

# Radiology Team 429

**BREAST  
LESIONS**



# Radiology Team 429

In this team we used the outlines from the:

Doctor's slides

Lecture notes

427 Radiology team

Diagnostic Imaging –PETER ARMSTRONG  
– 6<sup>Th</sup> Edition

Sorry we don't hold responsibility for any missing information or perhaps – perhaps -wrong material.

We tried our best to present this lecture in the best way, and we hope what we wrote is enough to cover the subjects.

## Team Leaders:

Abdulmajeed Al-Sadhan,  
Ibrahim Al-Sadhan, Sarah  
Mahasin

## Team Members:

Abdullah Alessa , Sultan Al-Salem ,  
Rana Al Khleif, MashaelAl-Towairqi

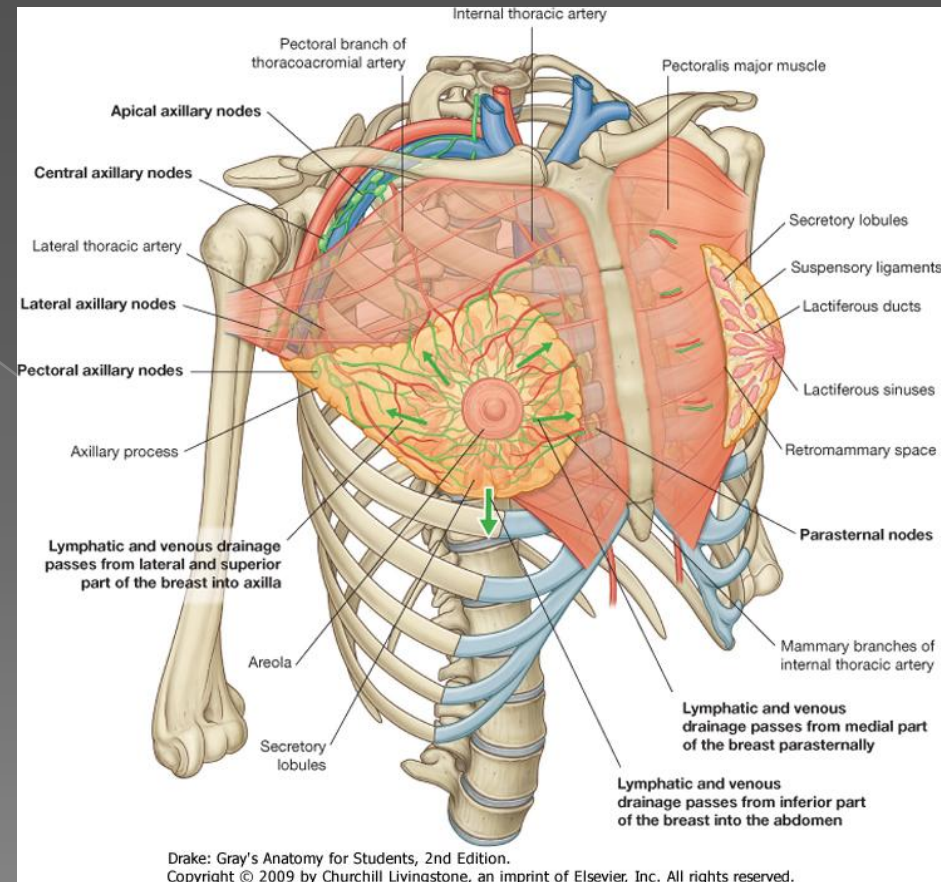
**Best Wishes : )**

# OBJECTIVES

- TO UNDERSTAND the anatomy of the breast radiology/imaging based.
- To highlight the suitable modality for age and disease of the breast.
- To understand the role of radiology in diagnosing breast lesions particularly breast cancer.

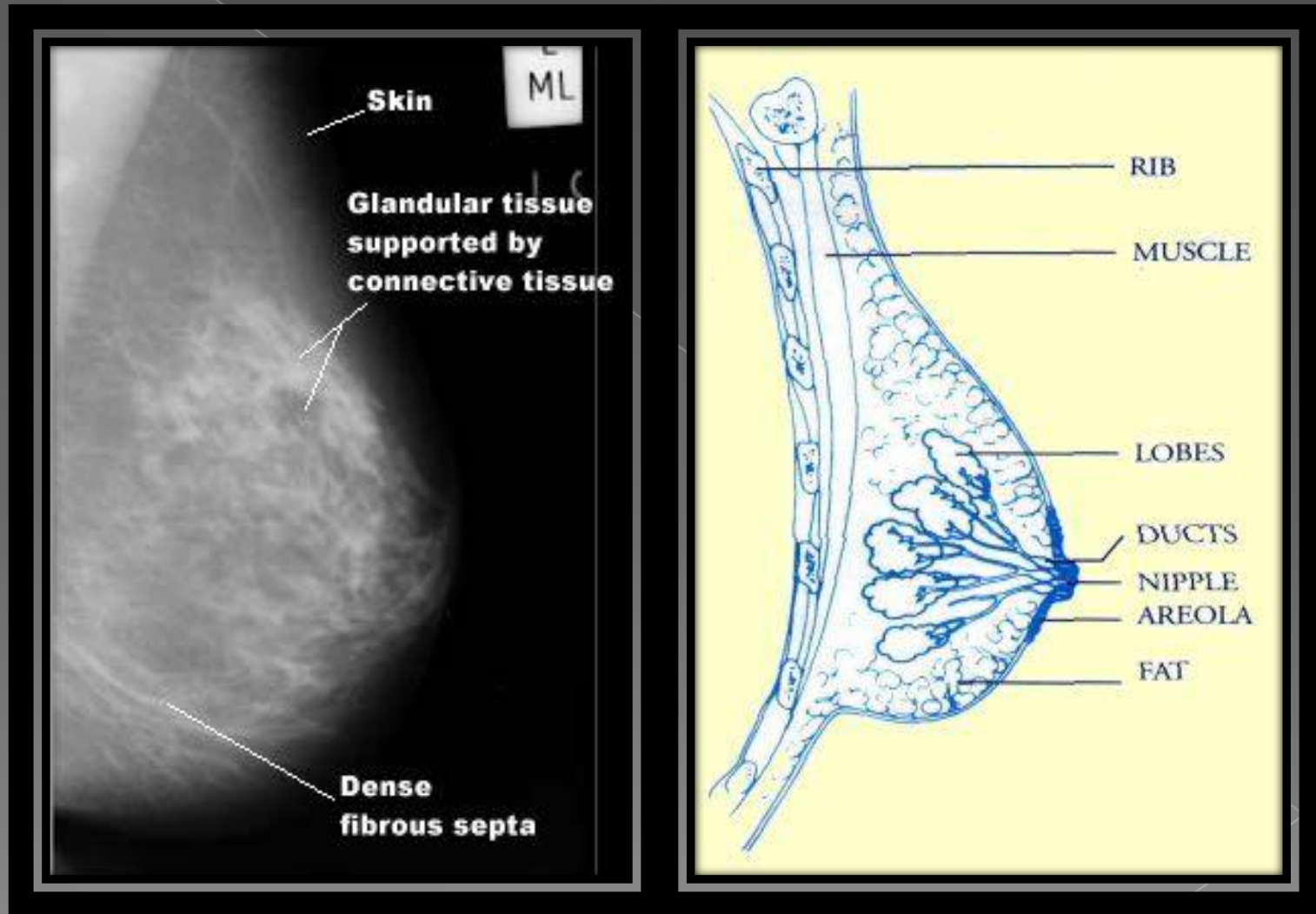
# Anatomy

- The breasts consist of mammary glands and associated skin and connective tissues. The mammary glands are modified sweat glands in the superficial fascia anterior to the pectoral muscles and the anterior thoracic wall.
- The mammary glands consist of a series of ducts and associated secretory lobules. These converge to form 15 to 20 lactiferous ducts, which open independently onto the nipple. The nipple is surrounded by a circular pigmented area of skin termed the areola. A well-developed, connective tissue stroma surrounds the ducts and lobules of the mammary gland. In certain regions, this condenses to form well-defined ligaments, the suspensory ligaments of breast, which are continuous with the dermis of the skin and support the breast
- Carcinoma of the breast creates tension on these ligaments, causing pitting of the skin. In nonlactating women, the predominant component of the breasts is fat, while glandular tissue is more abundant in lactating women.



# Anatomy

## Mammography of the breast ( normal )



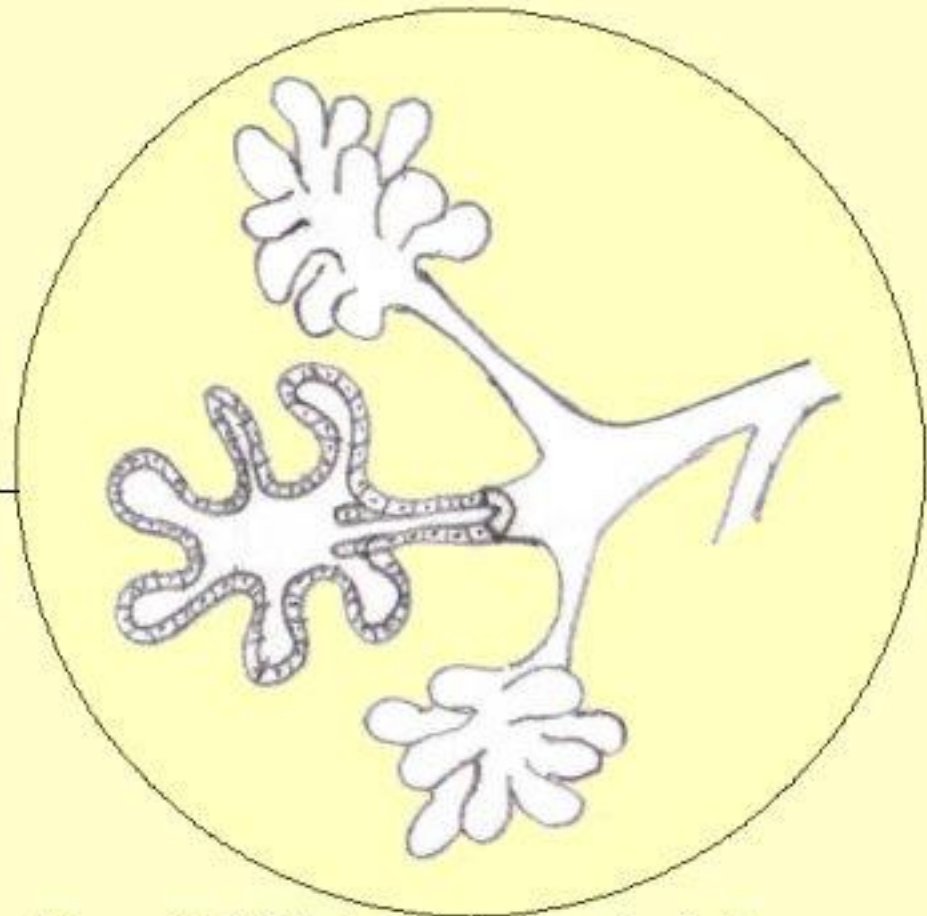
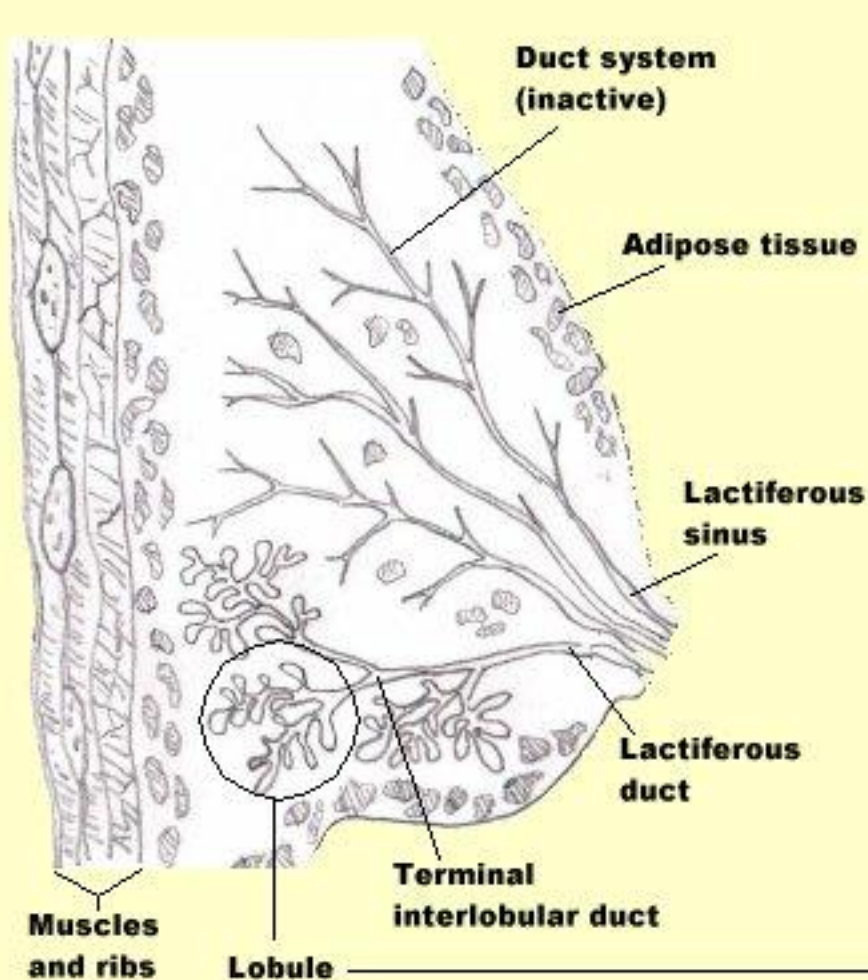




Mammogram: the fat appears black and the glandular tissue is white

In younger females, there is more glandular tissue, while in older females there is more fat

# Anatomy

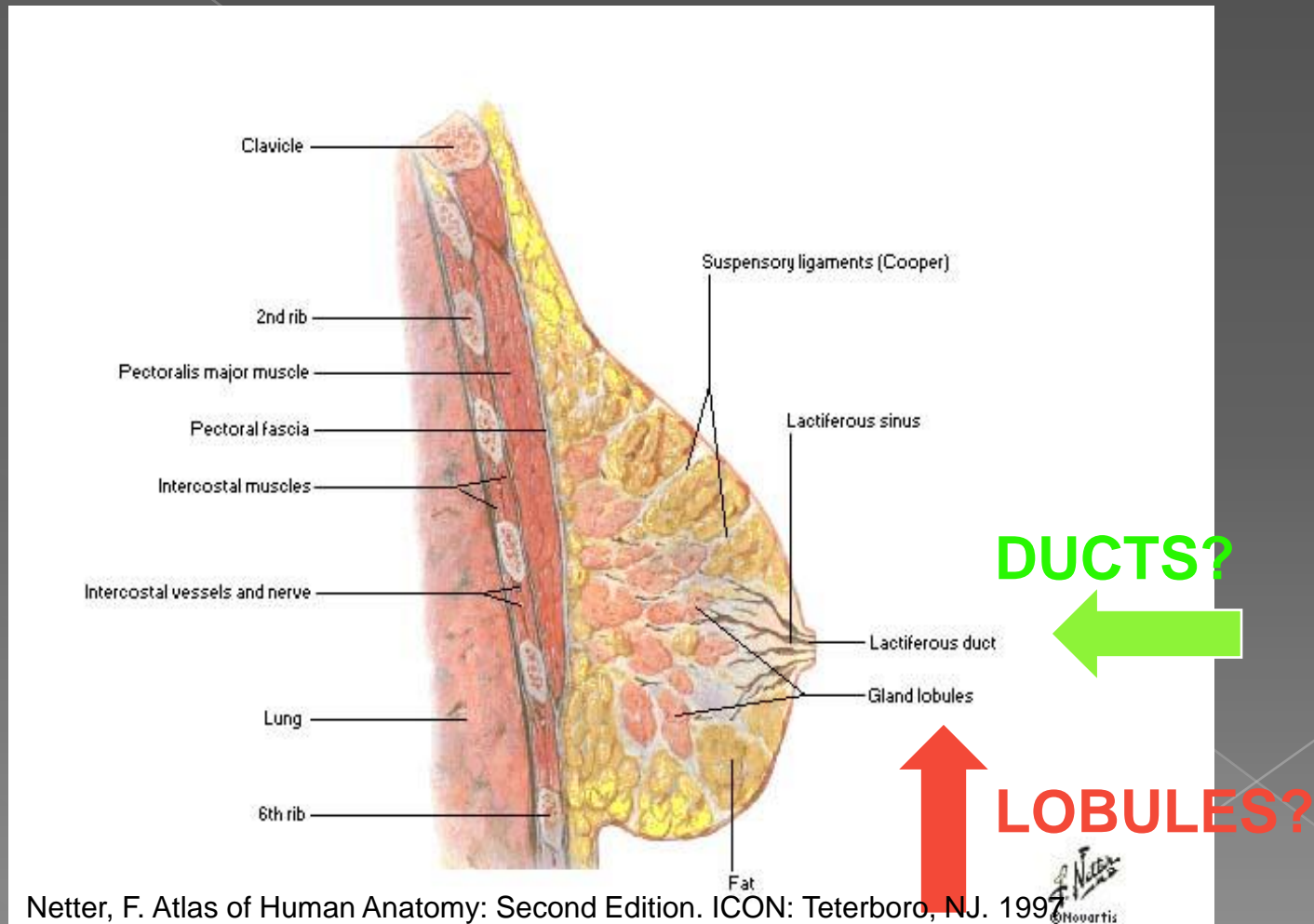


It is postulated that most cancers arise in the interlobular duct unit, either inside or just proximal to the lobule. There are two main categories of breast cancer: ductal carcinoma and lobular carcinoma.

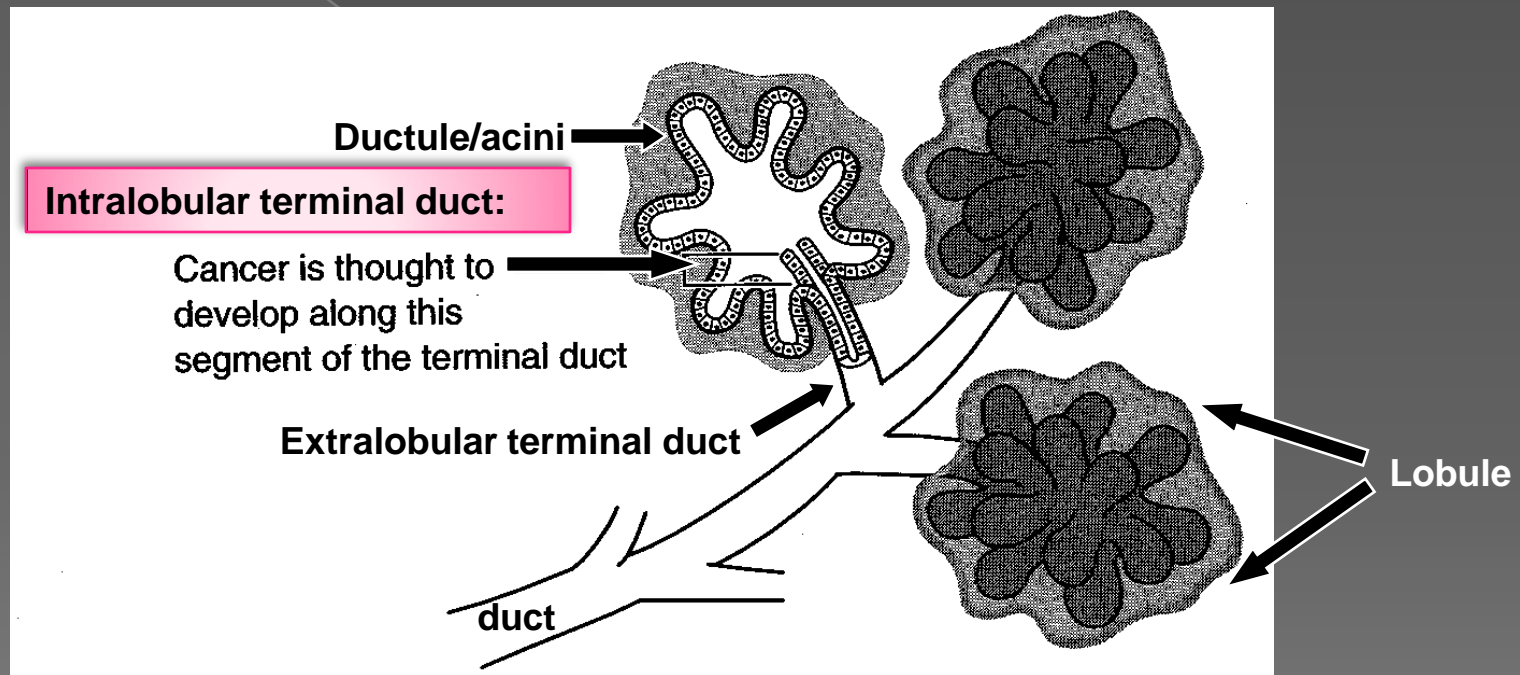
- Breast is formed of glands which are surrounded by fat and attached to the chest wall.
- Glandular tissue increases and decreases in size due to hormonal effect.
- 95 % of malignancies in the breast arises from The interlobular duct unit. MCQ !!!



# Where in the breast does cancer develop?



# Most breast cancer develops in the “terminal ductal lobular unit” (TDLU)



The epithelium inside the lobules is histologically distinct from the epithelium in the extralobular ducts.

Breast cancer can be divided into two major groups.

## IN SITU

Tumor cells have not invaded the basement membrane.

tumor cells remain confined to the ducts or lobules



## INVASIVE

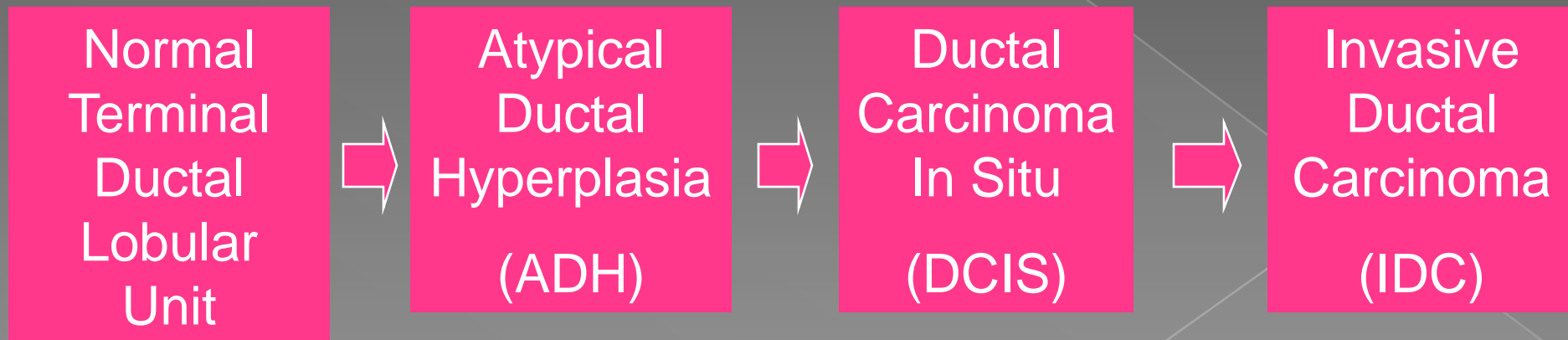
Tumor cells invade the breast stroma.

They have the potential to metastasize and result in death of the patient.

# Ductal cancer evolves over time.

Clinical and molecular research have demonstrated that there is likely often a linear progression of sequential stages of epithelial proliferation.

Note: Normal and Atypical Ductal Hyperplasia have no findings





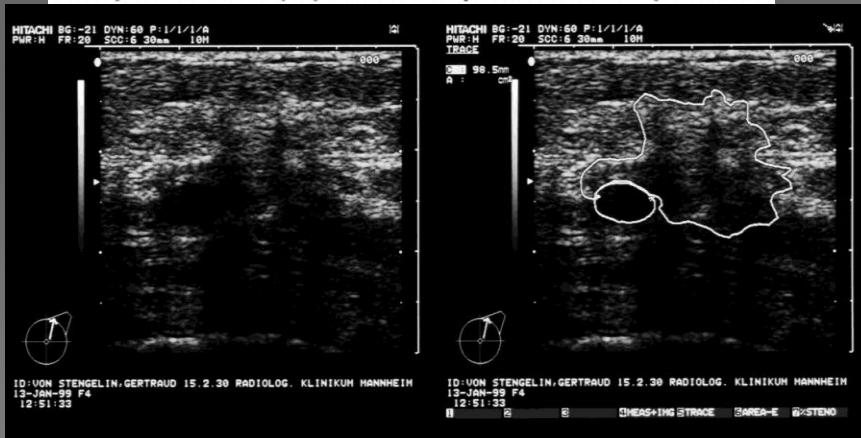
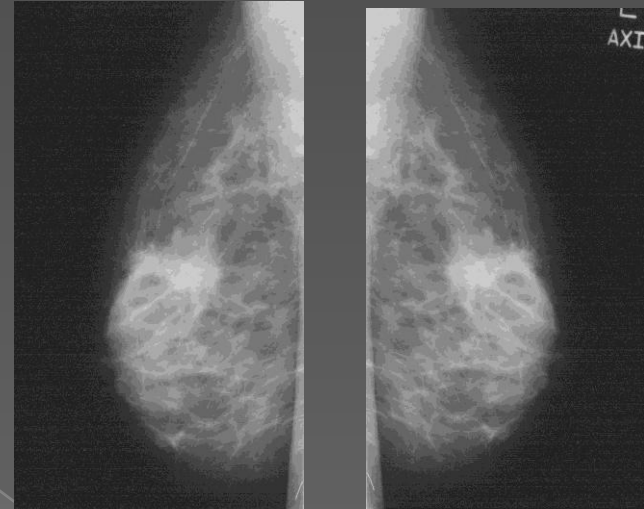
# The Four Pillars of Diagnosis

3 of these examinations are enough to  
confirm

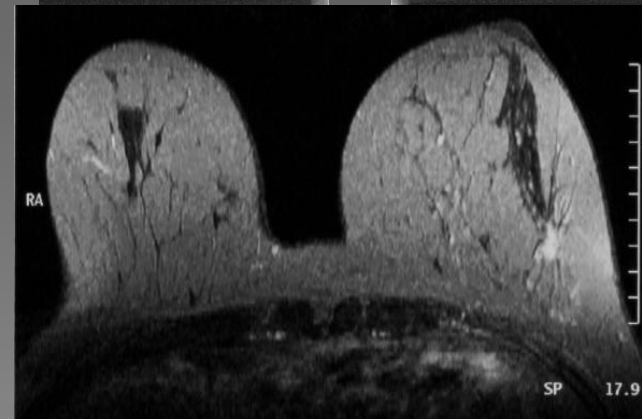
Clinical or Self Examination (PE)



Mammography (MG)



Ultrasound (US)



Magnetic Resonance Imaging (MRI)

# Four Pillars of Diagnosis

1. Clinical examination
2. Mammography:
  - > Screening mammography: for patients at risk
  - > Diagnostic mammography: patient presents with palpable mass or symptoms (nipple bleeding) or
3. Ultrasound: for malignant lesions and biopsy
4. MRI: a very accurate modality



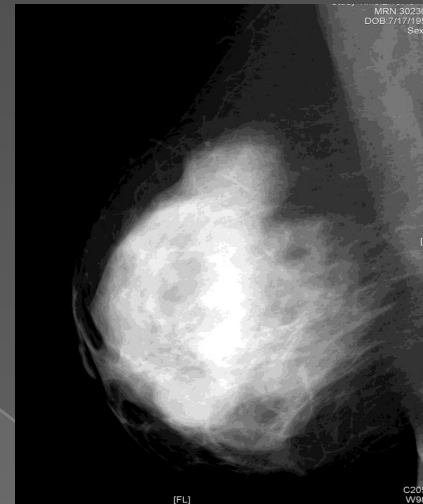
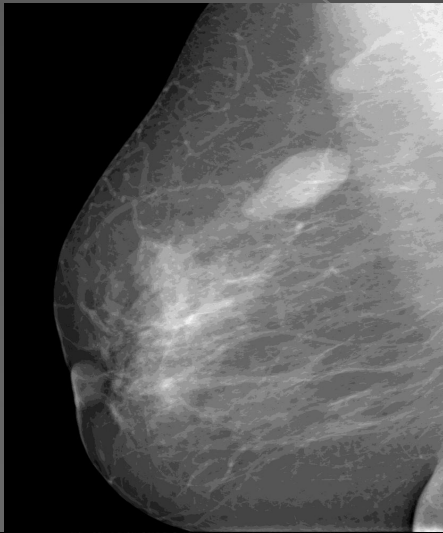
Dictation

Mice

Keyboards

Old patient

or young patient





- In old pt. :
- 1- Low or no glandular tissue
- 2- High fat
- 3- Easier to detect the lesion ( because the mass in the mammography is white and the glandular tissue is also white. So, less glandular tissue = better visualization of mass in old pts. than young pts.).

- Ultrasound is done to confirm the mammography results.
- Ultrasound is best for a pregnant lady

# Menu of Tests

1. Mammography: \*contraindicated in pregnancy\*  
Can rule IN cancer, but can not rule it OUT.
2. Ultrasound
3. CT scan (w/ and w/o contrast) \*used in malignant lesions and to detect metastasis \*
4. MRI (w/ and w/o Gd contrast) \*MRI of breast must be done with the aid of contrast → contraindicated in pregnancy.\*  
Ultrasound- or MR-guided biopsy and wire localization
5. Bone radionuclide scan
6. Lymphoscintigraphy



Mammography Saves Lives<sup>TM</sup>

*... one of them may be yours*



# 1. Mammography

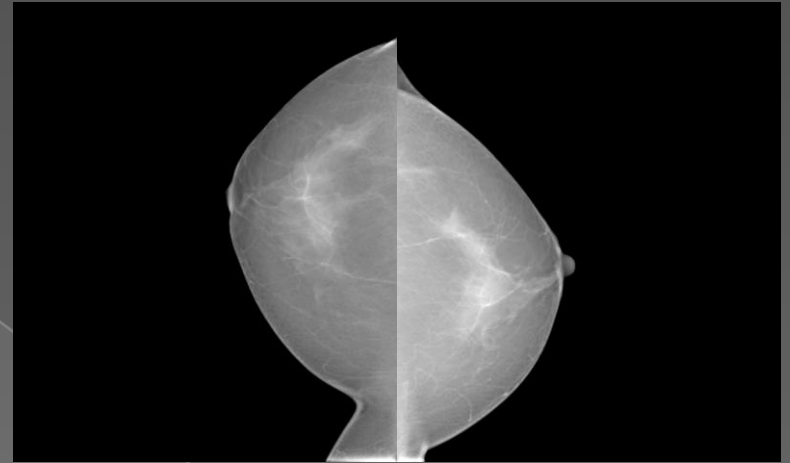
## **Mammography**

- X-ray examination of the breast is carried out with dedicated equipment designed to demonstrate the soft tissues of the breast to advantage.
- A normal mammogram shows ductal and connective tissue in a background of fat.
- With increasing age, glandular tissue atrophies and cancers become easier to identify.
- The mammographic appearances of the normal breast vary greatly from one patient to another.
- In younger patients, it is best to start with ultrasound because they have more glandular tissue which makes detecting abnormalities difficult.
- With older patients, start with mammography.

# 1. Mammography



**MLO**

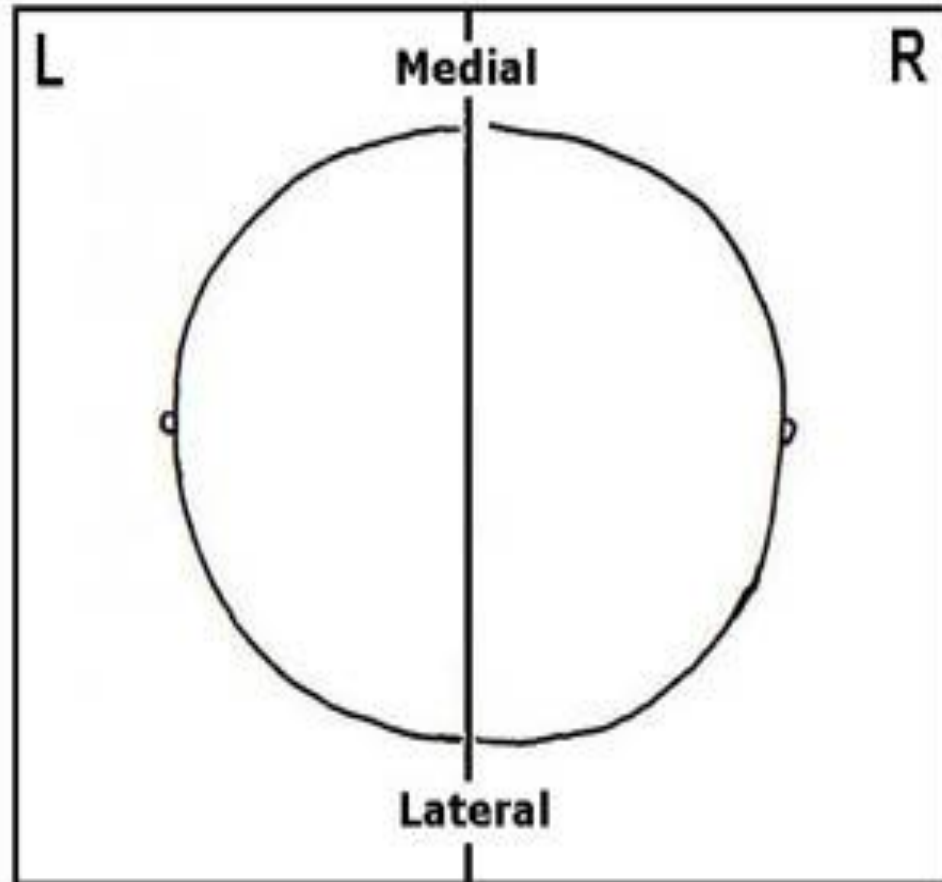
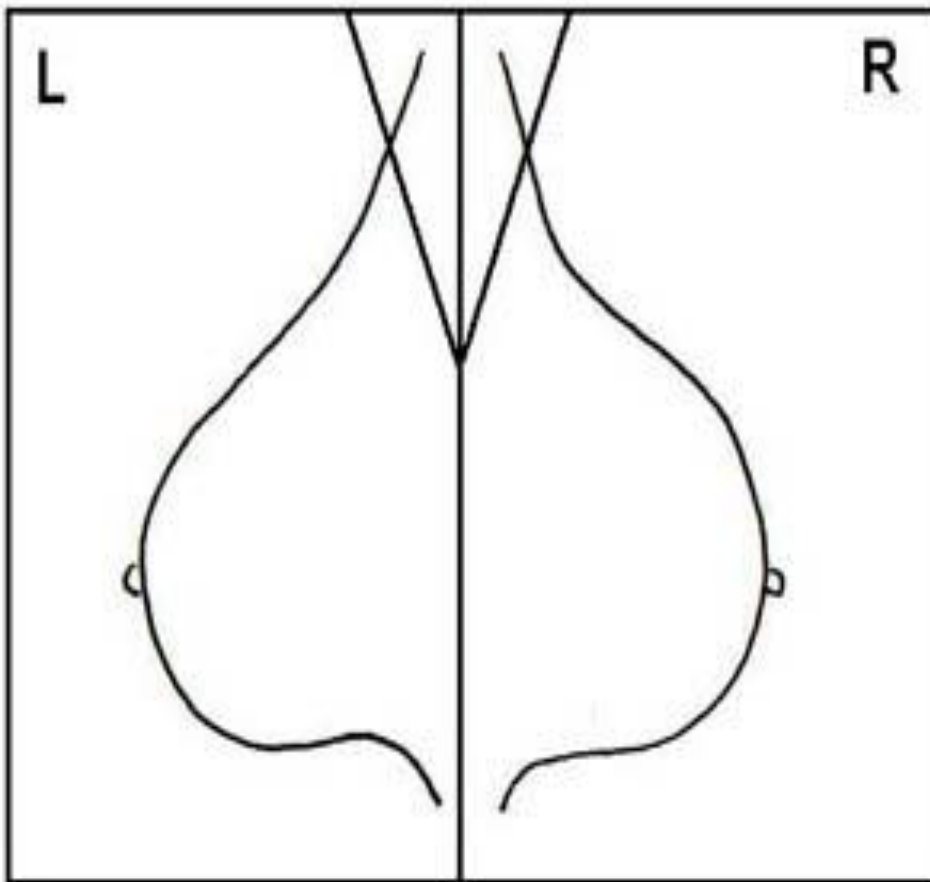


**CC**

2 views :

- 1- Mediolateral view ( tube is medially , film is laterally )
  - 2- cranio-caudal view ( tube is above the breast , film is under the breast )
- 
- Breast is compressed to decrease the thickness ( for a better visualization ) , And to decrease the amount of radiation to the breast.
  - Don't forget to compare both sides
  - Always examine both breast, don't examine one breast because 3 – 7% of pts. have bilateral lesions which may cause metastasis if missed.

# Viewing method



**Mediolat.obliques**

**cranio -caudal views**



# Review Areas

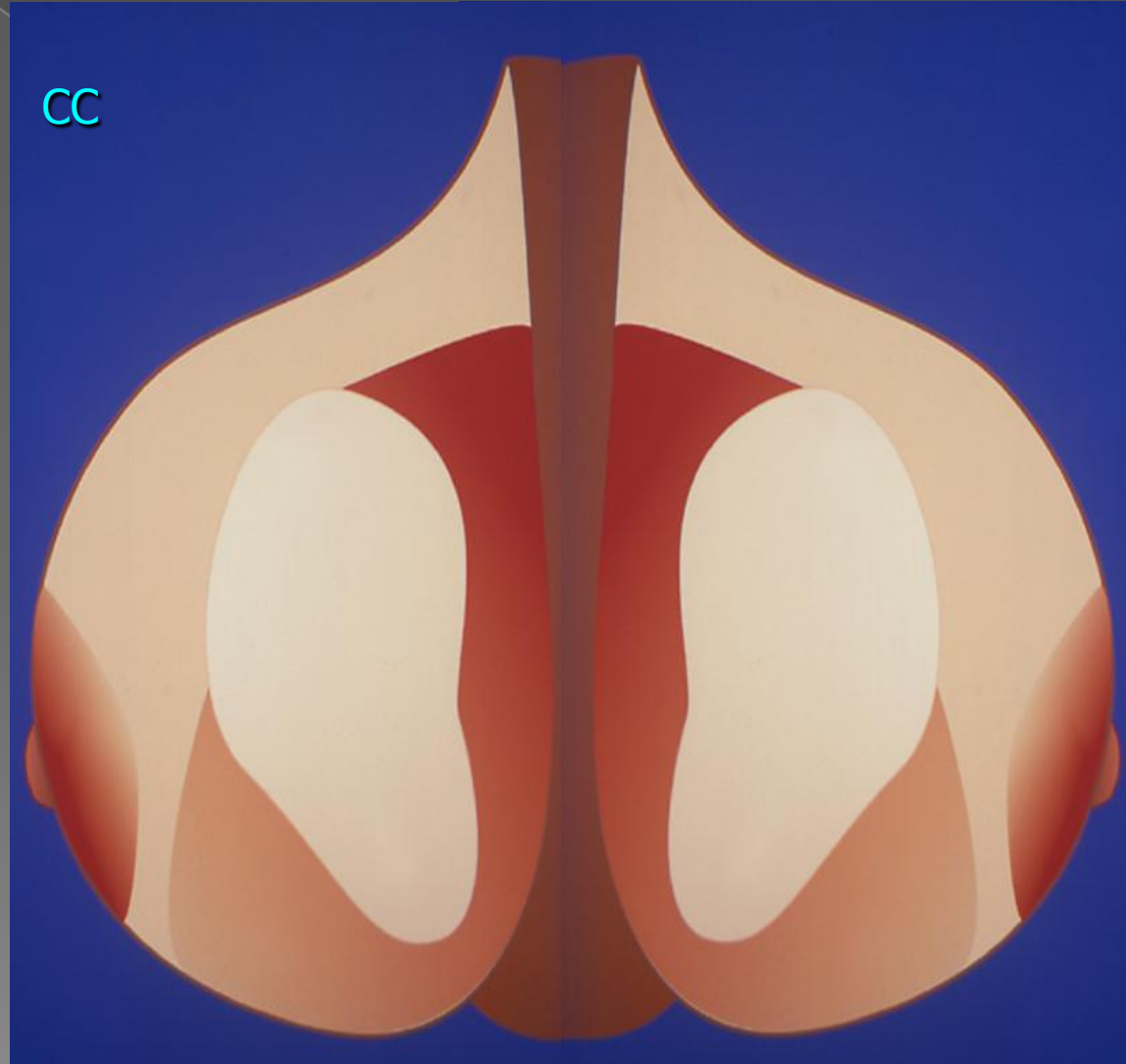
Mediolateral-oblique

MLO



# Review Areas

Cranio-Caudal View



FIRST Decide if there is a mass  
(compare both breasts)

<u>MASS</u>	<u>NORMAL ASSYM.DENSITY</u>
<u>CONVEX</u> borders	Ill-defined or irregular
<b>Denser towards center</b>	Amorphous
Distorts related parenchyma	No
Seen in <b>multiple projections</b>	No
Still seen in focal compression view	Tissues spread over it.

## Benign

Benign masses tend to be • spherical with well-defined borders and not infrequently contain calcification.

The calcifications differ from • malignant micro calcification in that they are larger, coarser and often ring-like in configuration.

Ultrasound can be very helpful in • determining whether a mass is a simple cyst, and, therefore, benign, or solid and, therefore, possibly a carcinoma

## Malignant

The cardinal mammographic signs of *carcinoma* are:

- A mass with ill-defined or spiculated borders.
- Clustered, fine linear or irregular calcifications – so called malignant microcalcifications, which can on occasion be the only sign of breast cancer even in the absence of a visible mass.

Other signs that may point to the • diagnosis of carcinoma are distortion of adjacent breast stroma and skin thickening.

IF mass is palpable at the at  
the site of focal asymmetry

# Biopsy

## 2. Ultrasound

### Indications for Breast Ultrasound

- ◆ Differentiation of both palpable and mammographic lesions as either cystic or solid
- ◆ Subsequent characterization and classification of solid nodules according to certain sonographic features
- ◆ Evaluation of palpable breast mass in patient younger than age 30 \*MCQ\*
- ◆ Interventional procedures (FNA, CNB)

Smith, DS. Radiologic clinics of North America 2001; 39:485-496.



# Methods: Identification of Malignant Features

- ◆ First, they identified lesions with any of the following malignant features:
  - Spiculation
    - \*a spiculated mass is a lump of tissue with spikes or points on the surface \*
  - Angular margins
  - Hypoechogenicity
  - Shadowing
  - Calcification
  - Duct extension
  - Branch pattern
  - Microlobulation

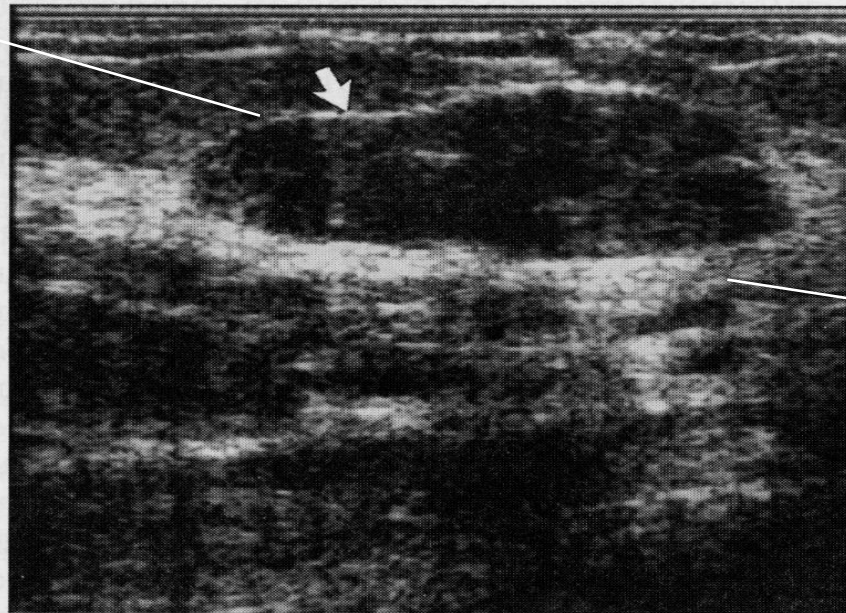
Stavros, et al. *Radiology* 1995; 196:123-134.

# Examples

## Benign fibroadenoma on ultrasound

Thin  
echogenic  
capsule

Most common  
benign solid  
mass of the  
breast



Ellipsoid  
shape  
(wider than  
tall)

**Figure 3.** Fibroadenoma showing an echogenic pseudo-capsule (arrow).

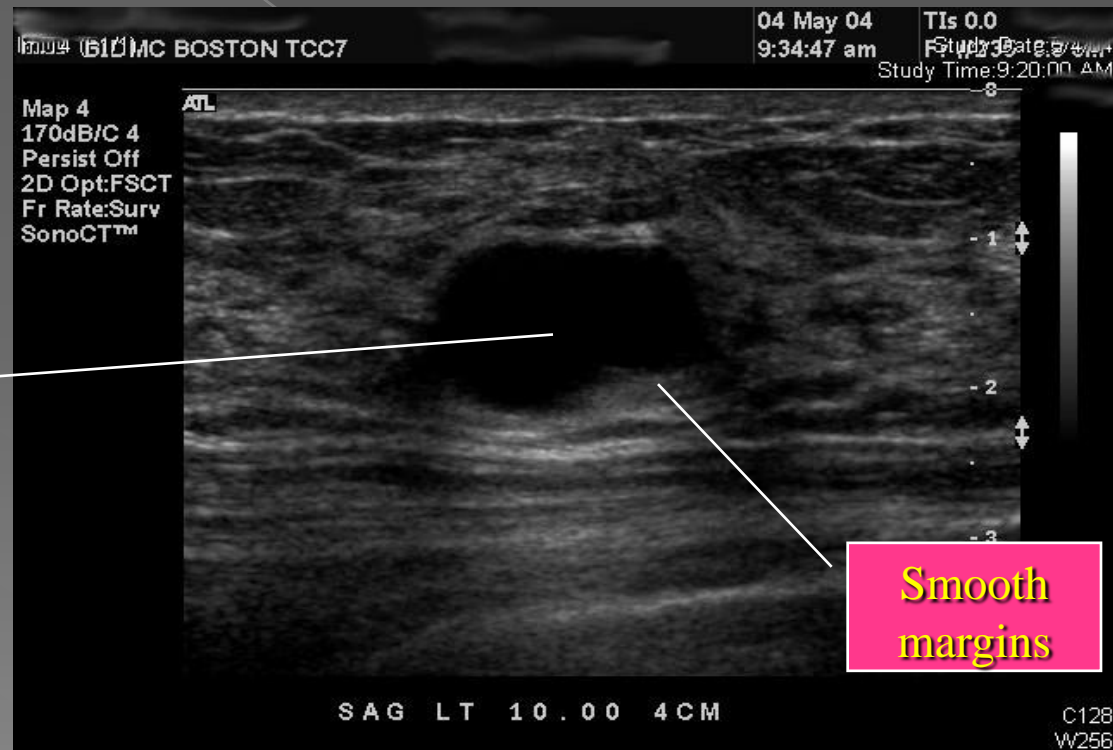
# IMP SLIDE !

- ◉ Hyperechogenic: non-malignant mass
- ◉ Hypoechogenic: could be mal. Or non-mal.
- ◉ Anechoic: cyst (Complete black hollow)
- ◉ Hypoechoic: solid mas (few small hyperechogenic structures)

# Example

## Simple cyst on breast ultrasound

(Cystic lesion well defined, smooth margins, anechoic ( benign )



Anechoic

Smooth  
margins

### 3. MRI breast

High-field strength (1.0 – 1.5 Tesla) necessary, resulting in :

- a higher signal-to-noise-ratio
- shorter acquisition time
- better separation of fat and water peaks
- better contrast characteristics

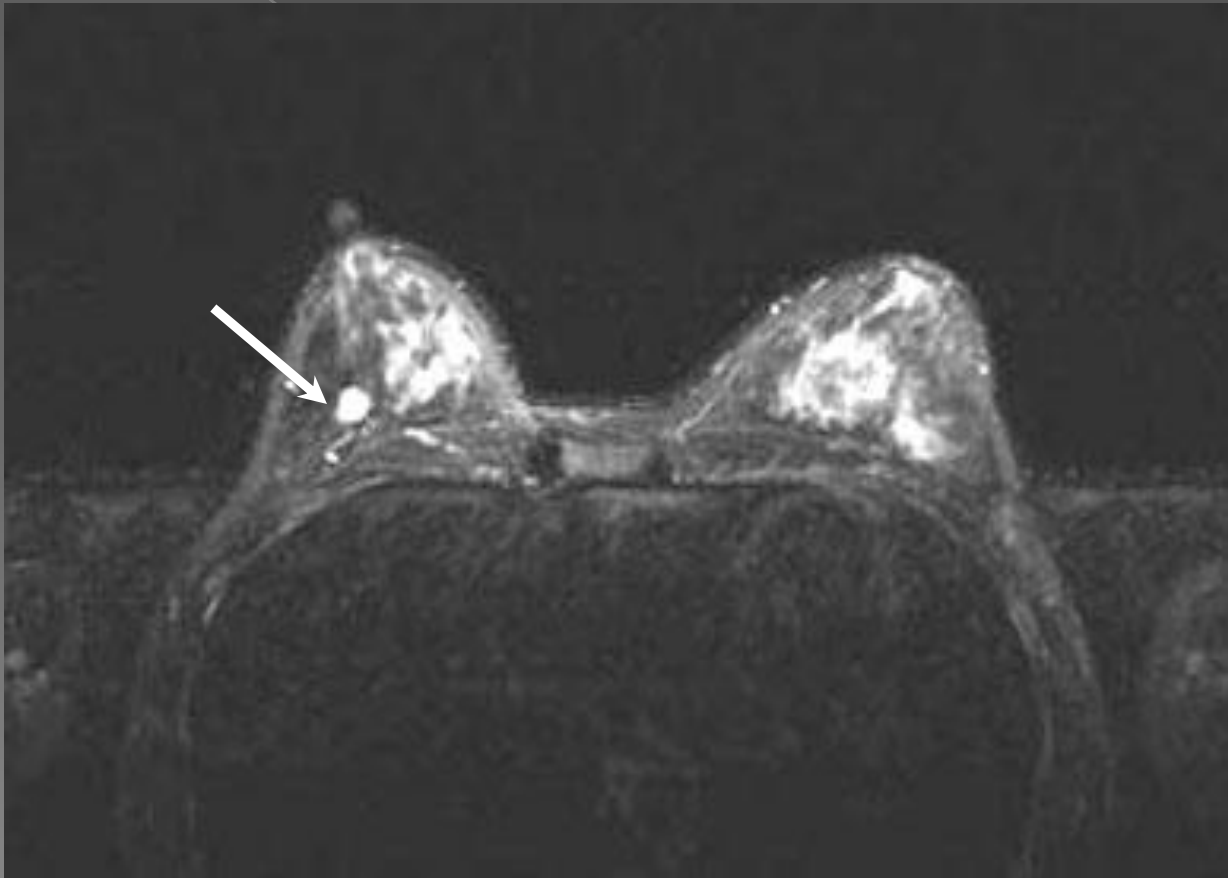
(T1 time increase)

\*- Not used for a pregnant lady.



# Static Imaging

STIR (Short tau inversion recovery)



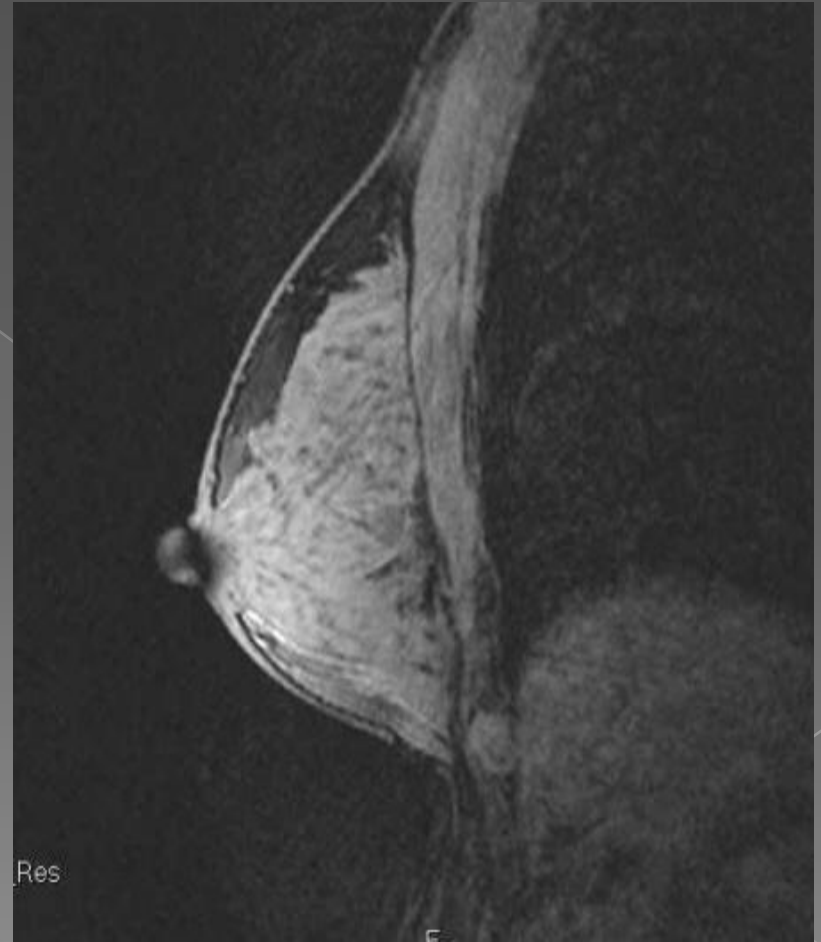


# High resolution Imaging

Flash 3D Vibe

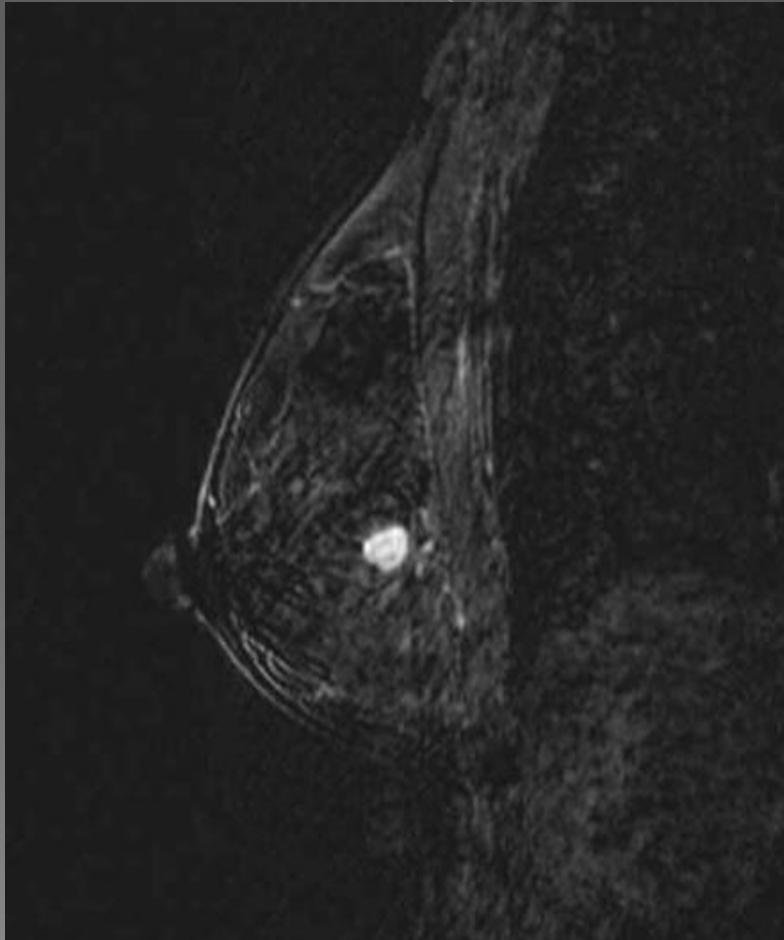


Flash 3D HR



# Dynamic Imaging

Post contrast with fat-suppression.



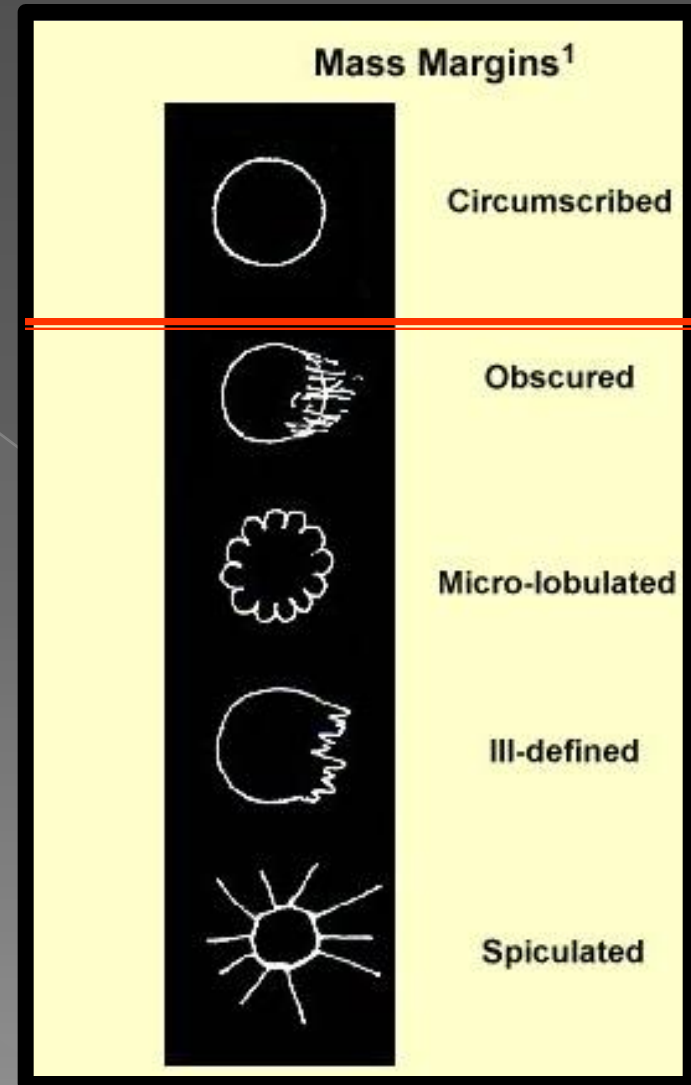
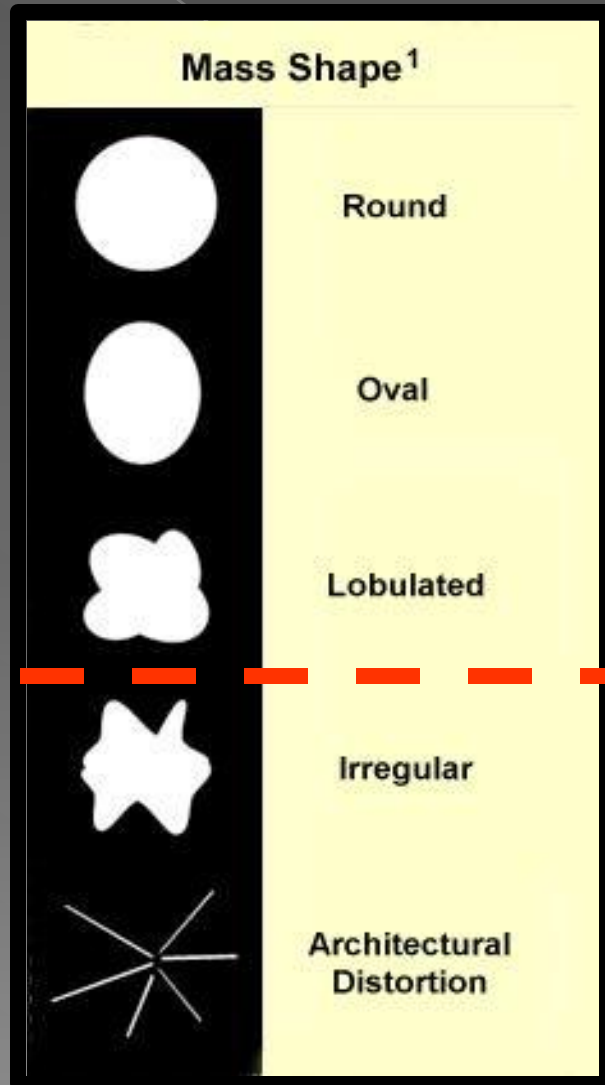
Flash 3D HR



- ◉ Fat suppression: a modality in MRI that lets you eliminate the opaqueness of the fat

# MASS

## A. Characters of masses



- ⦿ Above red line → can be malignant or benign
- ⦿ Below red line → malignant only

# Mass B. Margins

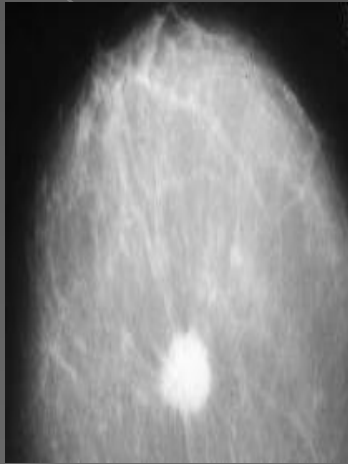
- ◉ Most important character .
- ◉ If margins are obscured by breast tissues



**Compression /magnification views**



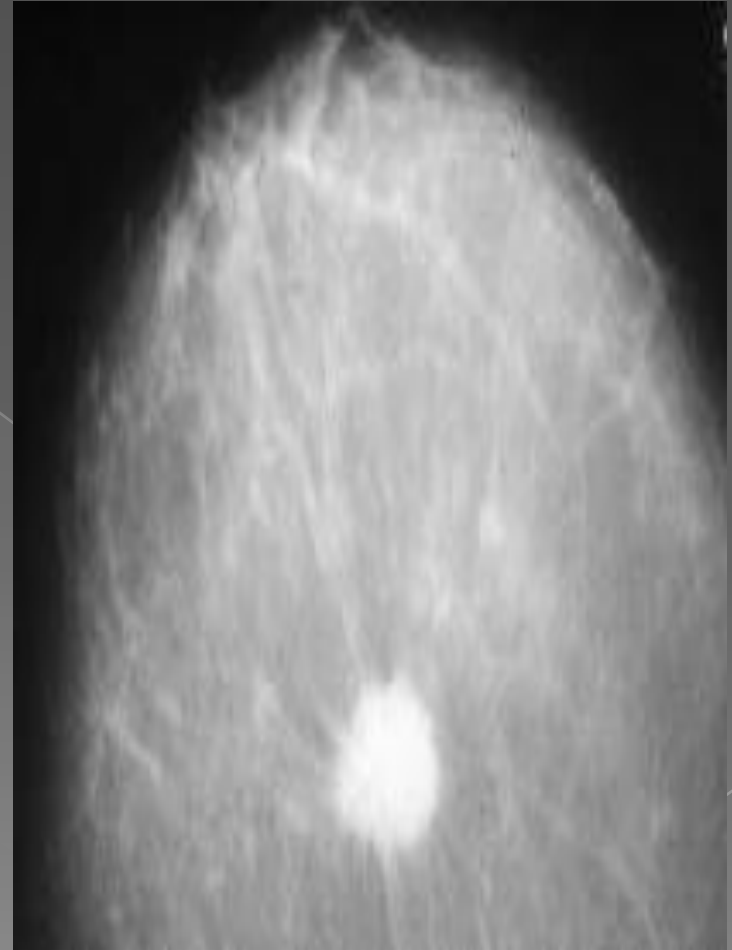
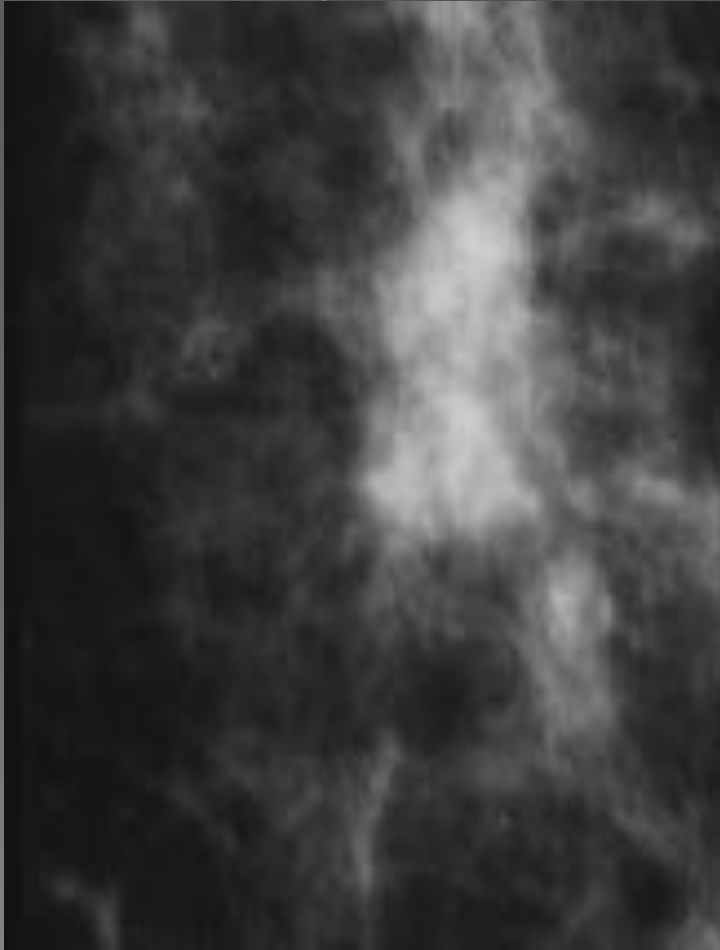
# Margins

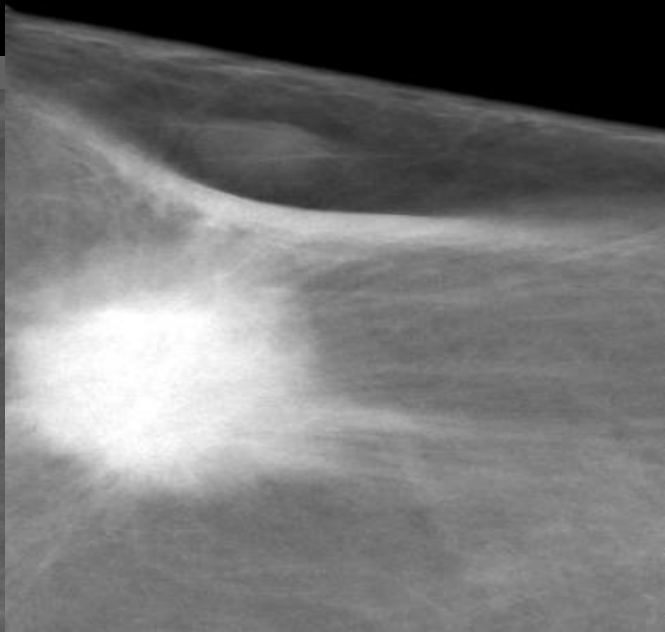
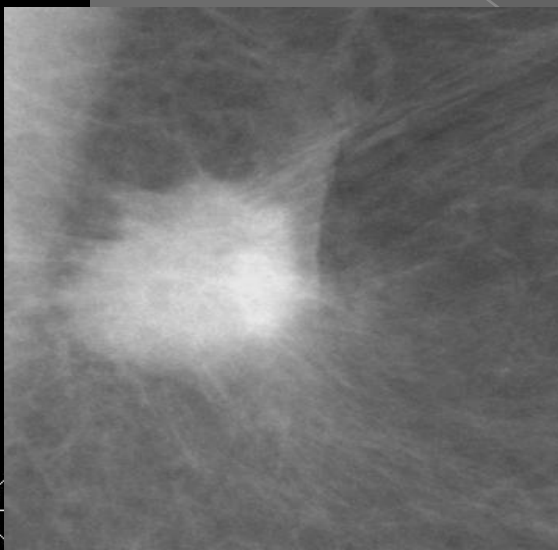
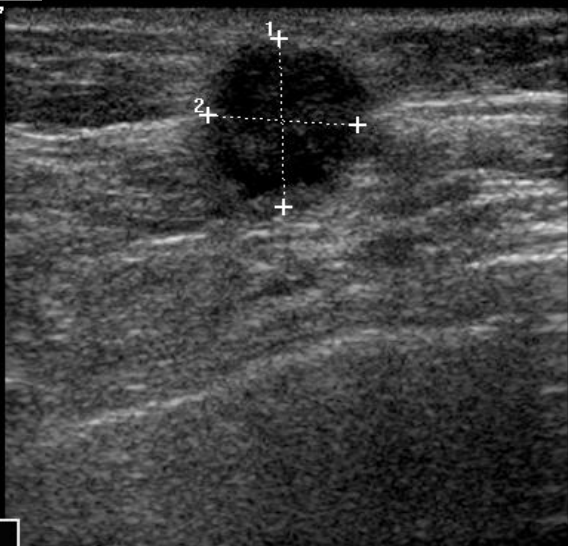
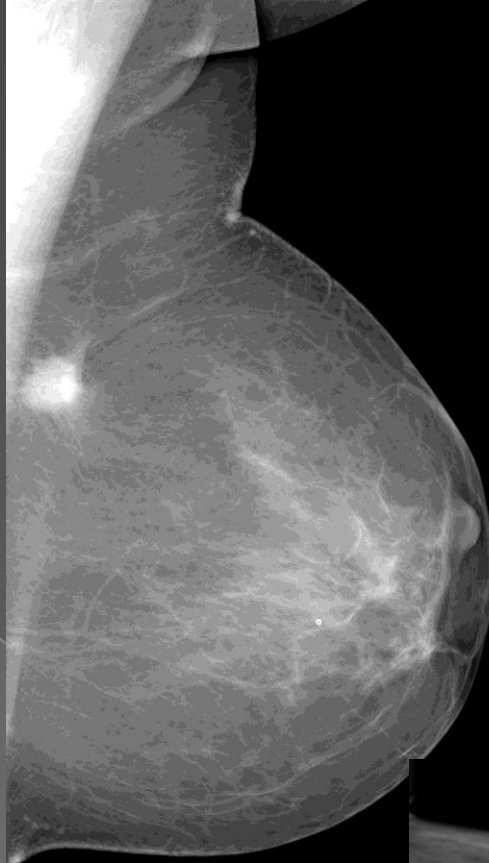
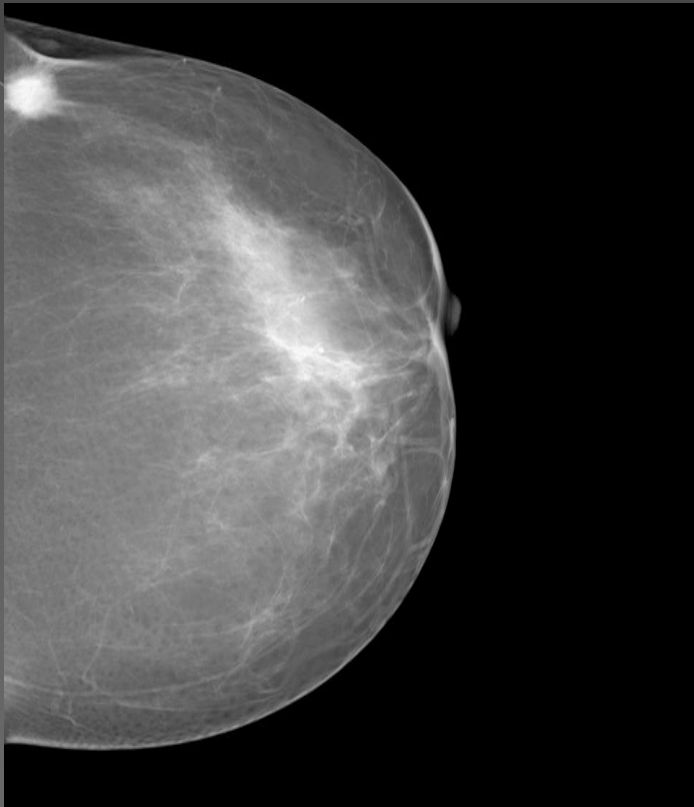


1. Spiculated  
Classical carcinoma.  
More common in :  
invasive>tubular>lobular



# 1. Spiculated mass Invasive ductal carcinoma





1 L 1.24 cm  
2 L 1.04 cm

- ◉ Skin dimpling is obvious with the speculated mass lesions ( only in malignant lesions )

# Spiculated Margins (cont.)

- ◆ DD :

FAT necrosis (previous surgical biopsy)

SCARS (previous surgery)

- ◆ Radio-opaque mark

- ◆ Previous scar

- ◆ Any increase in size----> biopsy

RADIAL SCAR (complex sclerosing lesions)

## 2. Well-circumscribed (well-defined) margins

- Almost always benign .
- 5% of them may be malignant .

**US**

```
graph TD; US[US] --> Cyst[CYST → NO FUTURE ASSESSMENT]; US --> Solid[SOLID ... ► COMP. MAGN. VIEWS]; Solid --> Micro[MICROLOBULATED BIOPSY]; Solid --> Well[WELLCIRCUMSCRIBED F/U];
```

**CYST → NO FUTURE ASSESSMENT**

**SOLID ... ► COMP. MAGN. VIEWS**

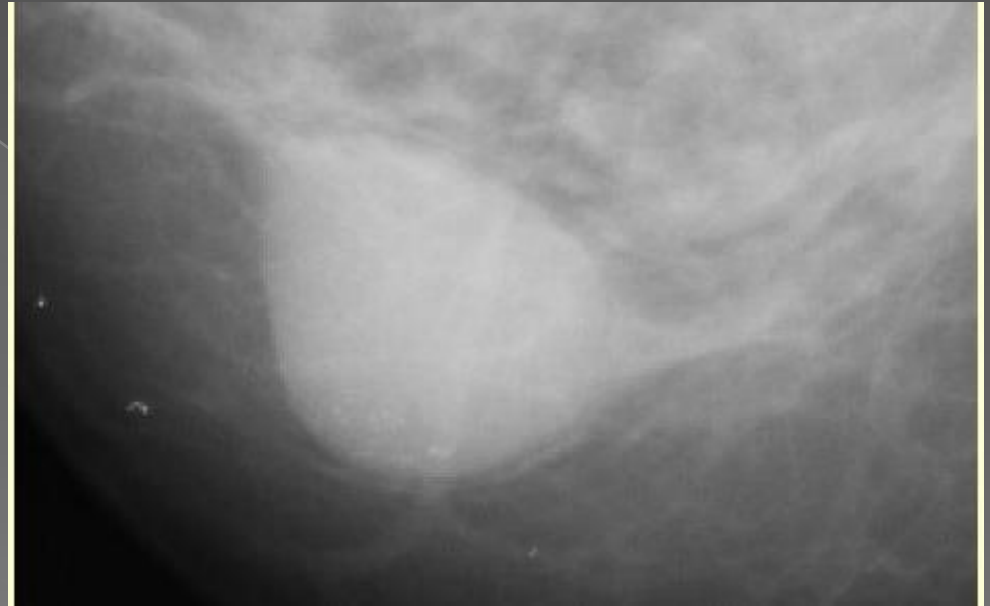
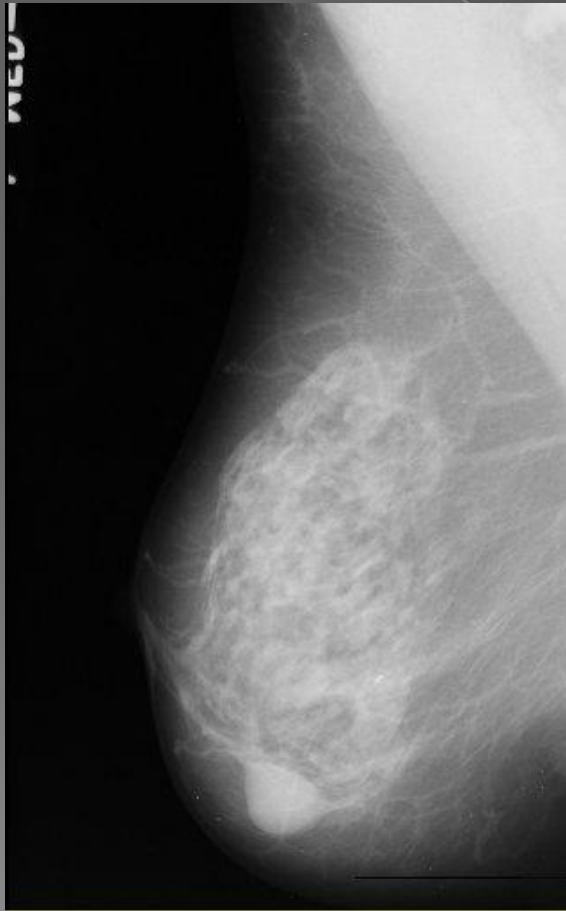
**MICROLOBULATED  
BIOPSY**

**WELLCIRCUMSCRIBED  
F/U**

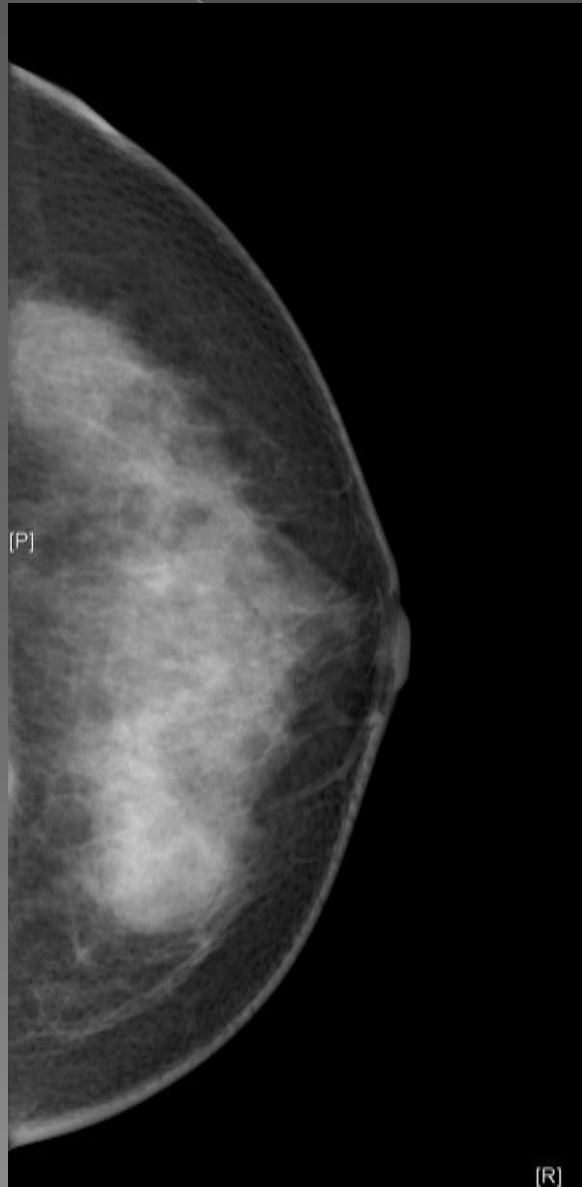


# Examples Of Well Circumscribed Margins

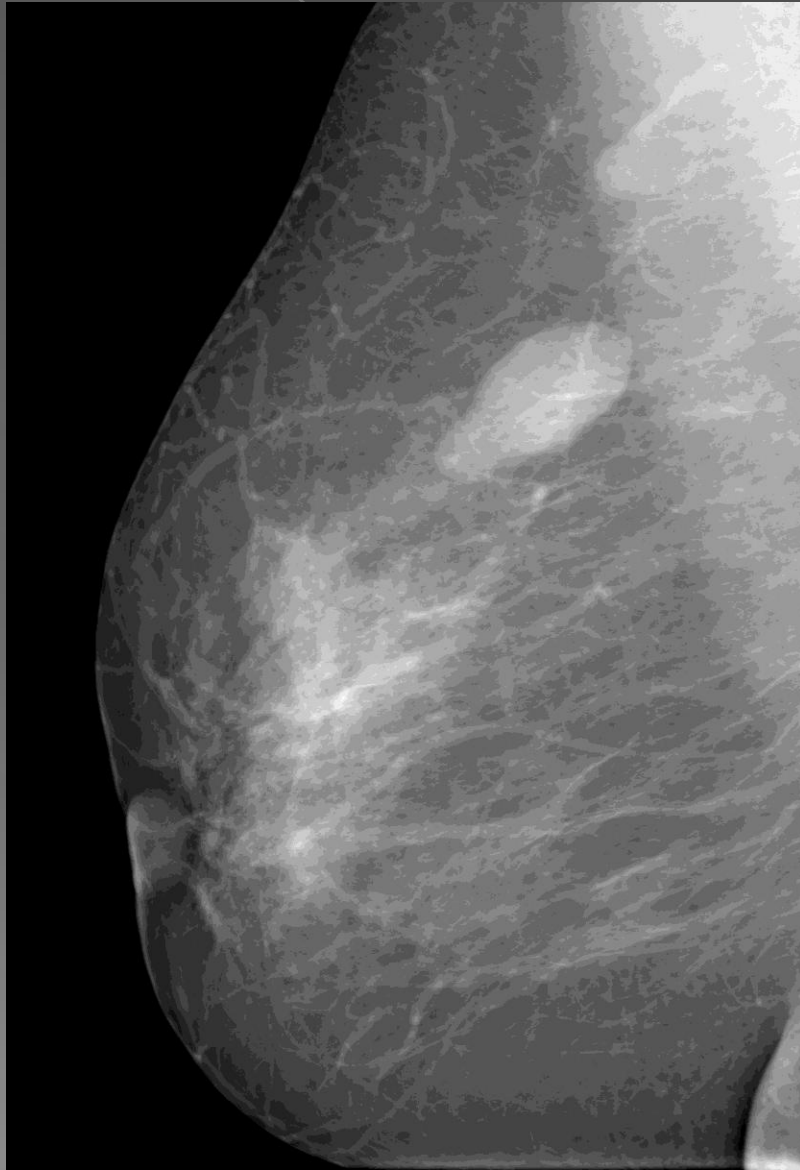
## OVAL WELL-CIRCUMSCRIBED



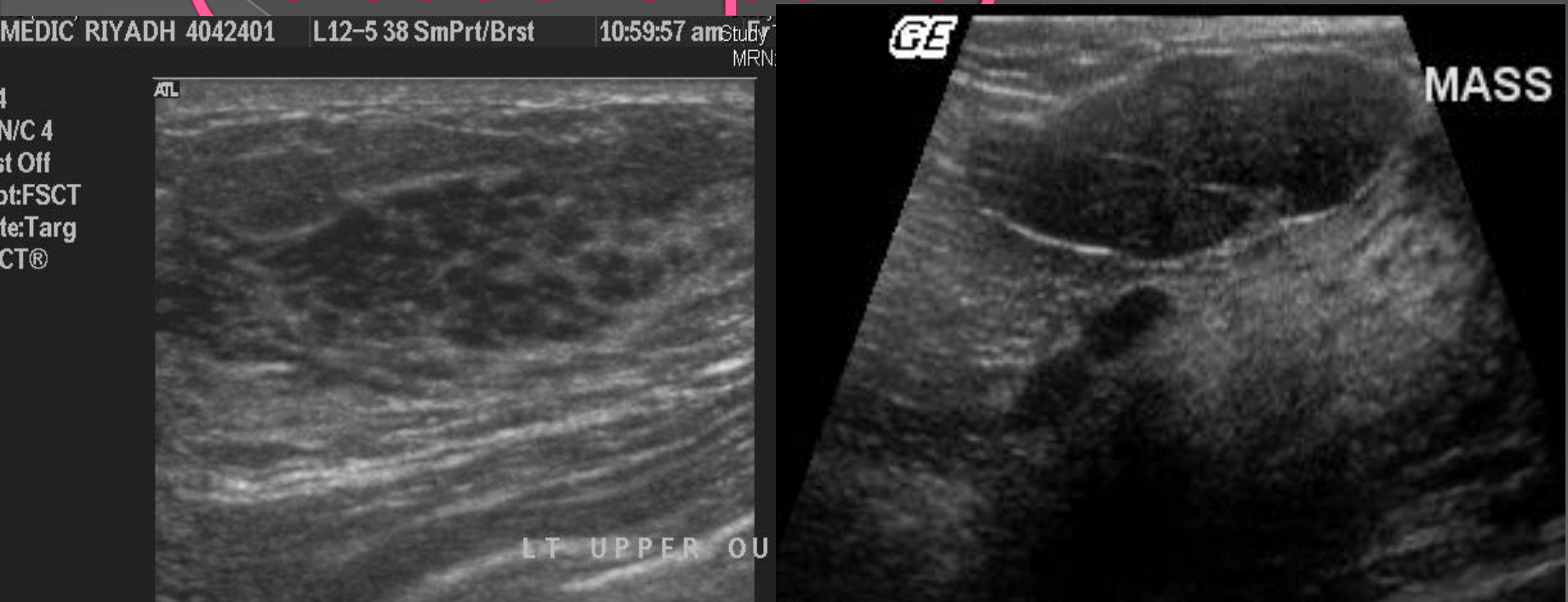
## 2. Large Fibroadenoma



### 3. FIBROADENOMA



## 4. Hamartoma (fibroadenolipoma)



At US, a sharply defined, heterogeneous oval mass is seen, or the lesion may manifest as normal glandular tissue

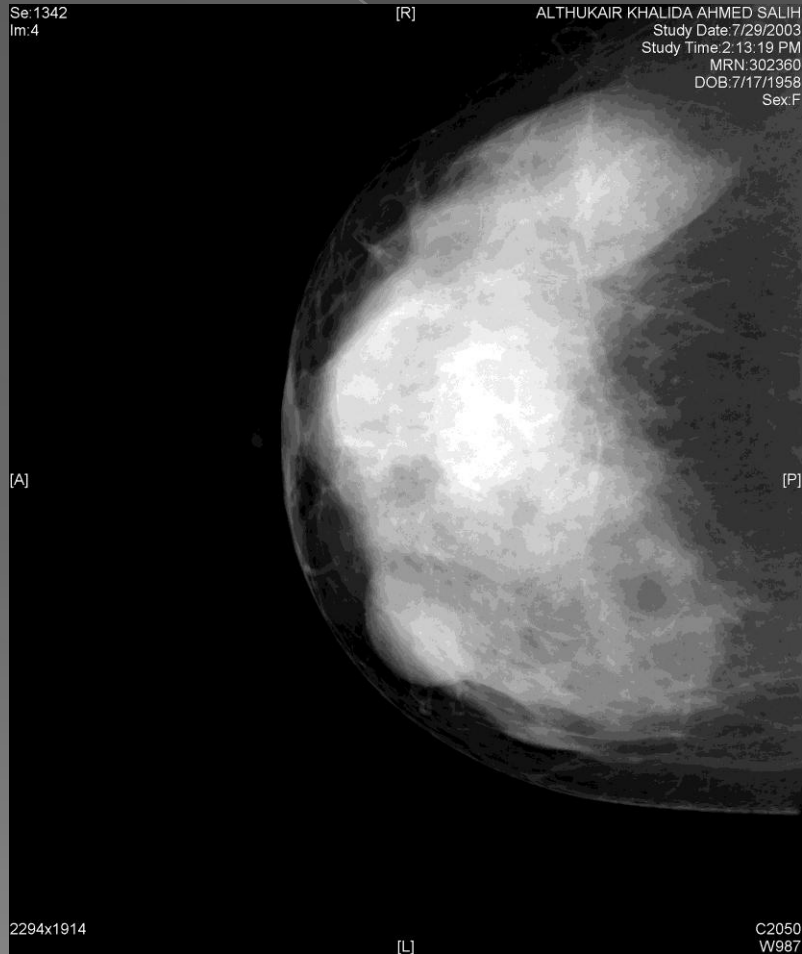
# 5. CYSTS



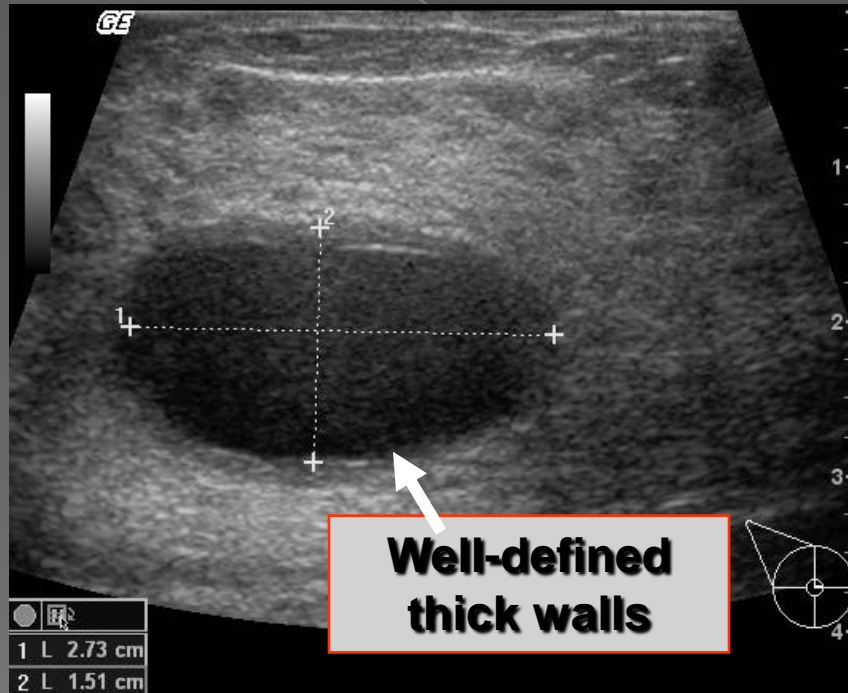
Hemorrhagic cyst in dense breast



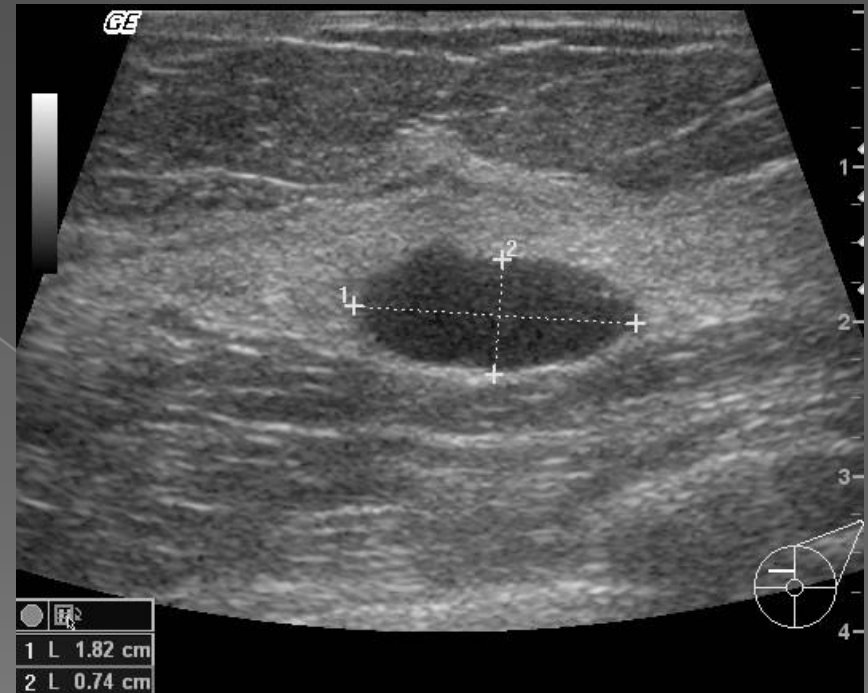
# 6. Complicated cysts



# 6. Complicated cysts



**Well-defined  
thick walls**



Complicated cysts have thick walls, dark fluid, and are well defined masses.  
May result in hemorrhage



# The density categories used

**\*Dr said forget about it \***

- ◆ High density: clearly higher than surrounding, suspicious.
- ◆ Equal density: density not appreciably different, neutral significance.
- ◆ Low density: density lower, but not fat containing, neutral significance.

# NUMBER OF MASSES

- ◆ FACT

MULTIPLE WELLDEFINED MASSES are probably benign .

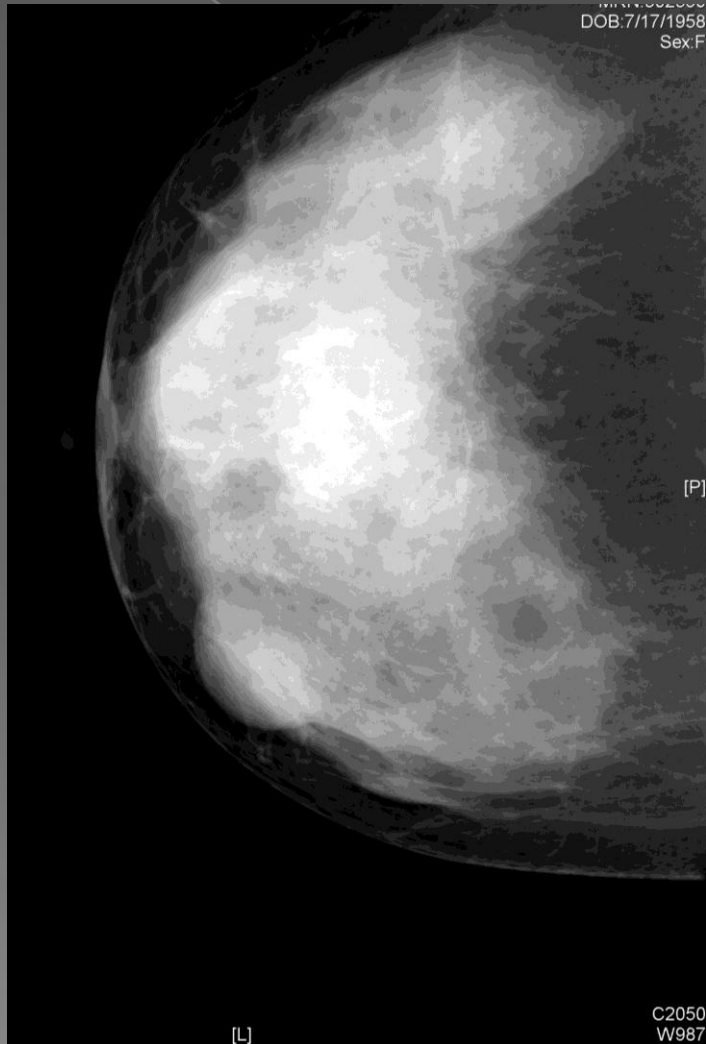
- ◆ FACT

MULTIPLE PRIMARY MALIGNANT LESIONS ARE OBVIOUSLY ILL-DEFINED OR STELLATE LESIONS.

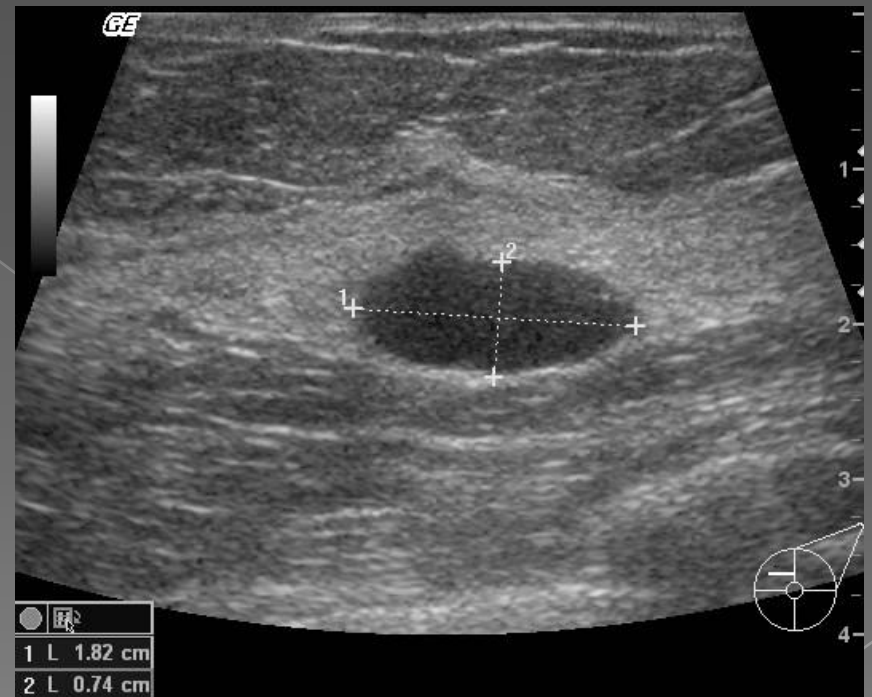
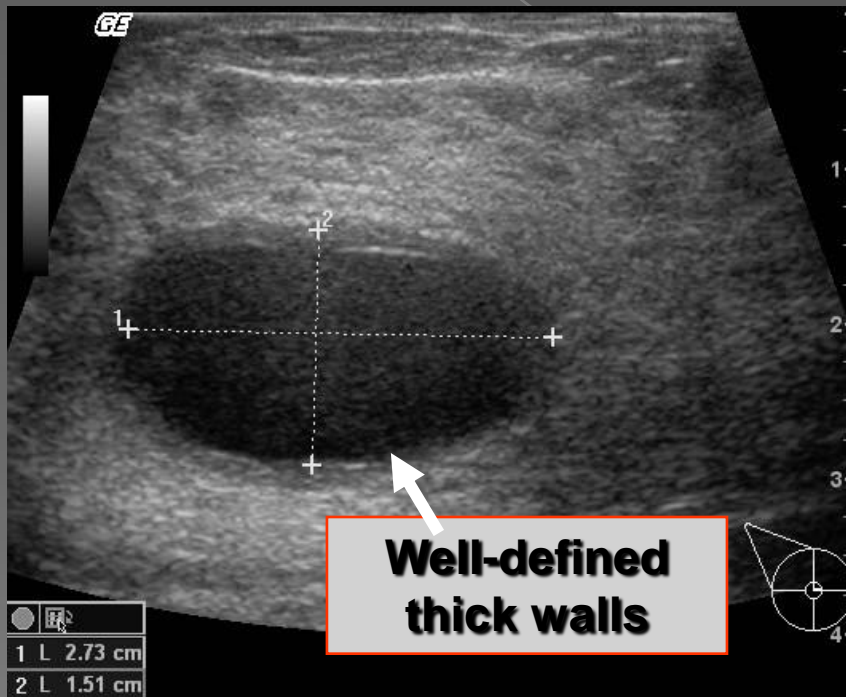
- ◆ FACT

**BENIGN AND MALIGNANT LESIONS CAN COEXIST !!!**

# Complicated cysts



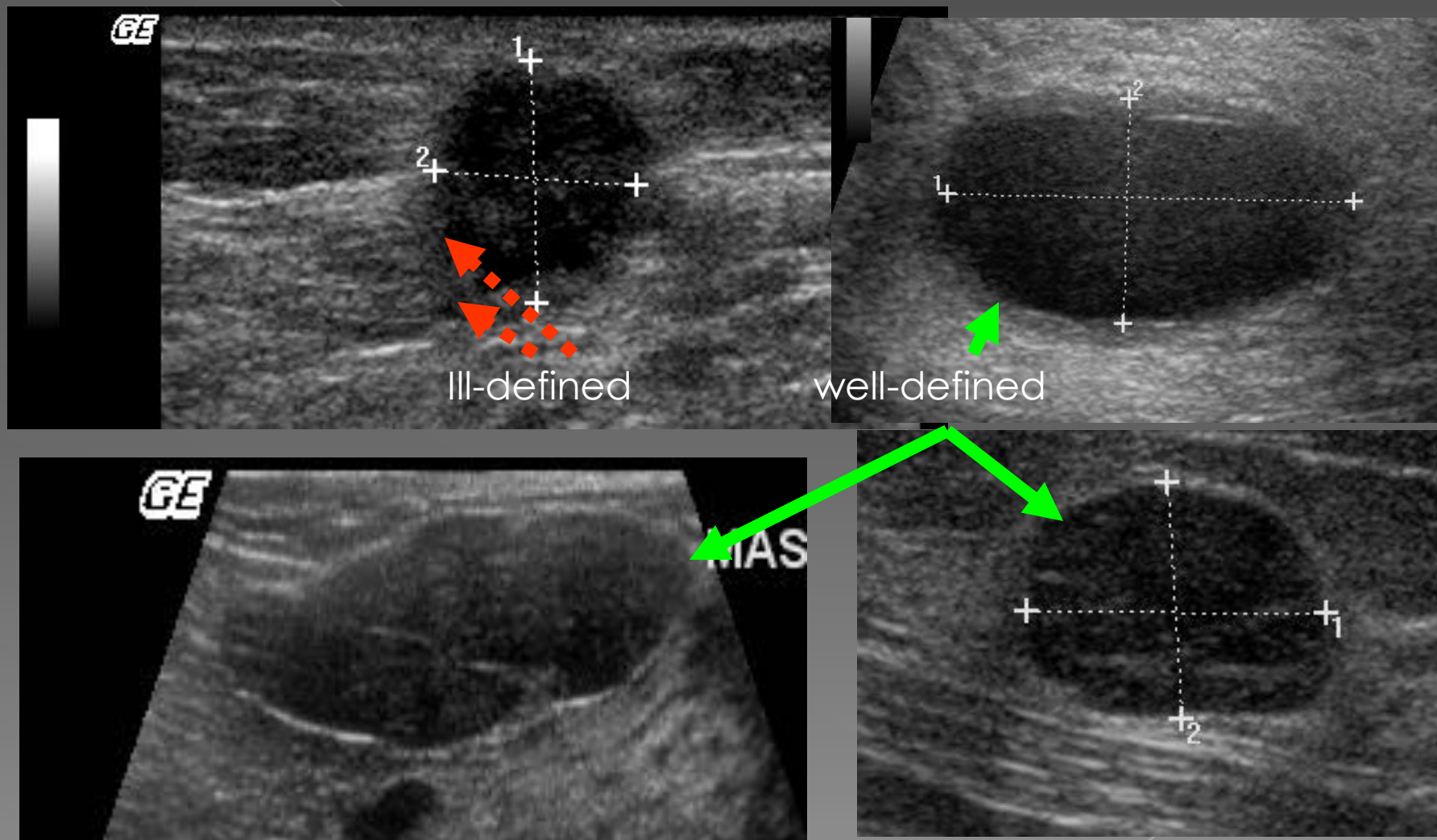
# Complicated cysts



- ◉ Left pic before compression
- ◉ Right pic. After compression ( it is smaller → cyst ) because solid masses won't decrease in size.

## Margins

Ill-defined borders have several small erosion-like sites



# E. Calcifications

## 1. Size

- ◉ **Microcalcifications  $\geq 2\text{mm}$ :** associated with a malignant process
- ◉ **Macrocalcifications  $\leq 2\text{mm}$ :** associated with a benign process .
- ◉ 0.5 mm or less to have a high probability of association with cancer
- ◉ 2.0 mm or larger are typical of a benign process
- ◉ The smallest visible calcifications on a mammogram is approximately 0.2 - 0.3 mm



- ◉ Scattered calcification: benign
- ◉ Clustered calcification: malignant
- ◉ Microcalcification  $<0.5$  mm  $\rightarrow$  malignant

# Calcifications (cont.)

## 2. Number

- Any number of calcifications less than four will rarely lead to the detection of breast cancer in and of itself.
- Two or three calcifications may merit greater suspicion if they exhibit worrisome morphologies.

# Calcifications

## 3. Morphology

- Most important indicator in differentiating benign from malignant.
- Round and oval shaped calcifications that are also uniform in shape and size are likely benign.
- Irregular in shape and size **CALCIFICATIONS** fall closer to the malignant end of the spectrum.
- It has been described that calcifications associated with a malignant process resemble small fragments of **broken glass** and are rarely round or smooth.

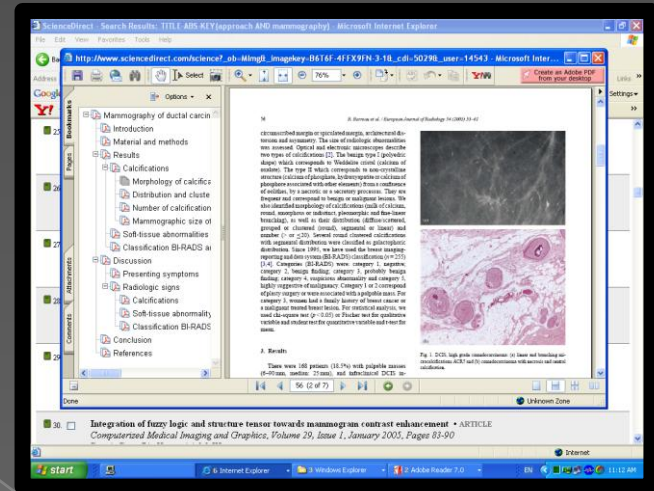
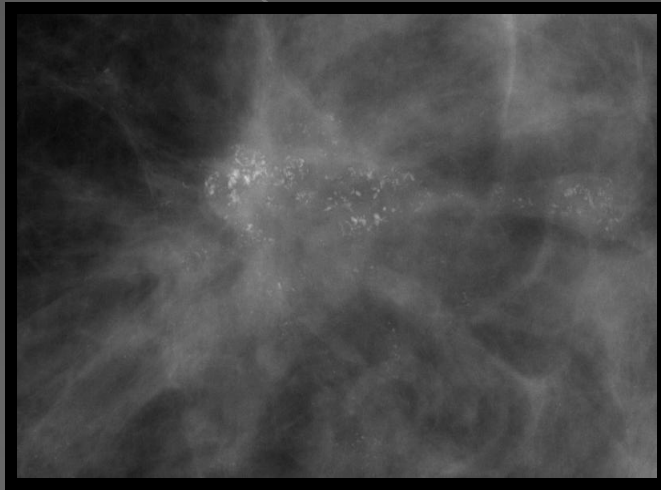
# CALCIFICATIONS

## 4. ACR BIRADS Classification:

The American College of Radiology (ACR) Breast Imaging Reporting and Data System (BIRADS) has classified findings of calcifications into three categories:

- (1) Typically benign;
- (2) Intermediate concern; and
- (3) Higher probability of malignancy.

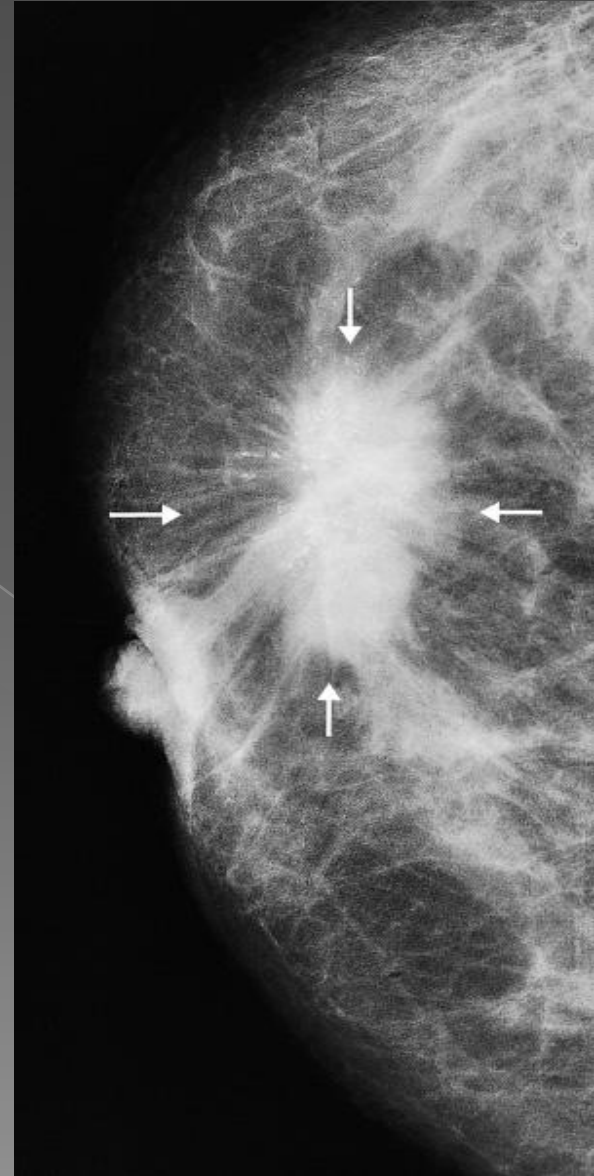
# MALIGNANT MICROCALCIFICATION



- ◆ CLUSTERED :  $> 5$  in  $1\text{cm}^2$
- ◆ Branching interrupted ill-defined ductal .

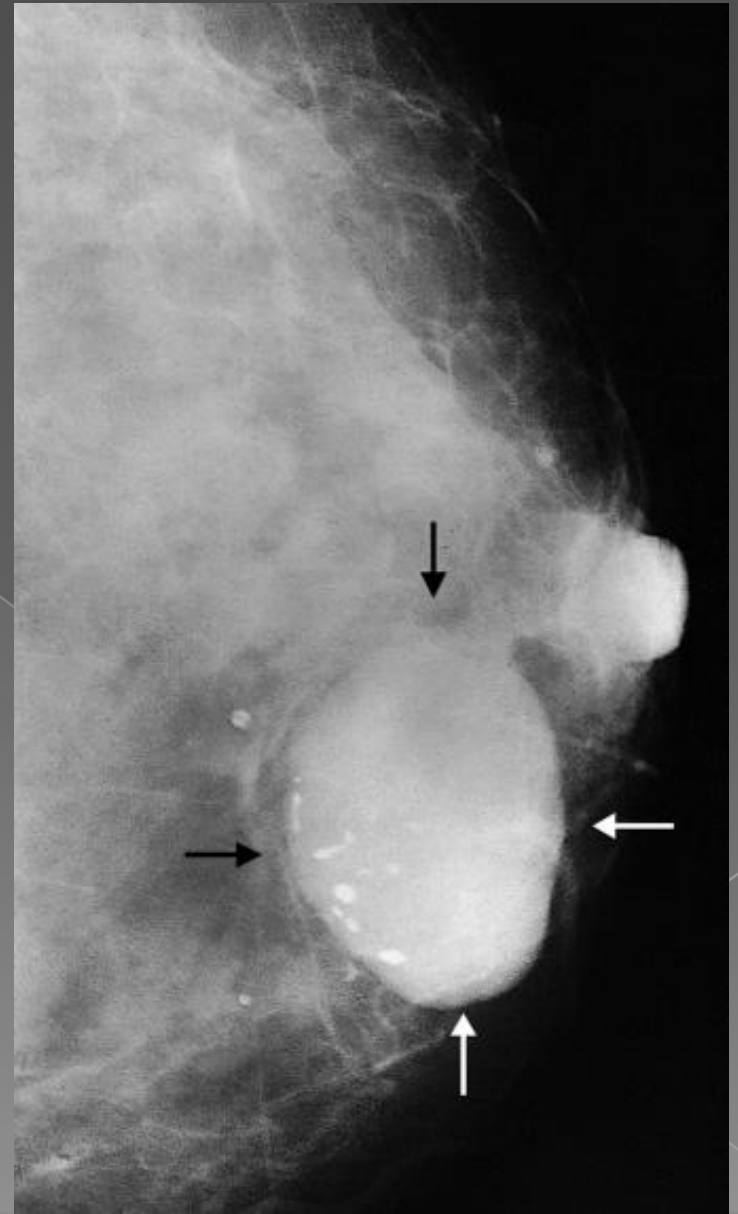
# Additional Pictures

- Carcinoma of the breast.
- Mammogram showing irregular soft tissue mass (arrows) behind the nipple.
- Microcalcifications are present but difficult to see in reproduction.



Benign mass in breast  
(fibroadenoma).  
Mammogram showing  
mass (arrows) with very  
well-defined borders and  
coarse structured  
calcification.

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# MCQs

The following MCQs are from an external source. It is optional to look through them. They are used as a tool to help you understand the course and be prepared for the exam.

- Screening Mammography I:  
<http://www.symptombasedradiology.com/RQW/RQW048%20Screening%20Mammography%20I%2011-26-2011.pdf>
- Screening Mammography II:  
<http://www.symptombasedradiology.com/RQW/RQW049%20Screening%20Mammography%20II%2012-03-2011.pdf>
- Diagnostic Mammography I:  
<http://www.symptombasedradiology.com/RQW/RQW050%20Diagnostic%20Mammography%20I%2012-10-2011.pdf>
- Diagnostic Mammography II:  
<http://www.symptombasedradiology.com/RQW/RQW051%20Diagnostic%20Mammography%20II%2012-17-2011.pdf>
- Breast Mass in a Young Woman:  
<http://www.symptombasedradiology.com/RQW/RQW052%20Breast%20Mass%20in%20a%20Young%20Woman%2012-24-2011.pdf>
- Bloody Nipple Discharge:  
<http://www.symptombasedradiology.com/RQW/RQW053%20Bloody%20Nipple%20Discharge%2012-31-2011.pdf>



FIGHT  
against  
Breast Cancer