Radiology
Team 438

Radiology of breast diseases

Lecture 21

Objectives

Reviewed By
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- 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 .

Color Index: Important | Doctor's Notes | Extra | Female slides | male slides

Team Leaders


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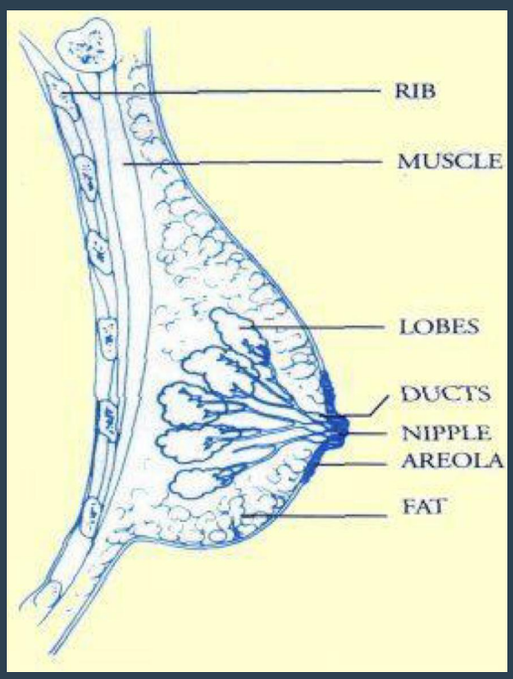
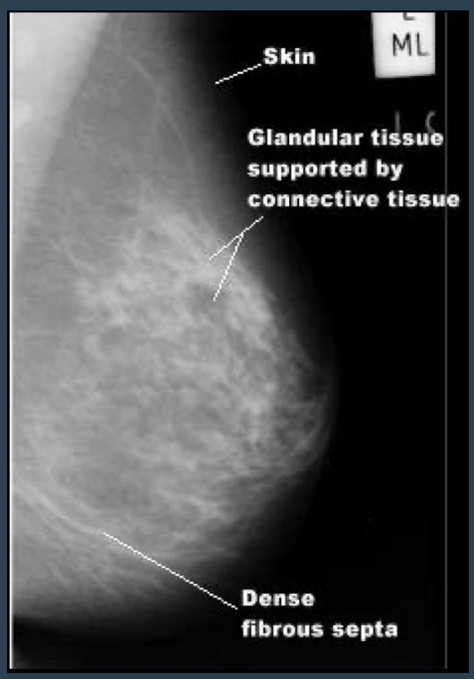
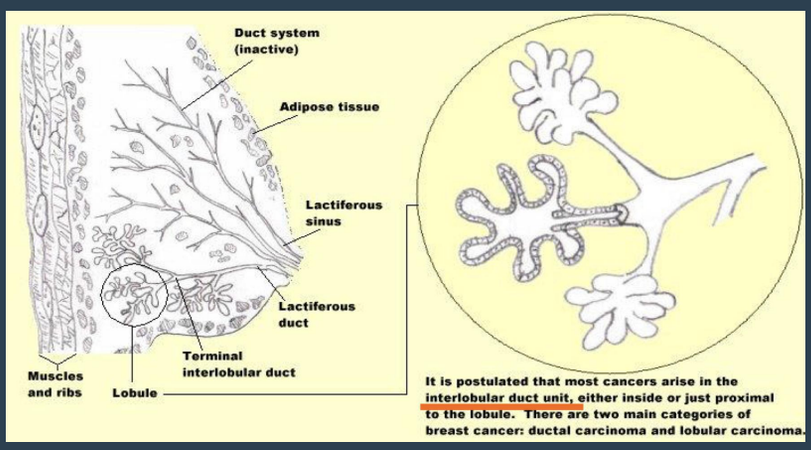
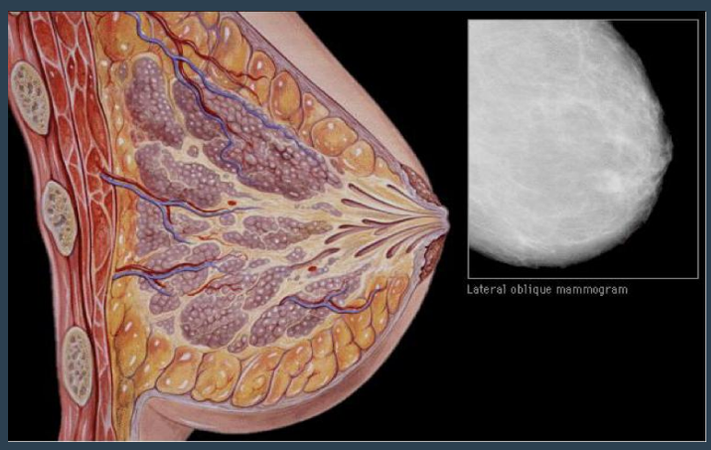
Editing file

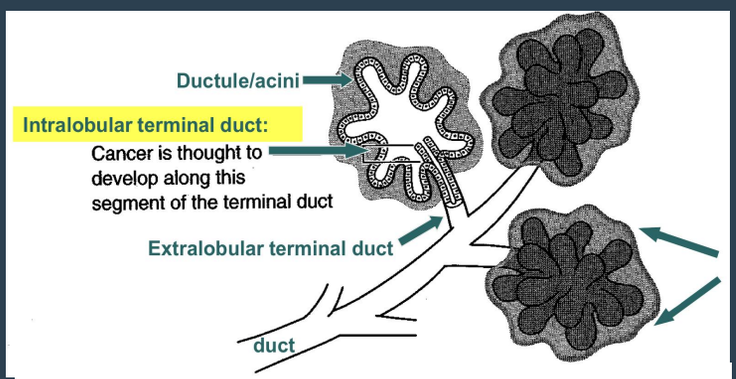
Basic Anatomy

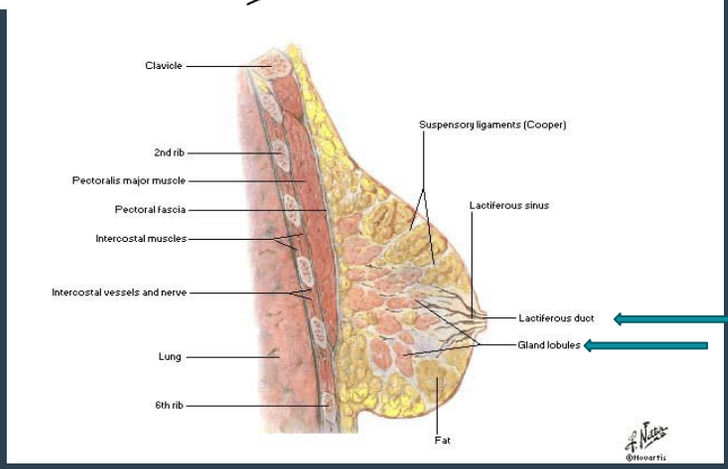












Most breast cancer develops in the terminal ductal lobular unit (TDLU)

Terminal ductal lobular unit is composed of:

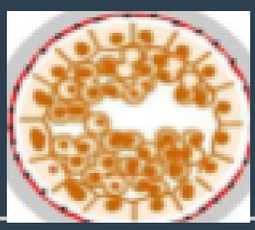
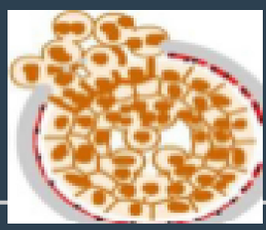
1- intralobular terminal ducts.

2- Acini

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

Breast Cancer

Breast Cancer can be divided into two major groups :

In situ	Invasive
• Tumor cells **have not** invaded the basement membrane . • Tumor cells remain confined to the ducts or lobules . DCIS The membrane here is intact 	• Tumor cells **invade** the breast stroma . • They have the potential to metastasize and result in death of the patient . Invasive ductal carcinoma The membrane here is invaded 

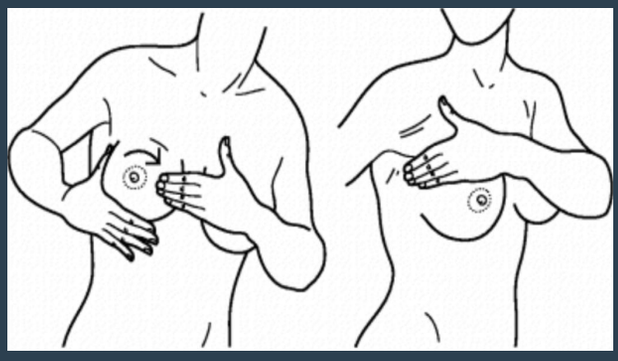
Ductal cancer evolves over time :

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

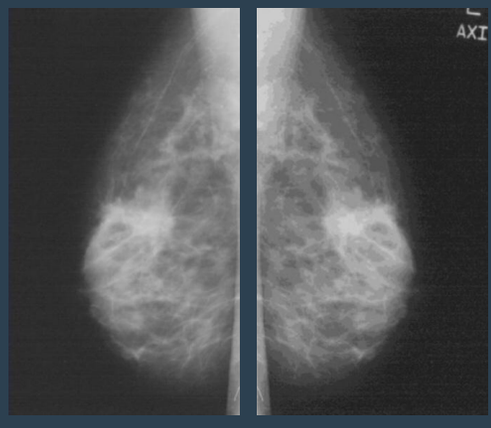
1. **Normal Terminal Ductal Lobular Unit**
2. **Atypical Ductal Hyperplasia (ADH)**
3. **Ductal Carcinoma In Situ (DCIS)**
4. **Invasive Ductal Carcinoma (IDC)**

The Four Pillars of Diagnosis :

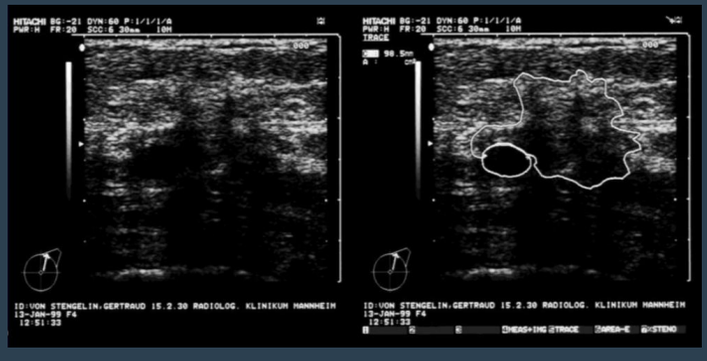
Clinical or Self Examination (PE)



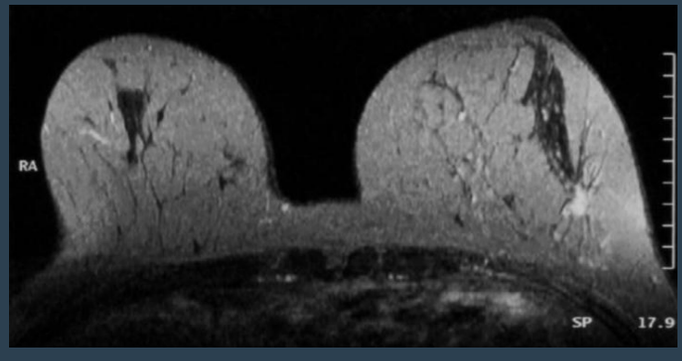
Mammography (MG)



Ultrasound (US)



Magnetic Resonance Imaging (MRI)

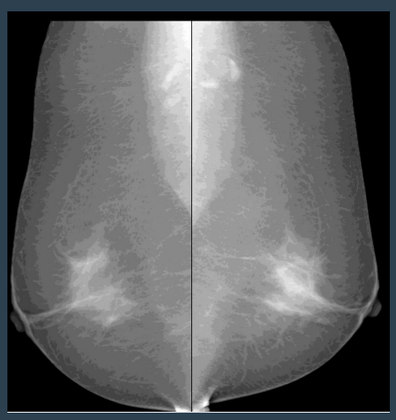


Breast Tests

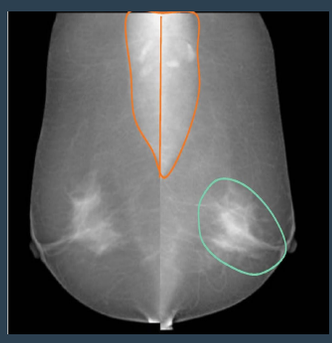
Breast Tests :

1. **Mammography**
   Can rule IN cancer, but **can not rule it OUT .**
2. **Ultrasound**
3. **CT scan**
   (with and without contrast)
   Not for breast lesions but for staging
4. **MRI**
   (with and without Gd contrast)
5. **Ultrasound or MRI guided biopsy and wire**
6. **Bone radionuclide scan**
7. **Lymphoscintigraphy**

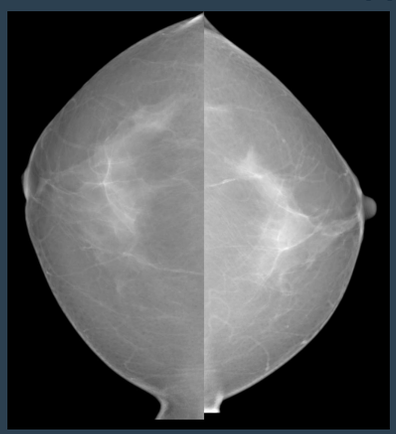
Views :

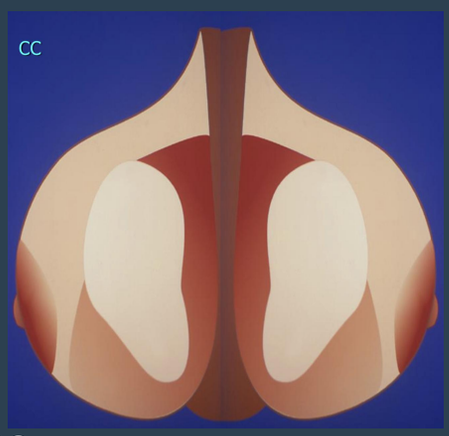


MLO



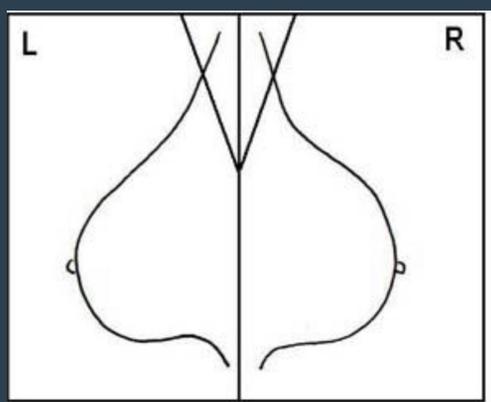
- Pectoralis muscle and axillary lymph nodes.
- fibroglandular tissue.



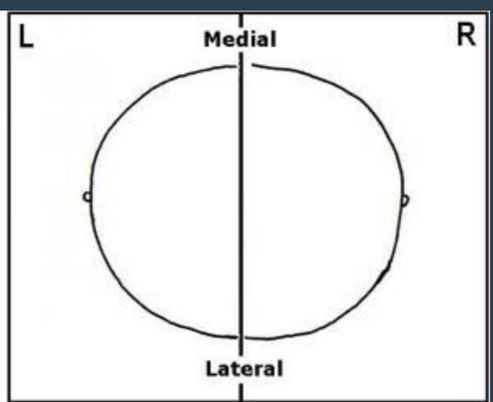


CC

Viewing method :



Mediolat.obliques



Carnio-caudal views

Breast Tests

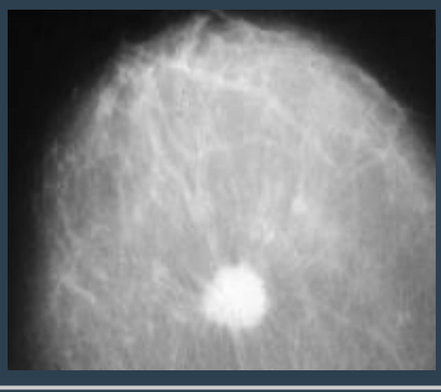
Dense breasts :

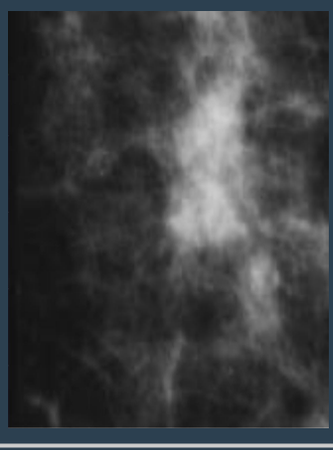
❖ Needs :
1- Extra images
2- Extra modality

Dense Breast | Fat-Replaced Breast

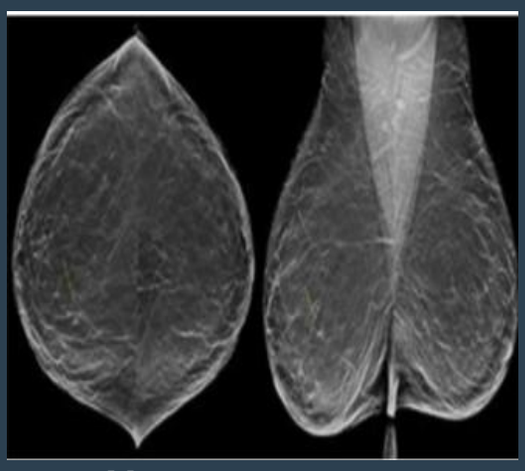
FIRST Decide if there is a mass (compare both breasts) :

Mass	Asymmetrical Density
• **Convex** borders • Denser towards center • Distorts related parenchyma • Seen in **multiple projections** • Still seen in focal compression view	• ill defined or irregular • Amorphous • Tissues spread over it

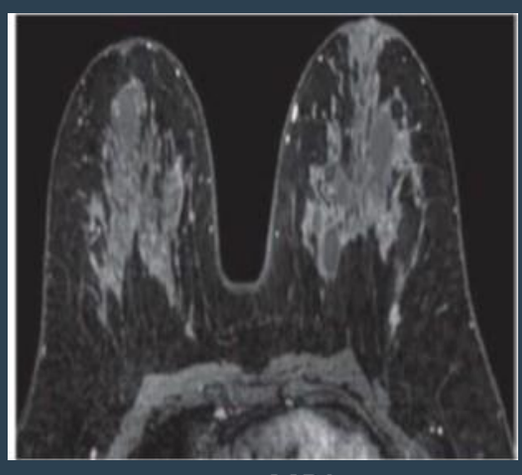




❖ If mass is palpable at the site of focal asymmetry —> Biopsy!


Mammogram


Ultrasound


MRI

Breast Tests

Modality and age

<30	Ultrasound
30-39	No complain —> **US** Complain —> **MG** then **US**
>=40	Mammogram : - If **+ve** Do **US** - If **-ve** you are **DONE**

❖ **US is preferred because:**

* Low radiation.
* Glandular tissue is more than the adipose tissue .

❖ Always start with mammogram in women above 40 year old .

❖ Mammography should be avoided in females age less than 30 as much as possible because of radiation .

Mammogram

Mammogram indications

Screening **(No complain)** :

❖ Patients 40 year old and above, it is not necessary to have a history of breast cancer.

❖ Young patient with first degree relative (Mother/ Sister) diagnosed with breast cancer due to genetic mutations in BRCAl & BRCA2 we start the screening 10 years before the first relative was diagnosed but remember we don't start screening before the age of 25!. Another situations includes one of these syndromes : **Cowden syndrome** (multiple hamartoma syndrome) or Li-Fraumeni syndrome , and if the patient has a history of chest exposure to radiation in her childhood .

Diagnostic **(Complain)** :

❖ Palpable mass .
❖ Nipple discharge .
❖ Skin changes .

Ultrasound :

Indications :

❖ 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 (**very dense breast**) and lactating and pregnant women. .

❖ Interventional procedures (**BIOPSY**) .

Ultrasound cont :

Identification of Malignant Features :

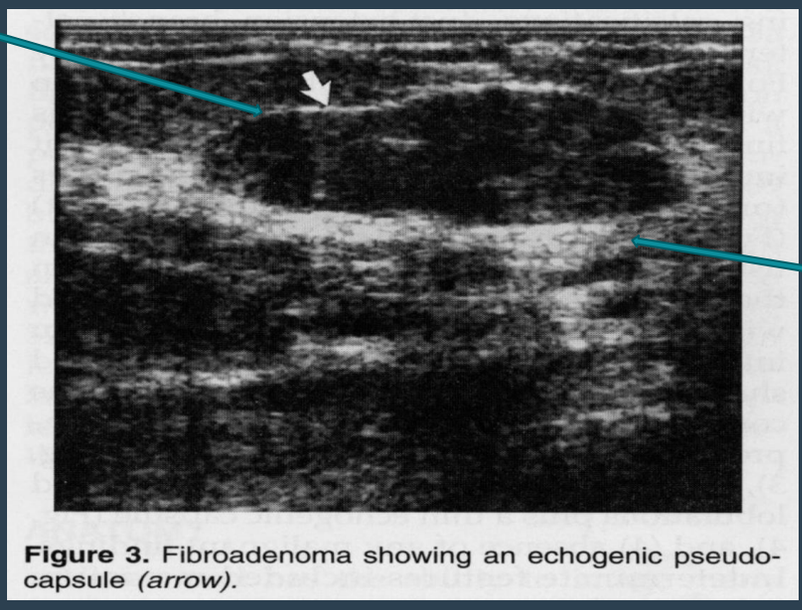
First , they identified lesions with any of the following malignant features :

- Spiculation
- **Angular margins**
- **Hypoechogenicity**
- Shadowing
- Calcification
- Duct extension
- Branch pattern
- **Microlobulation**

Example of benign fibroadenoma on ultrasound :

Thin echogenic capsule

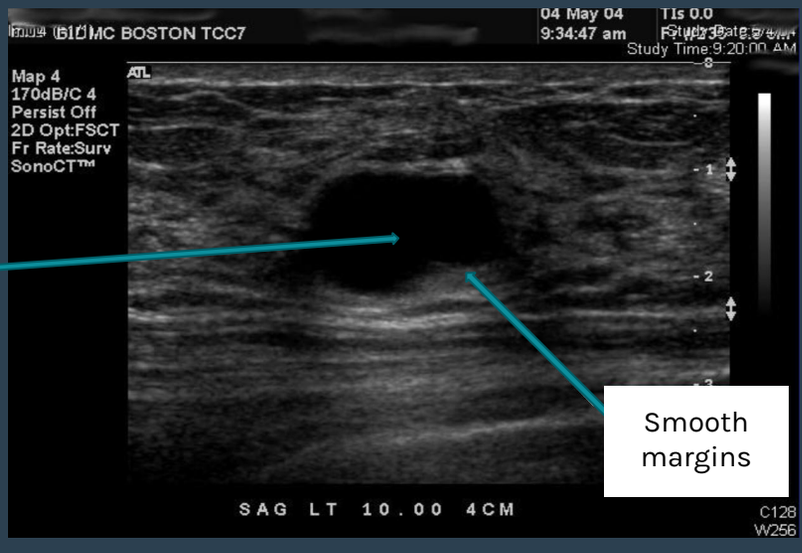
Most common benign solid mass of the breast



Ellipsoid shape (wider than tall)

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

Example of simple cyst on breast ultrasound :



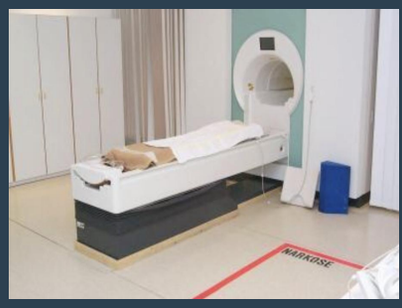
Anechoic Jet black

Smooth margins

Breast MRI

MRI :

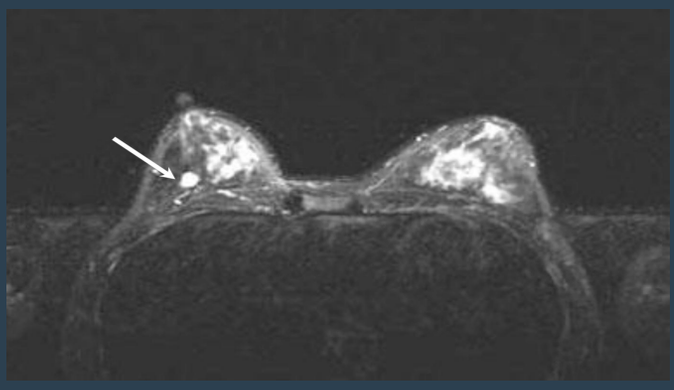
❖ High-field strength (1.0 – 1.5 Tesla) necessary , resulting in :
- a higher signal-to-noise-ratio
- shorter acquisition time
- better separation of fat and water peaks
- better contrast characteristics (T1 time increase)
-Prone positioning (the best position to perform breast MRI) .



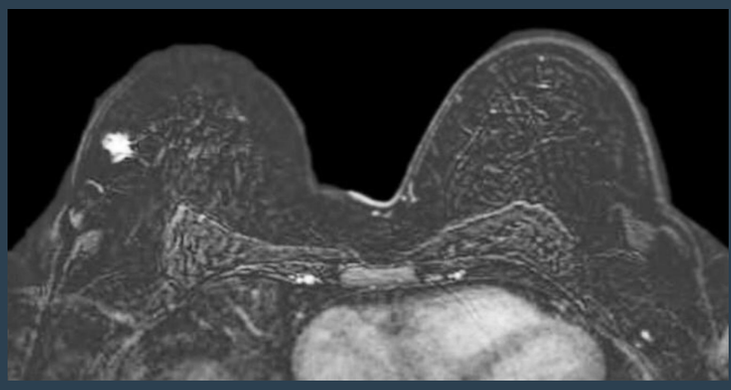
❖ **Indications:**
- Staging, adherence to nipple, surrounding parenchyma. Extension of the disease
- High risk patients, family Hx (mothers or sisters)BRCA1 and BRCA2.
- Monitoring response to therapy.
- Post operative to differentiate surgical scar versus recurrence.
- Occult breast cancer.
- Assess the contralateral breast.
- Breast implant (Silicon) patient with breast implant complains we do MRI .

❖ **Contraindicated in :**

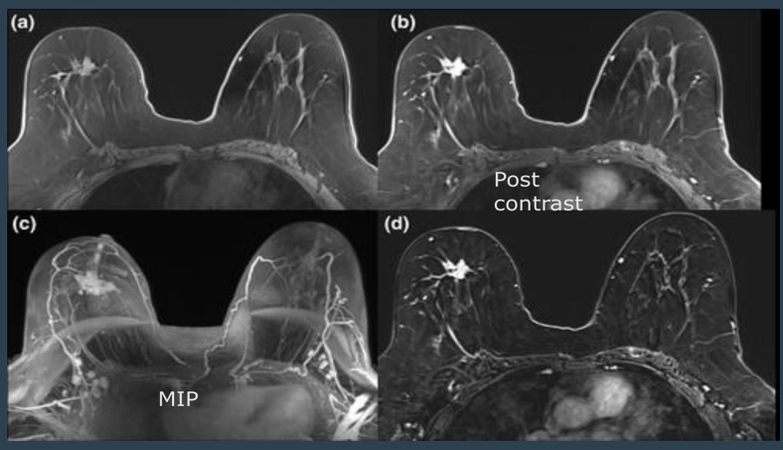
- Claustrophobia
- Cardiac pacemaker or any metal prosthesis



Static Imaging
STIR (Short tau inversion recovery)



Subtraction images in MRI



Different phases and post processing

Breast MRI

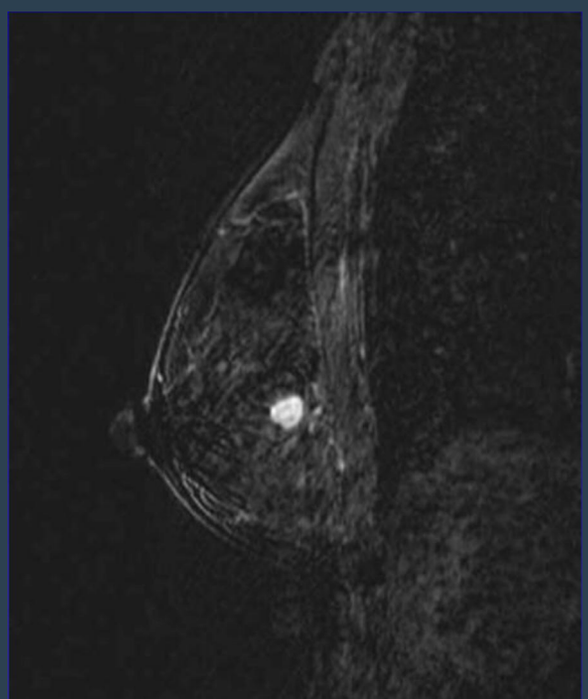
MRI Cont :

High resolution Imaging :

Flash 3D Vibe

Flash 3D HR

Dynamic Imaging :



Post contrast with fat-suppression

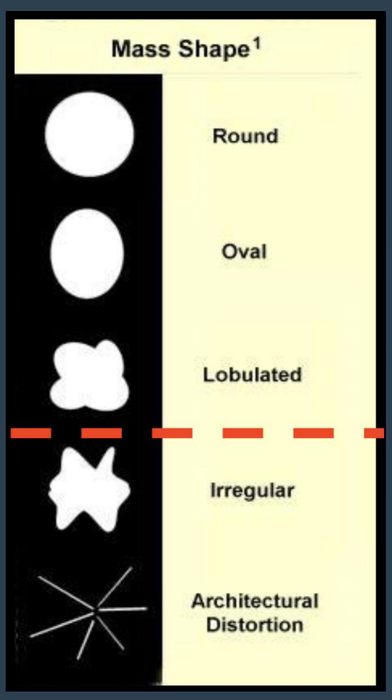
Flash 3D HR

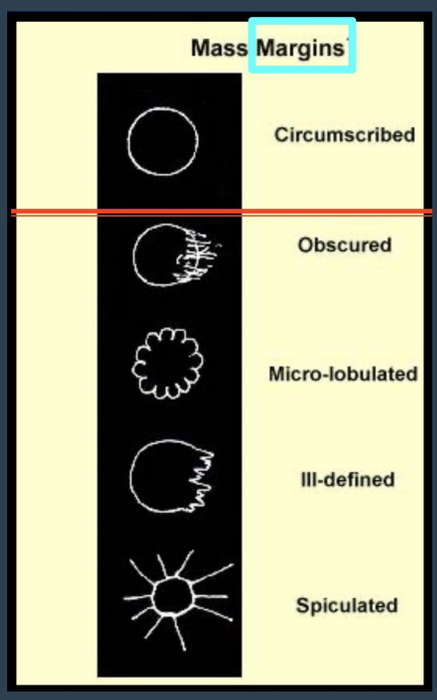
Breast malignancy

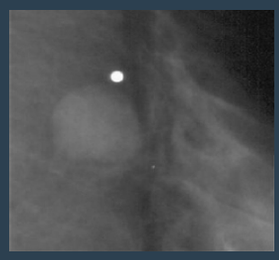
1- Mass | In the search of malignancy | 2- Calcifications

Mass :

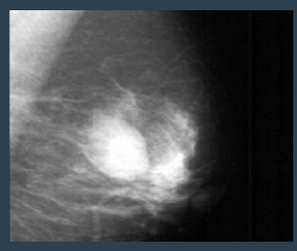
Characters of masses



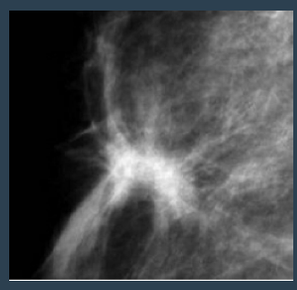




Rounded



Oval



Irregular (suspicious) more with aggressive mass

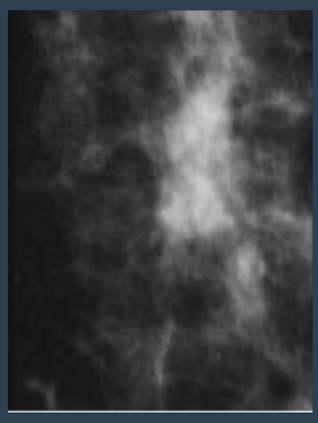
Margins

❖ **Most important character .**
❖ If margins are obscured by breast tissues ——> Compression / magnification views

What's the most important character to differentiate between benign and malignant?
Margins

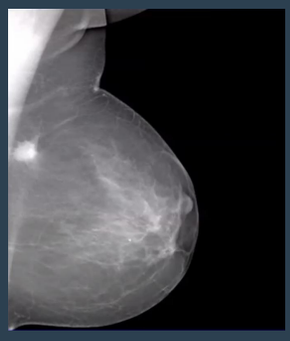
Spiculated margins	Well circumscribed (well-defined) margins
❖ **Classical carcinoma** ❖ **More common in :** invasive>tubular >lobular ❖ **DDx :** - Fat necrosis (previous surgical biopsy) - Scars (previous surgery) - Radio-opaque mark - Previous scar - Any increase in size —> biopsy - Radial scar (complex sclerosing lesions)	❖ **Almost always benign .** ❖ 5% of them may be malignant . ❖ **ultrasound :** **Cyst** —> No further assessment . **Solid** —> Compression / magnification views : - Microlobulated —> Biopsy - Well Circumscribed —> F/U

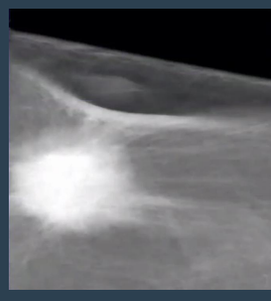
Spiculated margins



Spiculated mass
invasive ductal carcinoma

Spiculated Margins

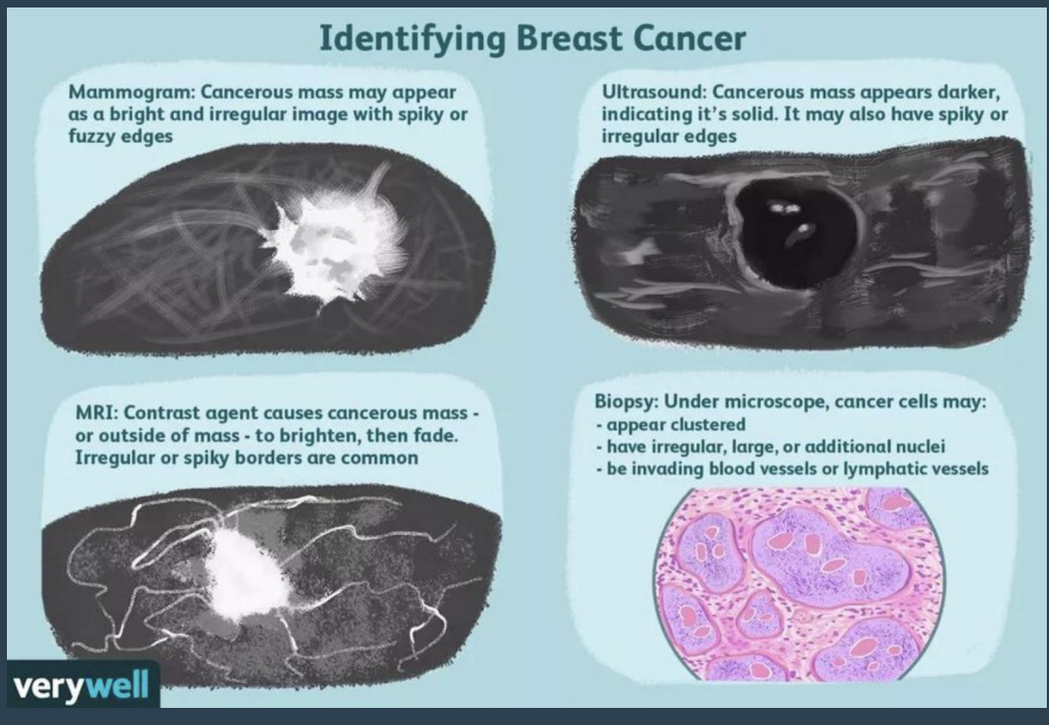




Spiculated Margins:
DD:
FAT necrosis (previous surgical biopsy) SCARS (previous surgery)

- Radio-opaque mark
- Previous scar
- Any increase in size----> biopsy

RADIAL SCAR (complex sclerosing lesions)



Well circumscribed

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

US

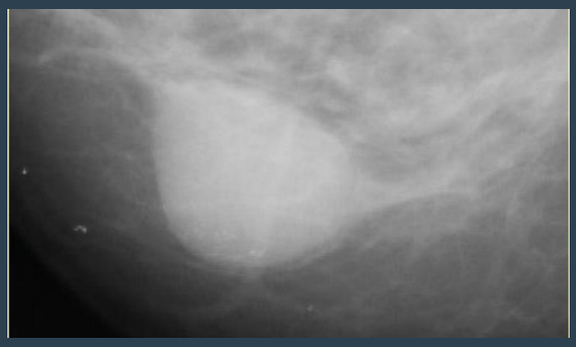
Cyst

Solid

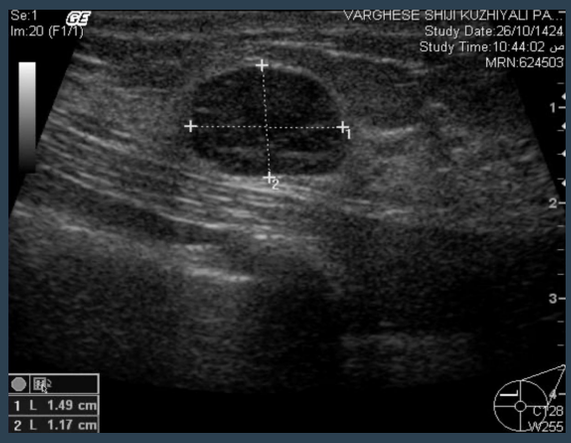
No further assessment

Microlobulated Biopsy

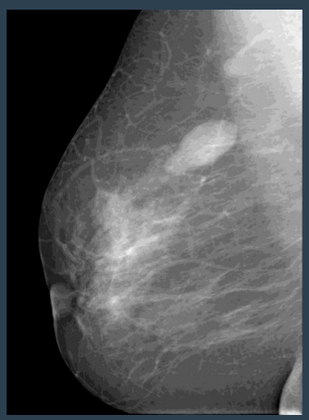
Well circumscribed F/U

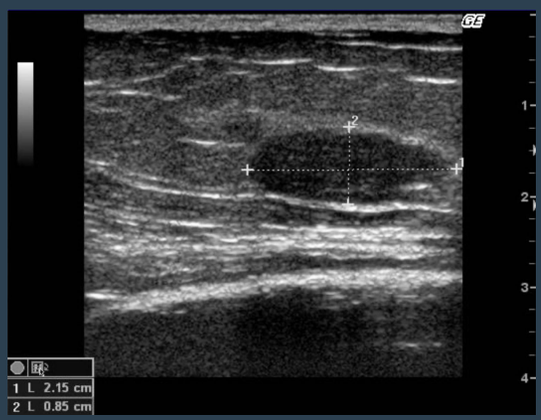


Oval well circumscribed

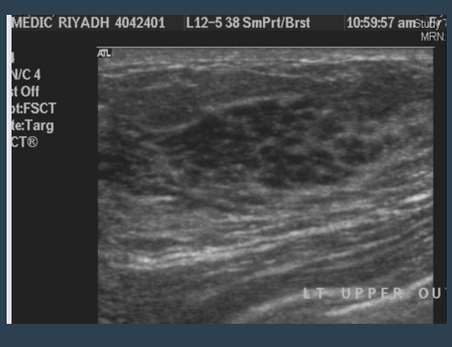


Large Fibroadenoma (benign)





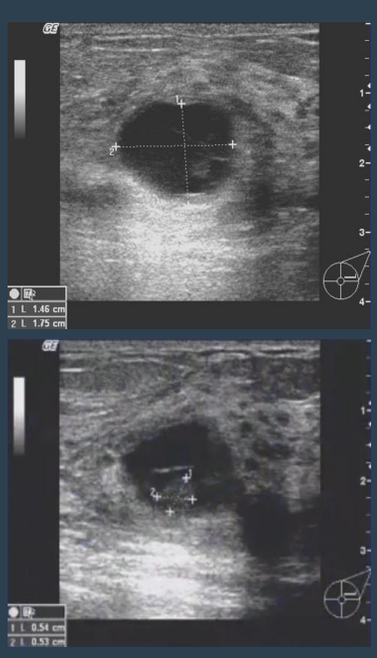
Fibroadenoma (benign)

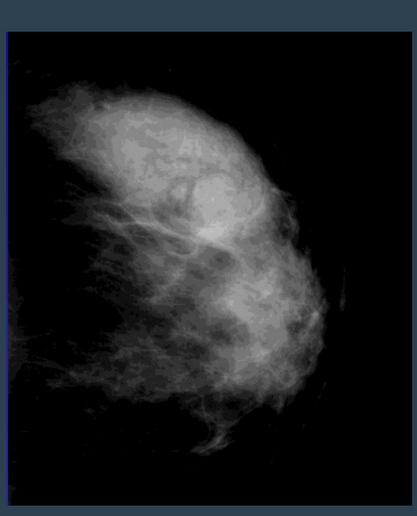


Hamartoma (Fibroadenolipoma)

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

Cysts





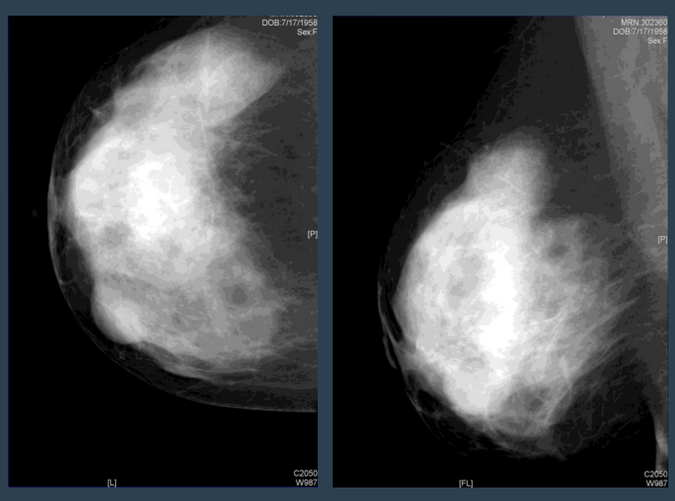
Hemorrhagic cyst in dense breast

Density categories :

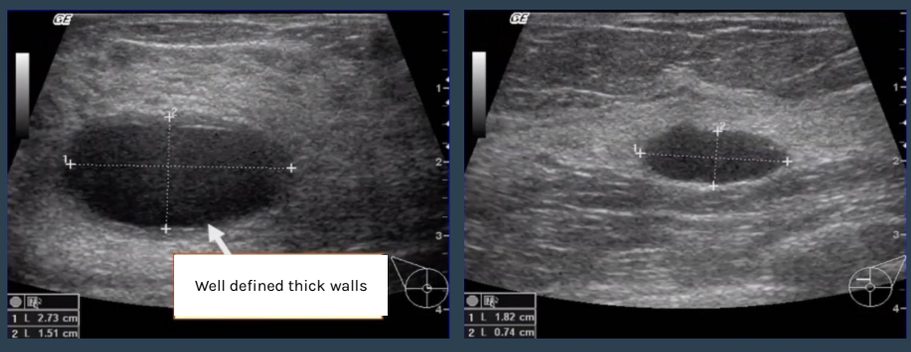
High Density	Clearly higher than surrounding , suspicious .
Equal Density	Density not appreciably different, neutral significance .
Low Density	Density lower, but not fat containing , neutral significance .

Number of masses :

- Multiple well defined masses are probably **benign** .
- Multiple primary malignant lesions are obviously **ill defined** or **stellate lesions** .
- **Benign and malignant lesions CAN coexist !!**



Complicated cysts mammography



Complicated cysts US

Calcifications

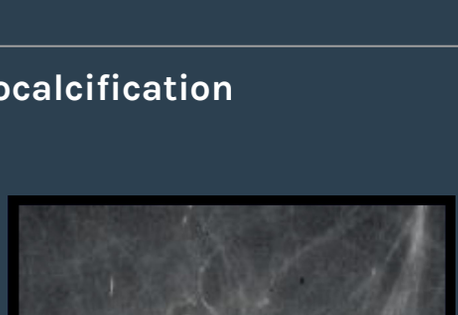
Calcifications

Size	Number	Morphology
❖ **Micro calcifications :** are associated with a malignant process . ❖ **Macro calcifications :** are 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 .	❖ 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 .	❖ **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 .

Malignant Microcalcification

❖ Clustered : > 5 in 1 cm_2

❖ Branching interrupted ill-defined ductal .



Breast Imaging Reporting system And Data System

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

- Typically benign ;
- Intermediate concern ; and
- Higher probability of malignancy .

0	**Incomplete**	Additional imaging/ view required
1	**Negative**	Routine screening recommended
2	**Benign**	Routine screening recommended
3	**Probably benign**	(<2% malignant) 6 month short interval follow up
4	**Suspicious of Malignancy**	(>= 2% to 95% malignant) Biopsy should be considered
5	**Highly suspicious of Malignancy**	(>95% malignancy) Take appropriate action
6	**Known Biopsy proven Malignancy**	Malignancy

Summary

4 Pillars for Diagnosis of breast cancer :

Clinical or Self Examination (PE)	Mammography (MG)	Ultrasound (US)	Magnetic Resonance Imaging (MRI)
	• Can rule IN cancer, but can not rule it OUT . • Not useful for dense breasts (< 30 y/o)	• **Indications :** • 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 (**very dense breast**) . • Interventional procedures (**BIOPSY**) . • Identification of Malignant Features	- 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) **Contraindicated in :** - Claustrophobia - Cardiac pacemaker or any metal prosthesis

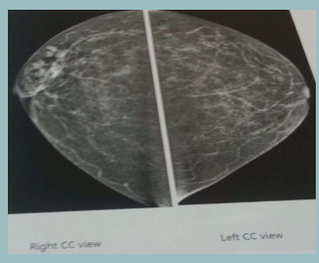
In searching for Breast malignancies :

Mass : Margins is most imp character		Calcification
Spiculated margins	**Well circumscribed (well-defined) margins**	**Morphology is most important indicator in differentiating Benign vs malignant lesions**
Classical carcinoma ❖ **DDx :** - Fat necrosis (previous surgical biopsy) - Scars (previous surgery) - Radio-opaque mark - Previous scar - Any increase in size —> biopsy - Radial scar (complex sclerosing lesions)	❖ **Almost always benign .** ❖ 5% of them may be malignant . ❖ **ultrasound :** **Cyst** —> No further assessment . **Solid** —> Compression / magnification views : - Microlobulated —> Biopsy - Well Circumscribed —> F/U	❖ 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 .

quiz

1-The abnormality seen in the shown mammogram is consistent with which ONE of the following?

A- Lipoma
B- Hamartoma
C- Spiculated mass
D- Intra-mammary lymph node



2-What's the most important character to differentiate between benign and malignant breast tumor ?

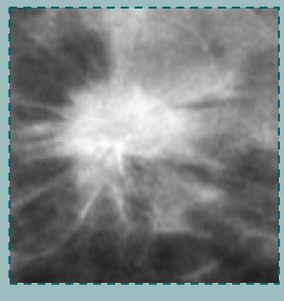
A- Density
B- Margins
C- Shape
D- Location

3-What is the best modality of breast imaging used for staging ?

A- MRI
B- Ultrasound
C- Mammogram
D- CT scan

4- **describe the picture seen below :**

a. Circumscribed marigin - benign
b. Indistinct - intermediate probability of malignancy
c. Spiculated - benign
d. Spiculated- high probability of malignancy



5- from which of the following most breast cancer develop ?

a. terminal ductal lobular unit
b. Adipose tissue
c. Areola
d. Lobules

6- which of the following calcification character is considered benign lesion ?

a. Irregular
b. Micro calcification
c. Broken glass fragment
d. Round, oval

Answers
1)B
2)B
3)A
4)D
5)A
6)D