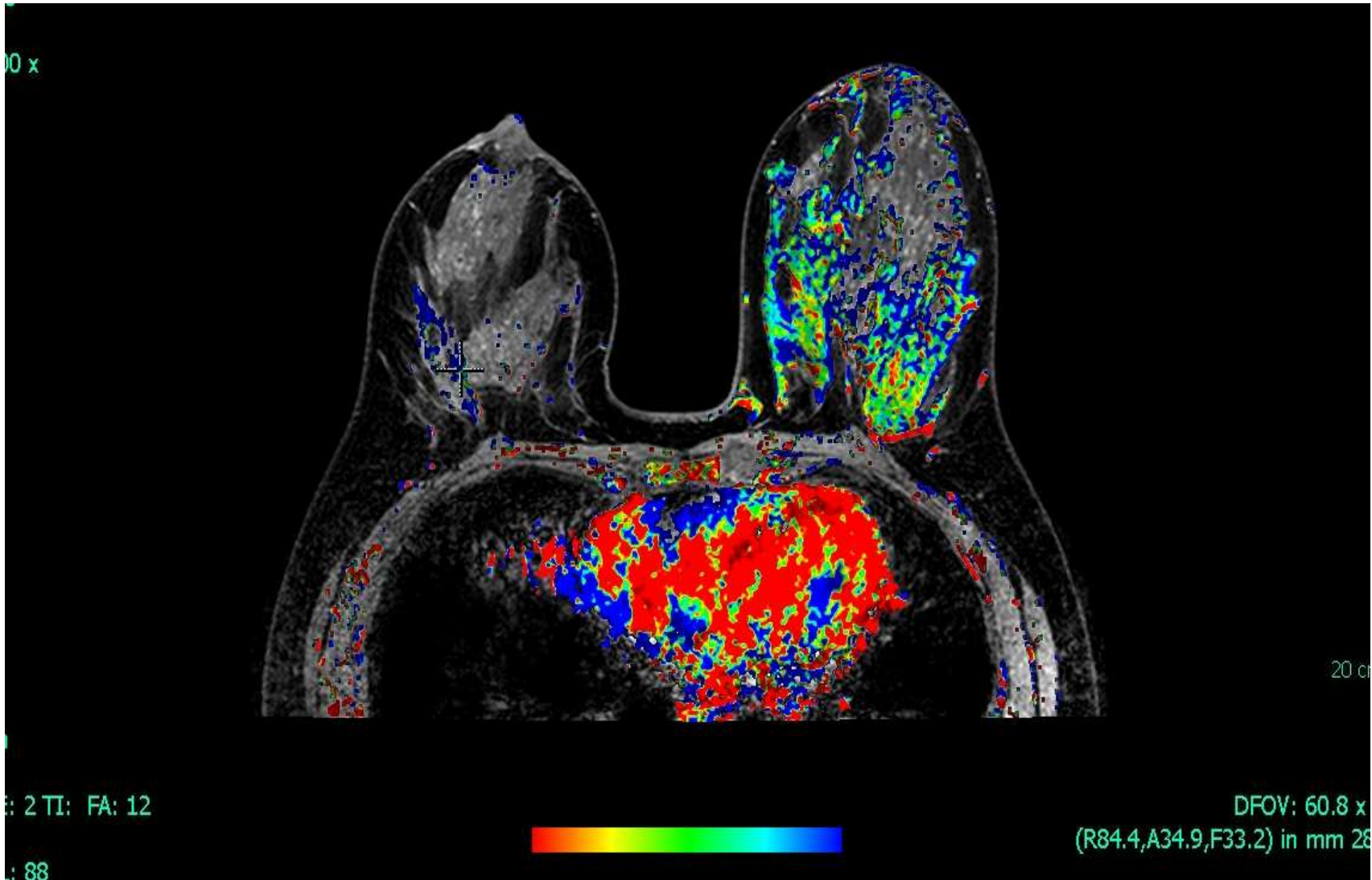
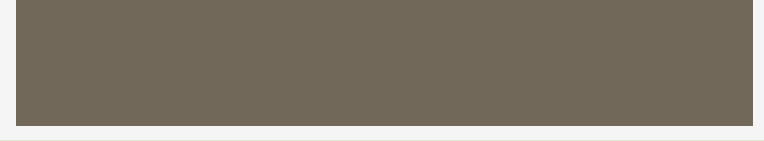
9fps

3.5cm

Fr32



SIEMENS
VFX13.5 / *Breast
2D
GEN / 11.43 MHz
21 dB / DR 60
Map G / RS 3
C
VEL / 7.3 MHz
-1 dB / Flow Gen
PRF 488 / F 2



Thank you

