Radiology of the Breast

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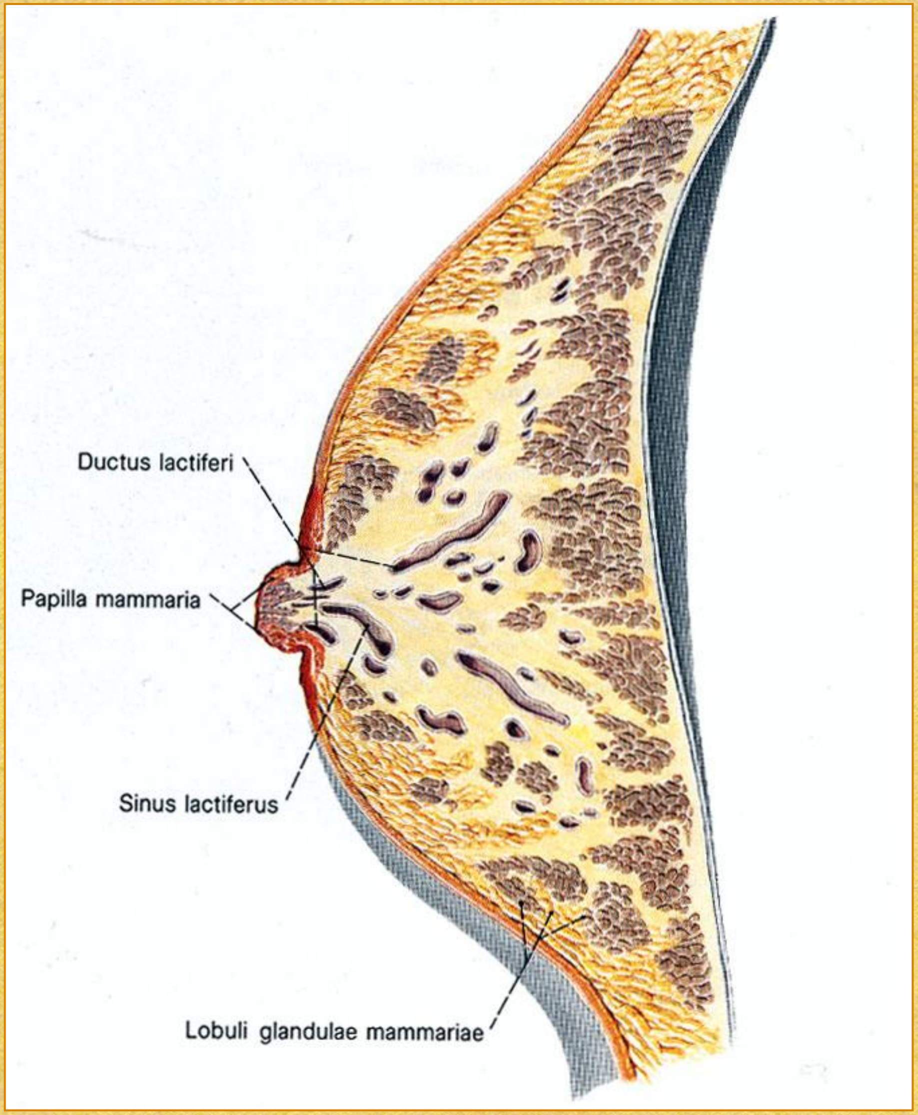
2014./2015.


Ductus lactiferi
Papilla mammaria
Sinus lactiferus
Lobuli glandulae mammariae

The primary purpose of breast imaging is to detect breast carcinoma.

A secondary purpose is to evaluate benign disease, such as cyst formation, infection, implant complication, and trauma.

- **The diagnosis of breast cancer is used**
  - **Clinical exam (status)**
  - **Imaging methods**
  - **Tissue analysis**

There is different degree of sensitivity, specificity and diagnostic accuracy of different methods of imaging

- **Most important imaging methods: mammography, ultrasound, magnetic resonance**

Mammography

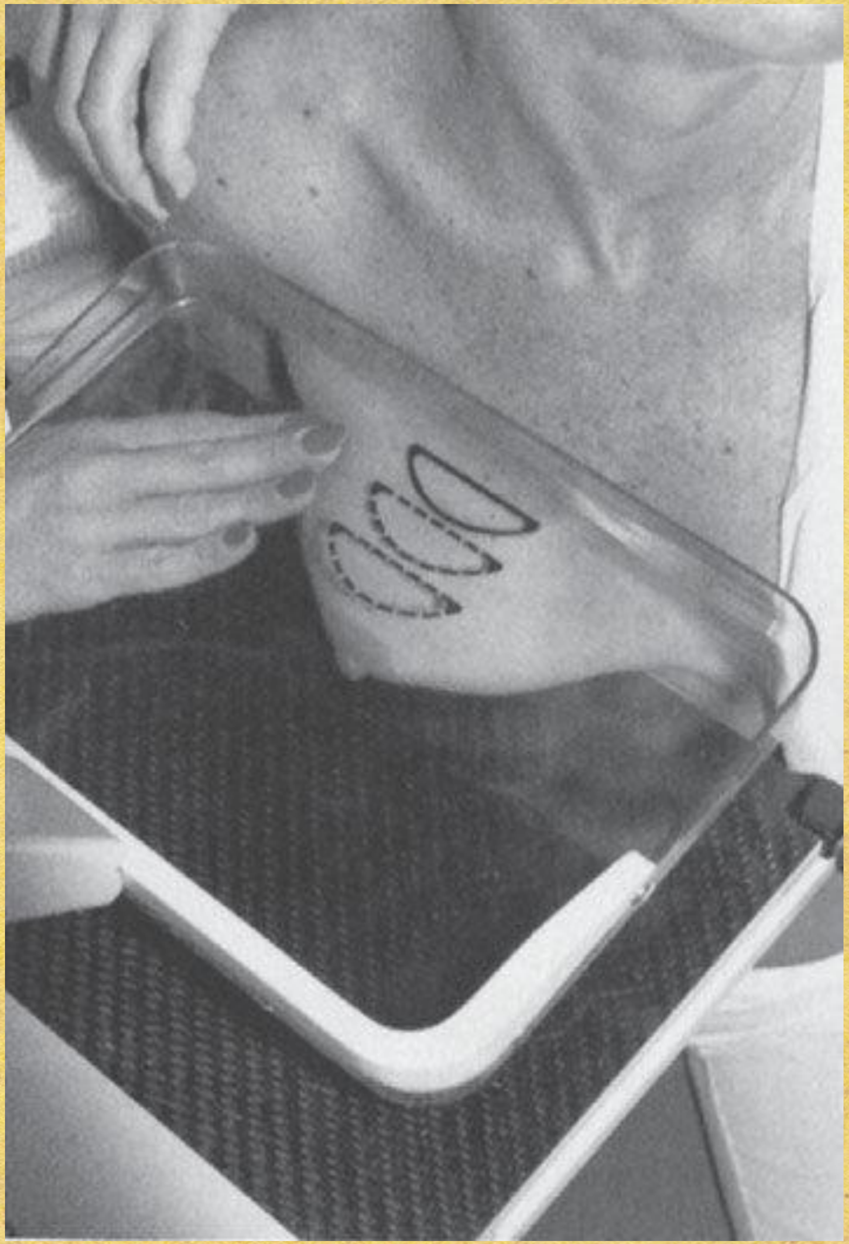
- has been in common use since about 1980
- the film-screen mammogram is created with x-rays, radiographic film, and intensifying screens adjacent to the film within the cassette
- the digital mammogram is created using a similar system, but replacing the film and screen with a digital detector.

Mammography

- the routine examination consists of two views of each breast, the craniocaudal (C-C) view and the mediolateral oblique (MLO) view, with a total of four films
- The C-C view can be considered the “top-down” view, and the MLO an angled view from the side

Mammography

- the patient undresses from the waist up and stands for the examination, leaning slightly against the mammography unit
- the technologist must mobilize, elevate, and pull the breast to place as much breast tissue as possible on the surface of the film cassette holder



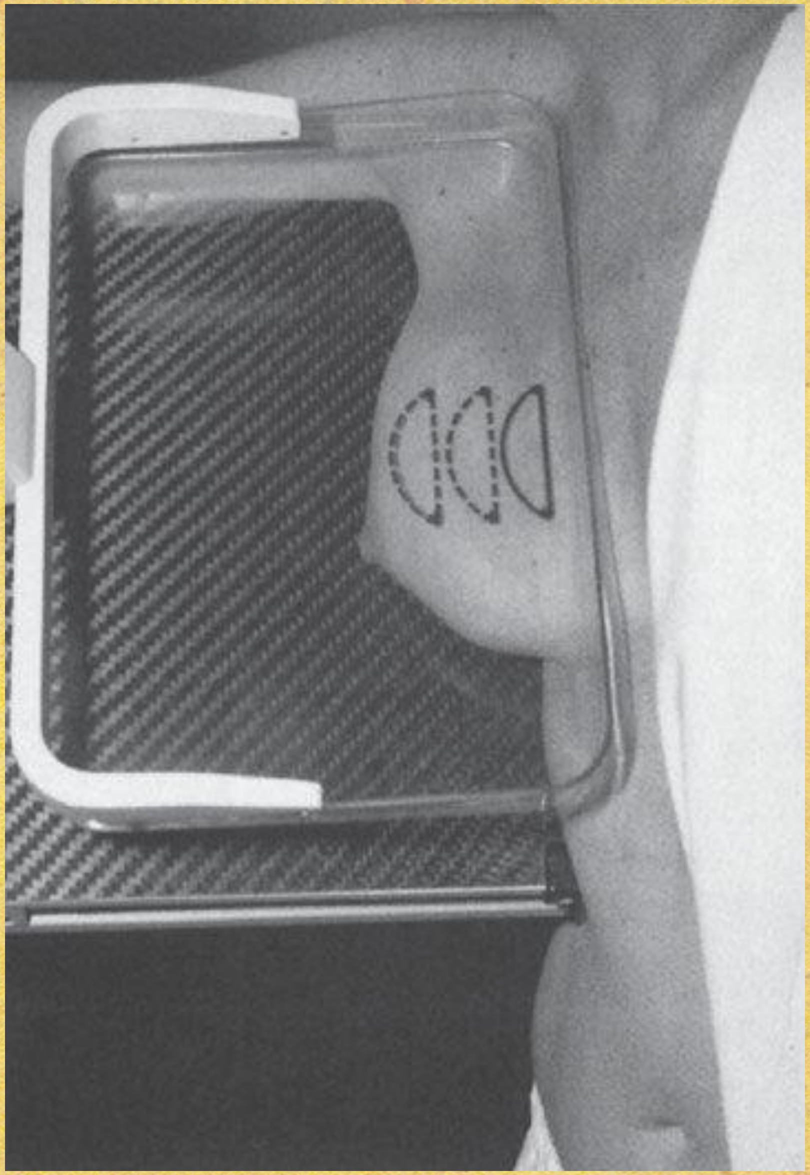
(C-C) view

Mammography

- A flat, plastic compression paddle is then gently but firmly lowered onto the breast surface to compress the breast into as thin a layer as possible.

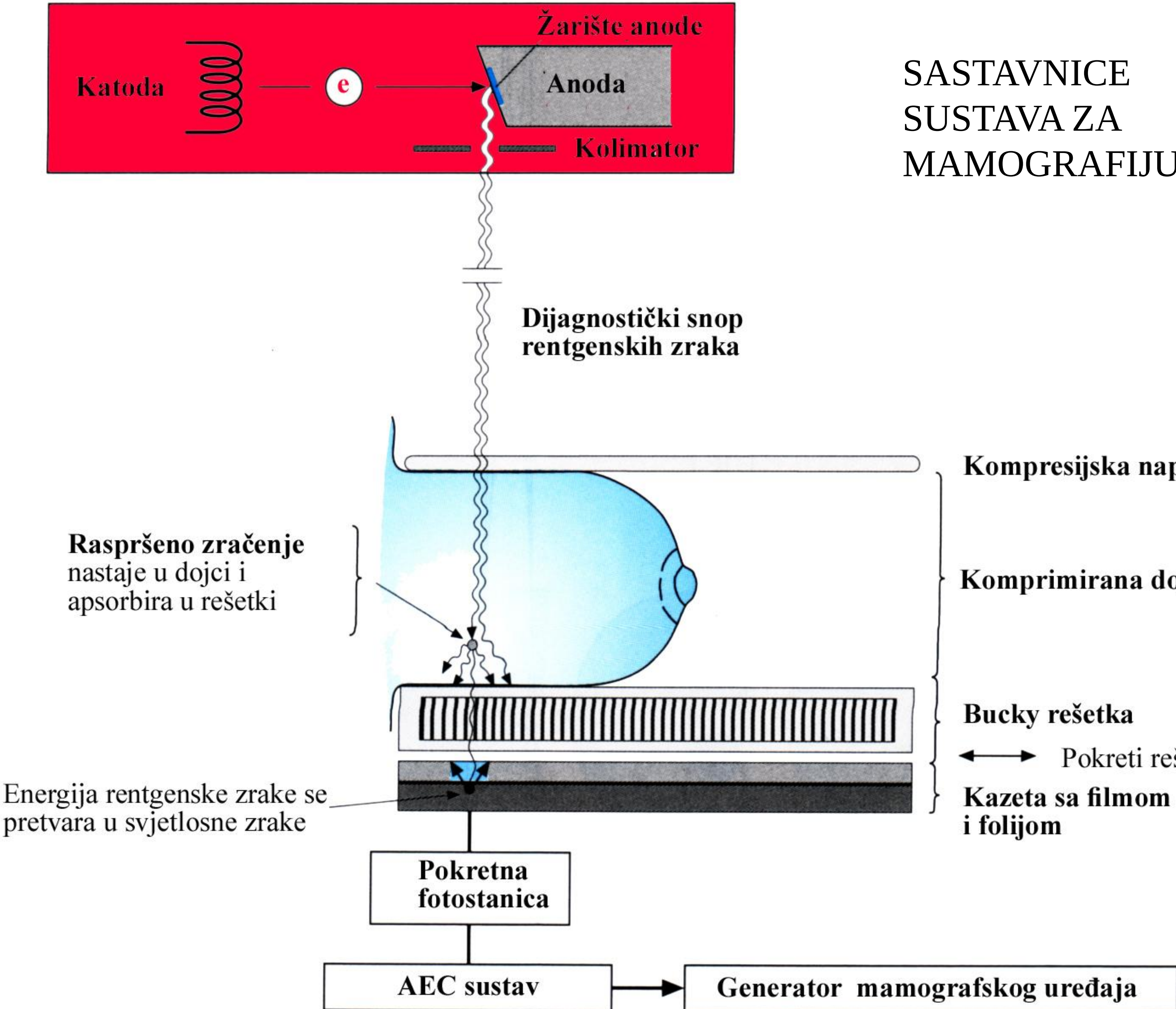
- This compression achieves both immobilization during exposure and dispersion of breast tissue shadows over a larger area, thereby permitting better visual separation of imaged structures.

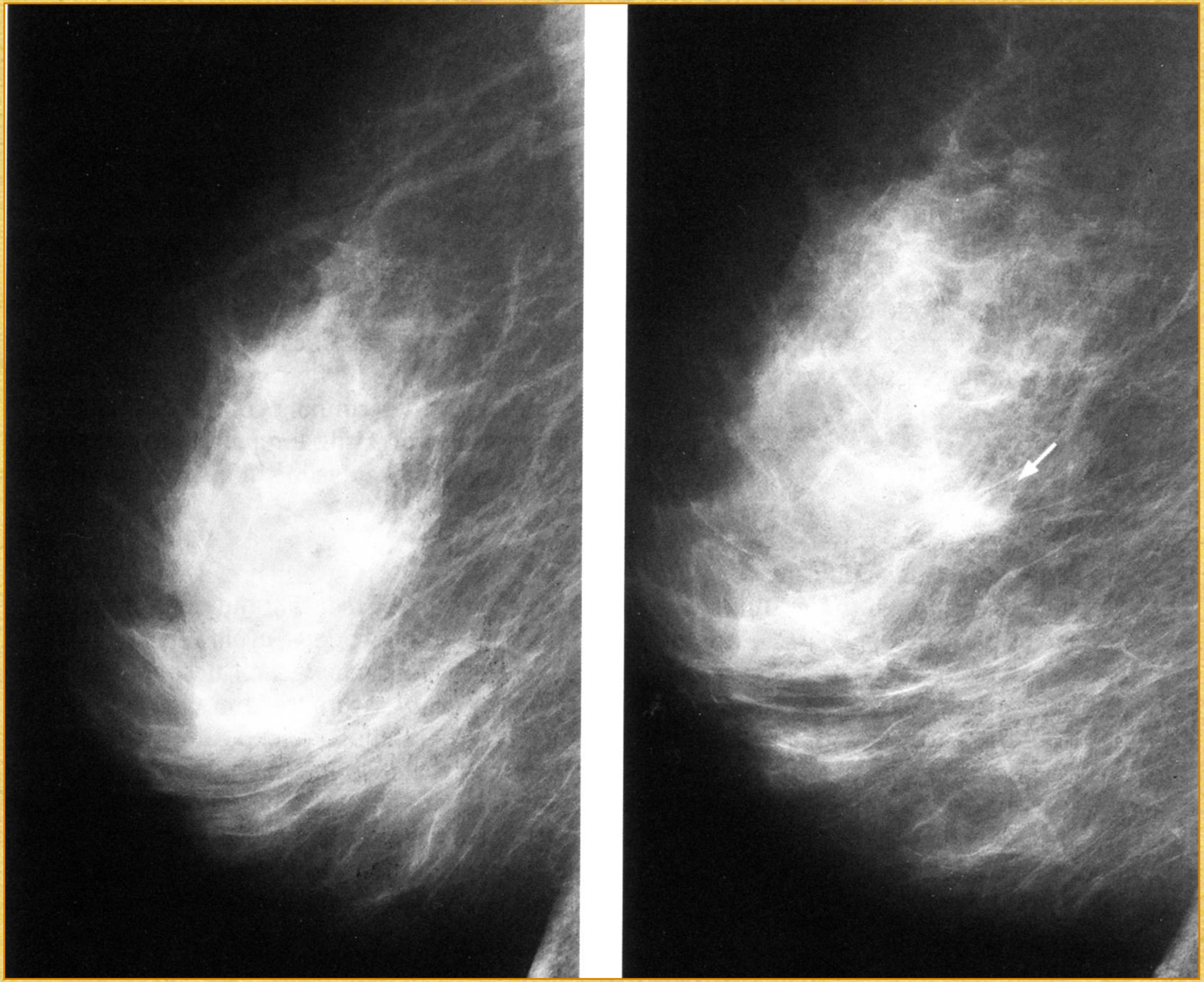
- Compression may be uncomfortable, and painful



MLO view

SASTAVNICE SUSTAVA ZA MAMOGRAFIJU





Importance of breast compression

Mammography

- has proved to be more cost-effective, while maintaining resolution high enough to demonstrate early malignant lesions, than any other breast imaging technique.

- the sensitivity of adiomammography ranges from 85% to 95%.

Mammography

Limitations

Sensitivity is limited by three factors:

(1) the nature of breast parenchyma

(2) the difficulty in positioning the organ for imaging

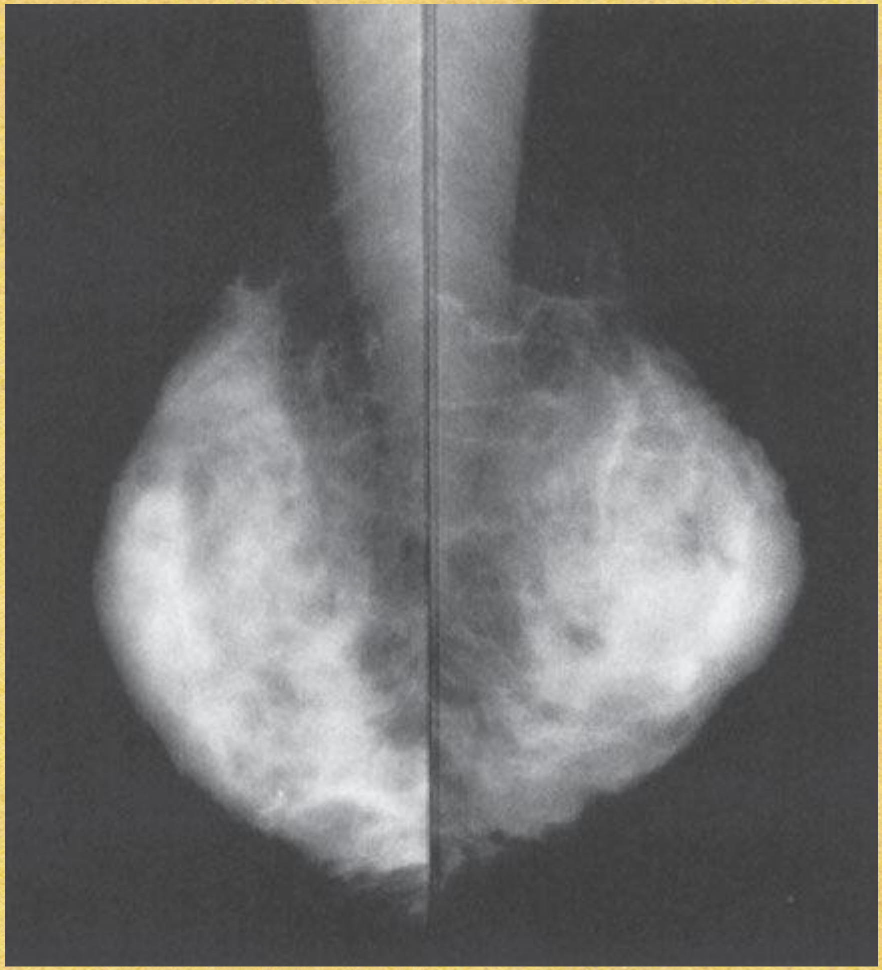
(3) the nature of breast carcinoma

Mammography

Limitations

The Nature of Breast Parenchyma

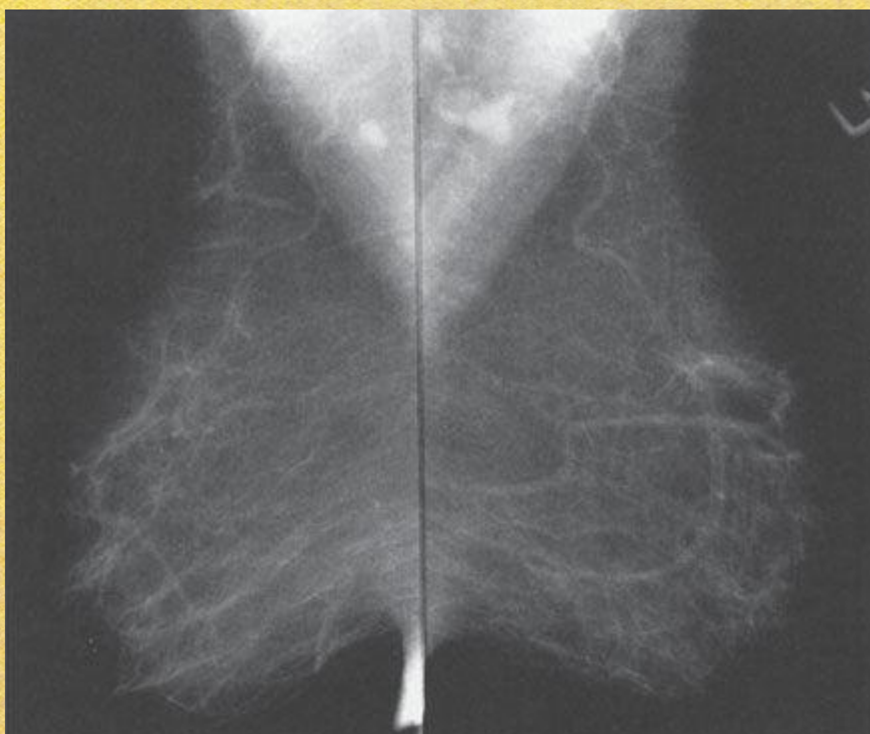
- very dense breast tissue may obscure masses lying within adjacent tissue. Masses are more easily detected in a fatty breast.

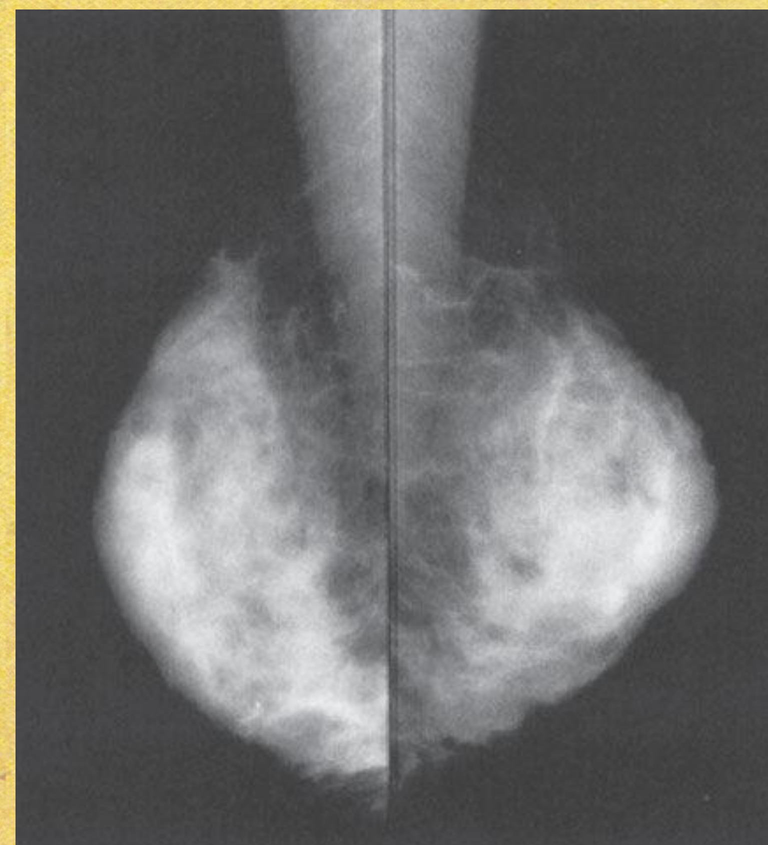


Mammography

Limitations

The Nature of Breast Parenchyma





Mammography

Limitations

Positioning

- must include as much breast tissue as possible in the field of view for each image
- this requires both a cooperative patient and a skilled technologistt
- if a breast mass is located in a portion of the breast that is difficult to include in the image, mammography may fail to demonstrate the lesion

Mammography

Limitations

The Nature of Breast Carcinoma

- some breast carcinomas are seen as well-defined rounded masses or as tiny, but bright, calcifications, and are easily detected
- may be poorly defined and irregular, mimicking normal breast tissue
- rarely, still others may have no radiographic signs at all

Mammography

Limitations

it must be remembered that mammography has significant limitations in detection of carcinom

it cannot be overemphasized that any suspicious finding on breast physical examination should be evaluated further, even if the mammogram shows no abnormality

Mammography

Normal Structures

Normal breast is composed mainly of parenchyma (lobules and ducts), connective tissue, and fat

Lobules are drained by ducts, which arborize within lobes. There are about 15 to 20 lobes in the breast. The lobar ducts converge upon the nipple

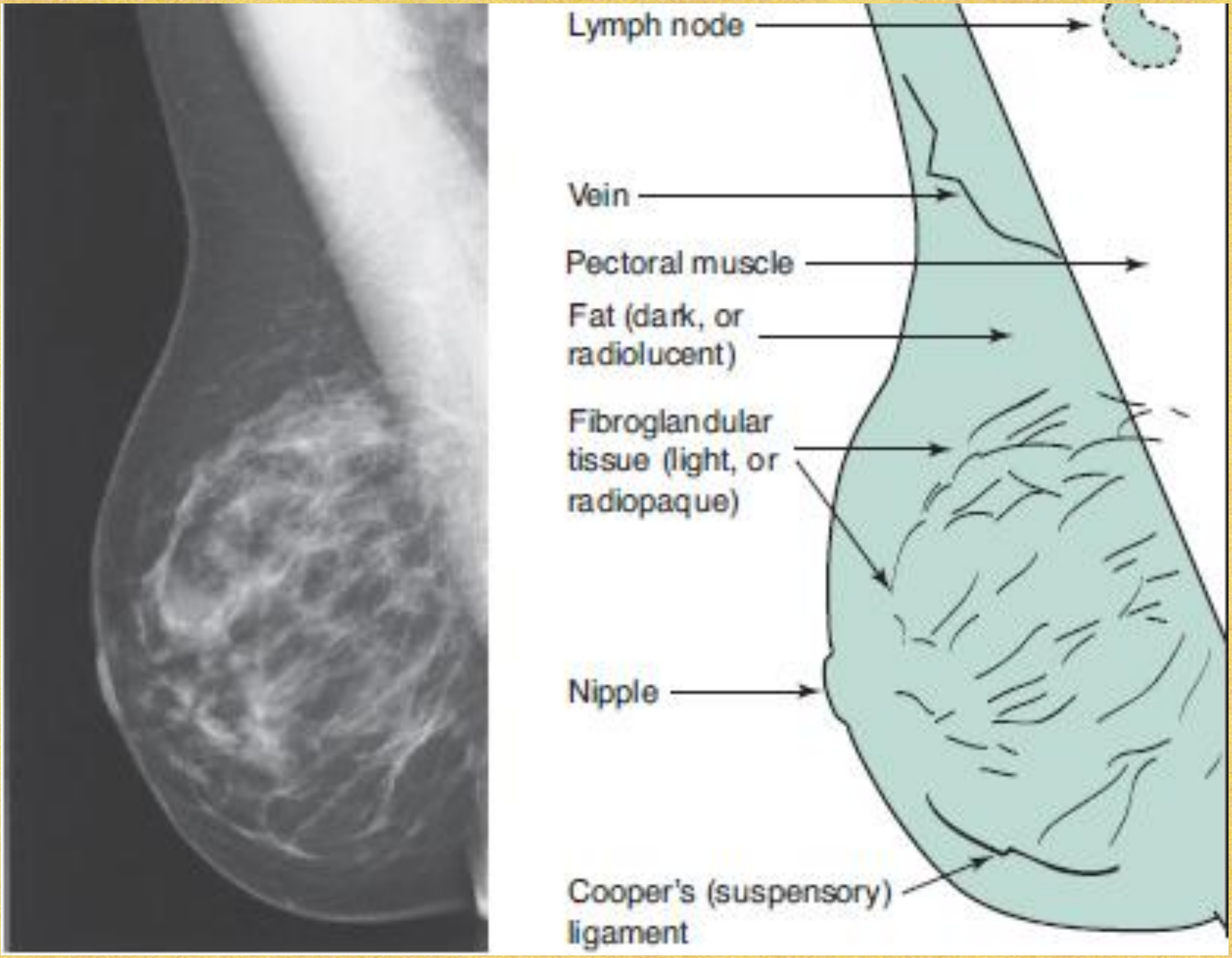
Mammography

Normal Structures

Parenchyma

The lobules are glandular units and are seen as ill-defined, splotchy opacities of medium density. Their size varies from 1 to several millimeters, and larger opacities result from conglomerates of lobules with little interspersed fat.

The amount and distribution of glandular tissue are highly variable. Younger women tend to have more glandular do older women


Lymph node
Vein
Pectoral muscle
Fat (dark, or radiolucent)
Fibroglandular tissue (light, or radiopaque)
Nipple
Cooper's (suspensory) ligament

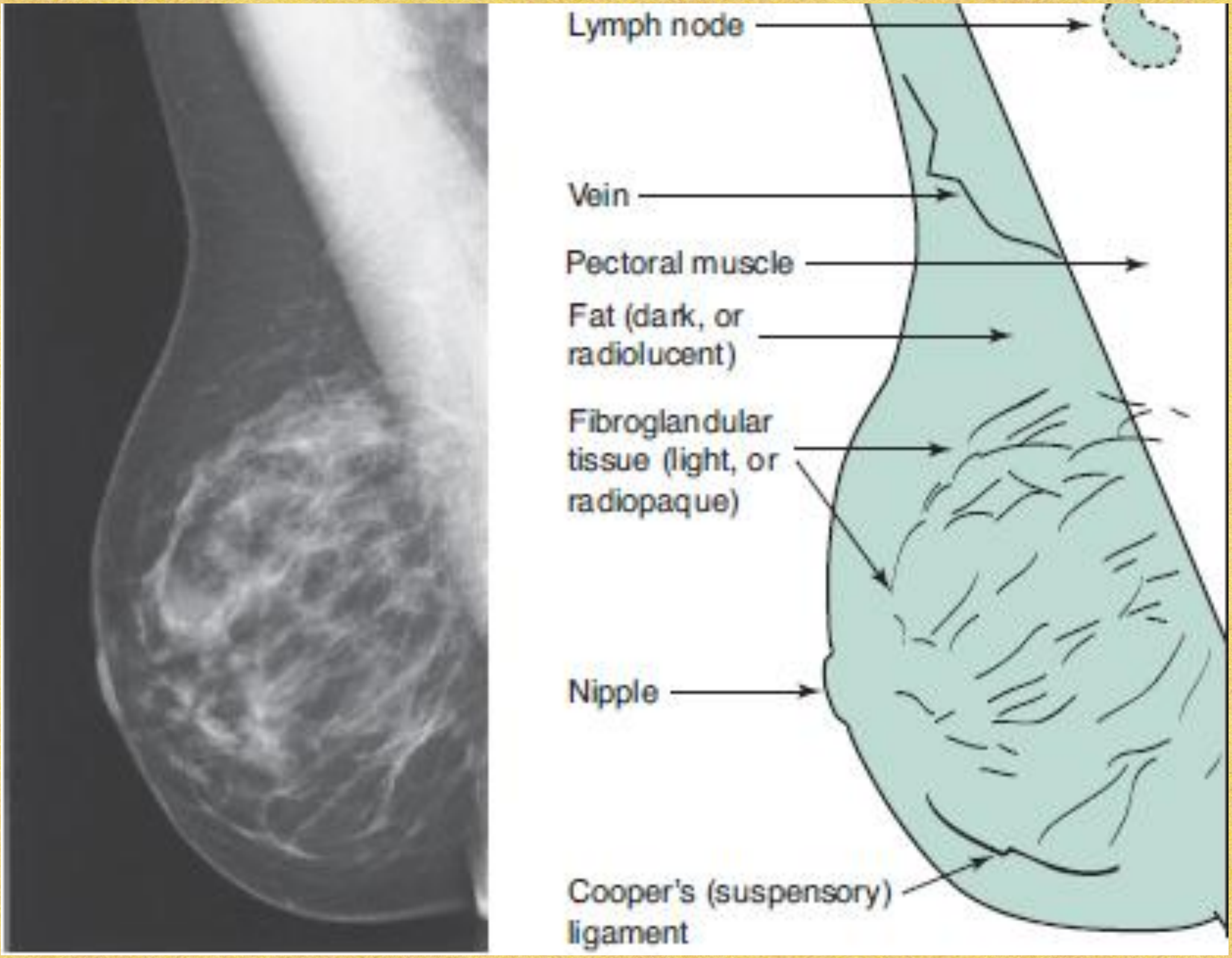
Mammography

Normal Structures

Connective Tissue

Trabecular structures, which are condensations of connective tissue, appear as thin (1 mm) linear opacities of medium to high density.

Cooper’s ligaments are the supporting trabeculae over the breast that give the organ its characteristic shape, and are thus seen as curved lines around fat lobules along the skin-parenchyma interface within any one breast


Lymph node
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Fibroglandular tissue (light, or radiopaque)
Nipple
Cooper's (suspensory) ligament

Mammography

Normal Structures

Fat

The breast is composed of a large amount of fat, which is lucent, or almost black, on mammograms. Fat is distributed in the subcutaneous layer, in among the parenchymal elements centrally, and in the retromammary layer anterior to the pectoral Muscle

Lymph Nodes

Lymph nodes are seen in the axillae and occasionally in the breast itself

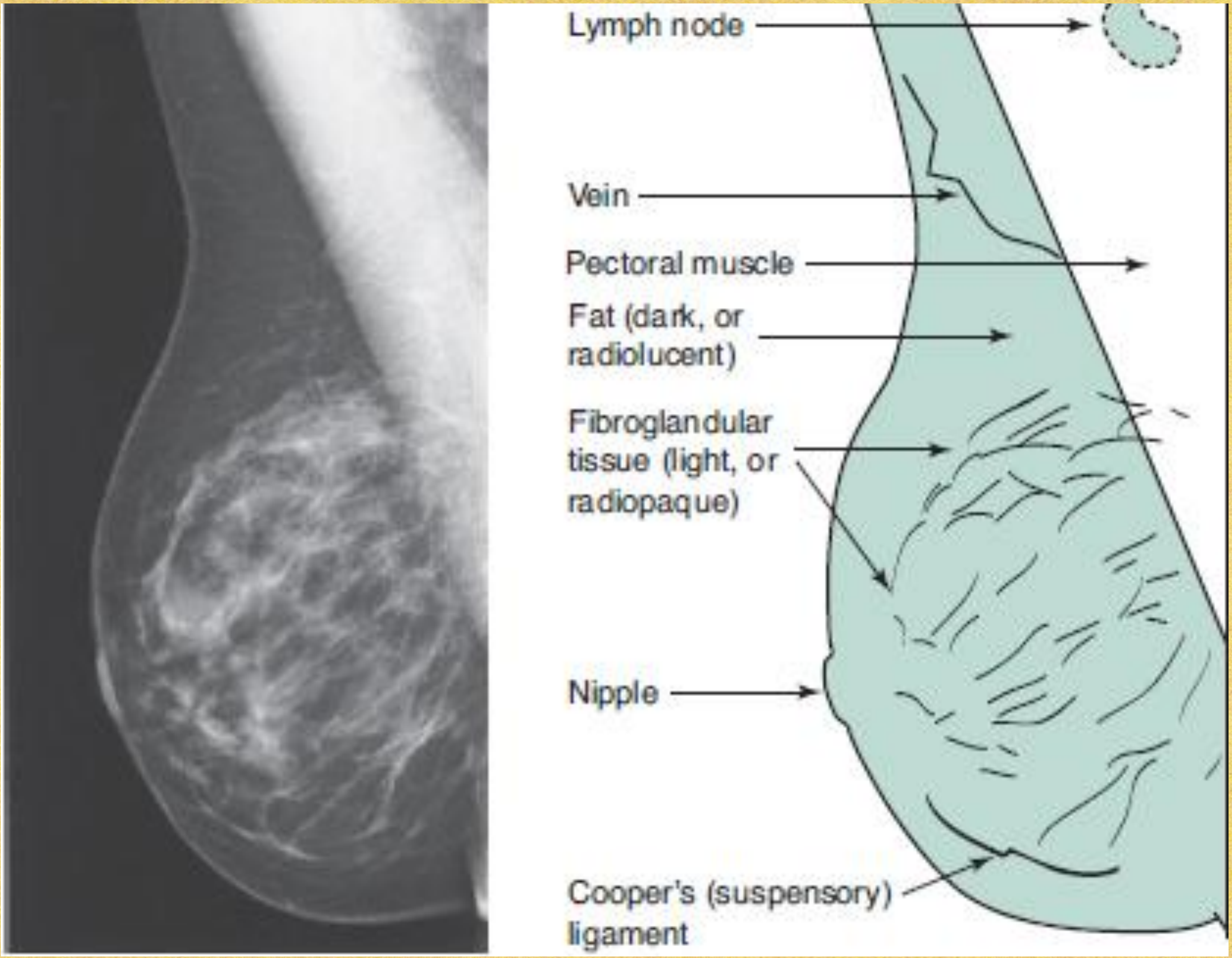
Mammography

Normal Structures

Veins
Veins are seen traversing the breast as uniform, linear opacities, about 1 to 5 mm in diameter (Figure 5-4).

Arteries
Arteries appear as slightly thinner, uniform, linear densities and are best seen when calcified, as in patients with atherosclerosis, diabetes, or renal disease.

Skin
Skin lines are normally thin and are not easily seen without the aid of a bright light for film-screen mammograms


Lymph node
Vein
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Fat (dark, or radiolucent)
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Nipple
Cooper's (suspensory) ligament

Mammography

Screening Mammography

The indication for this examination is the search for occult carcinoma in an asymptomatic patient.

Physical examination by the patient’s physician, known as the clinical breast examination (CBE), is an indispensable element in complete breast screening.

Although the American Cancer Society no longer recommends routine breast self-examination (BSE), particular attention should be paid to lumps identified by the patient as new or enlarging. Such patients should be referred for diagnostic mammography

American Cancer Society Recommendations for Breast Cancer Detection in Asymptomatic Women

Age group	Examination	Frequency
20 to 39	Breast self-examination Clinical breast examination	Optional Every 3 years
40 and older	Breast self-examination Clinical breast examination Mammography	Optional Annual Annual
High risk (>20% lifetime risk)	MRI	Annual
Moderate risk (15% to 20%)	MRI	Talk with doctor about possible annual examinations
Risk<15%	MRI	Not recommended

Mammography

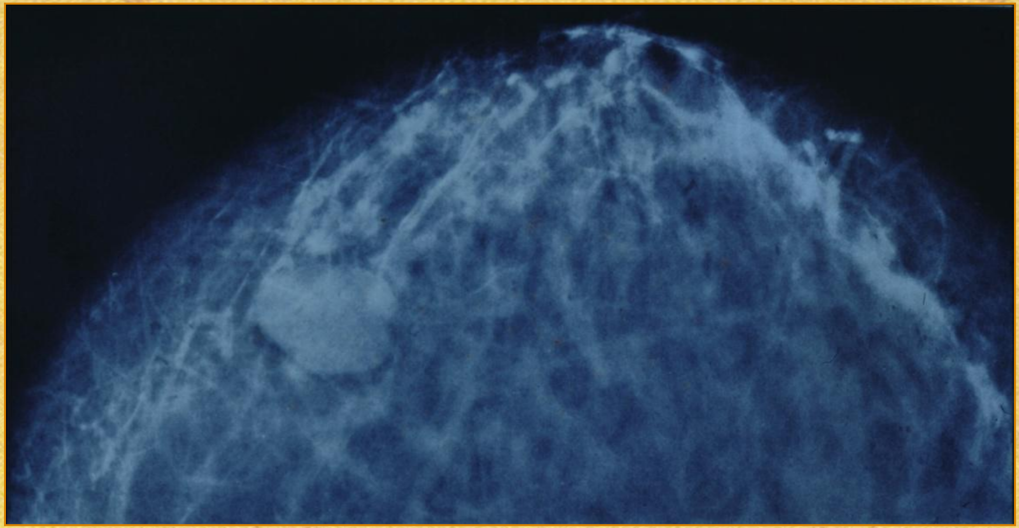
Diagnostic Mammography

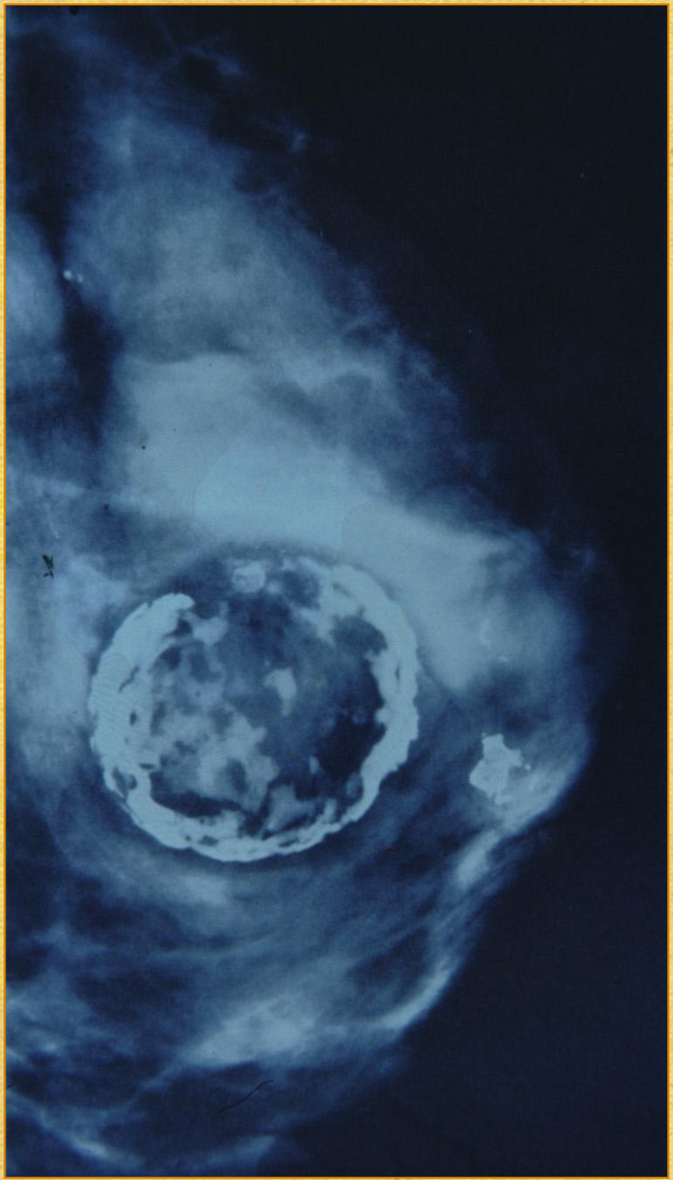
The diagnostic mammogram begins with the two-view standard mammogram.

Indications for diagnostic mammography are:
(1) a palpable mass or other symptom or sign (eg, nipple retraction, or nipple discharge that is clear or bloody),

(2) a radiographic abnormality on a screening mammogram. Other projections, magnification, and spot compression may be used to further evaluate abnormalities.

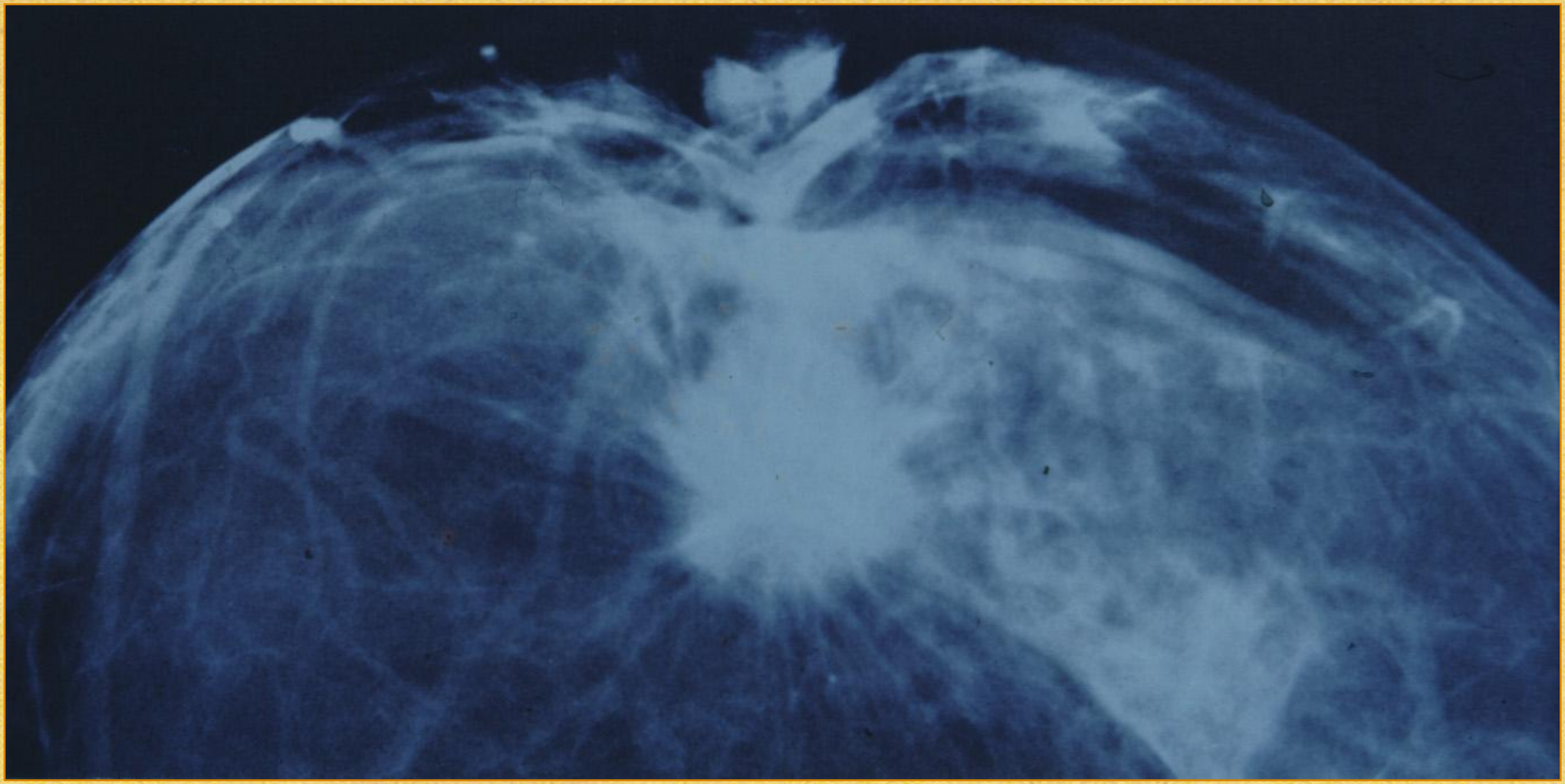
Multiple breast cysts



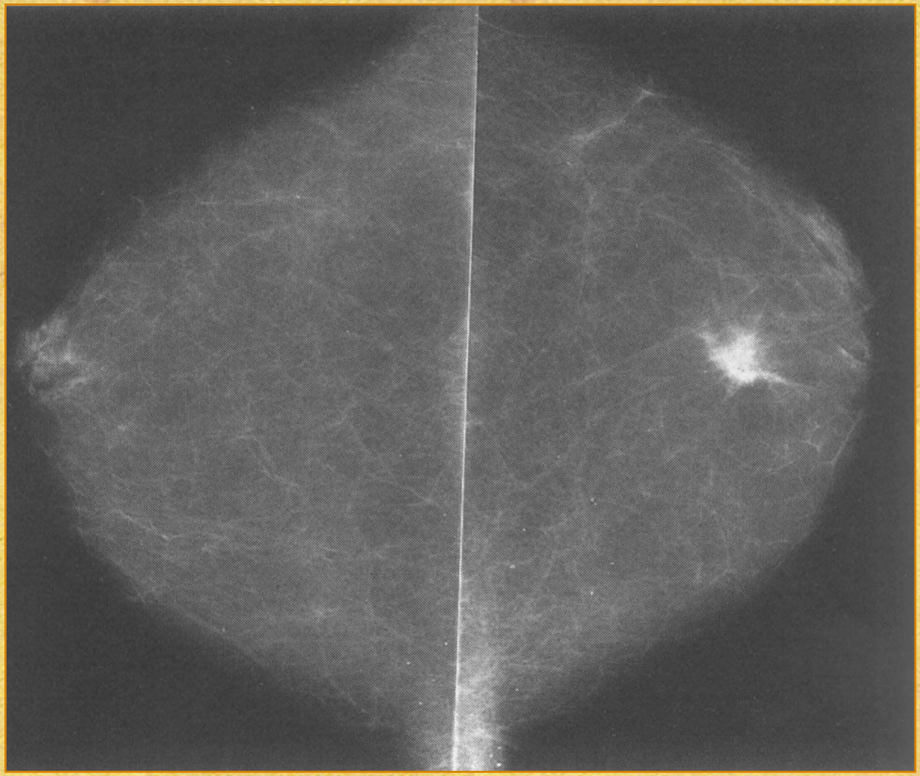


Fibroadenoma

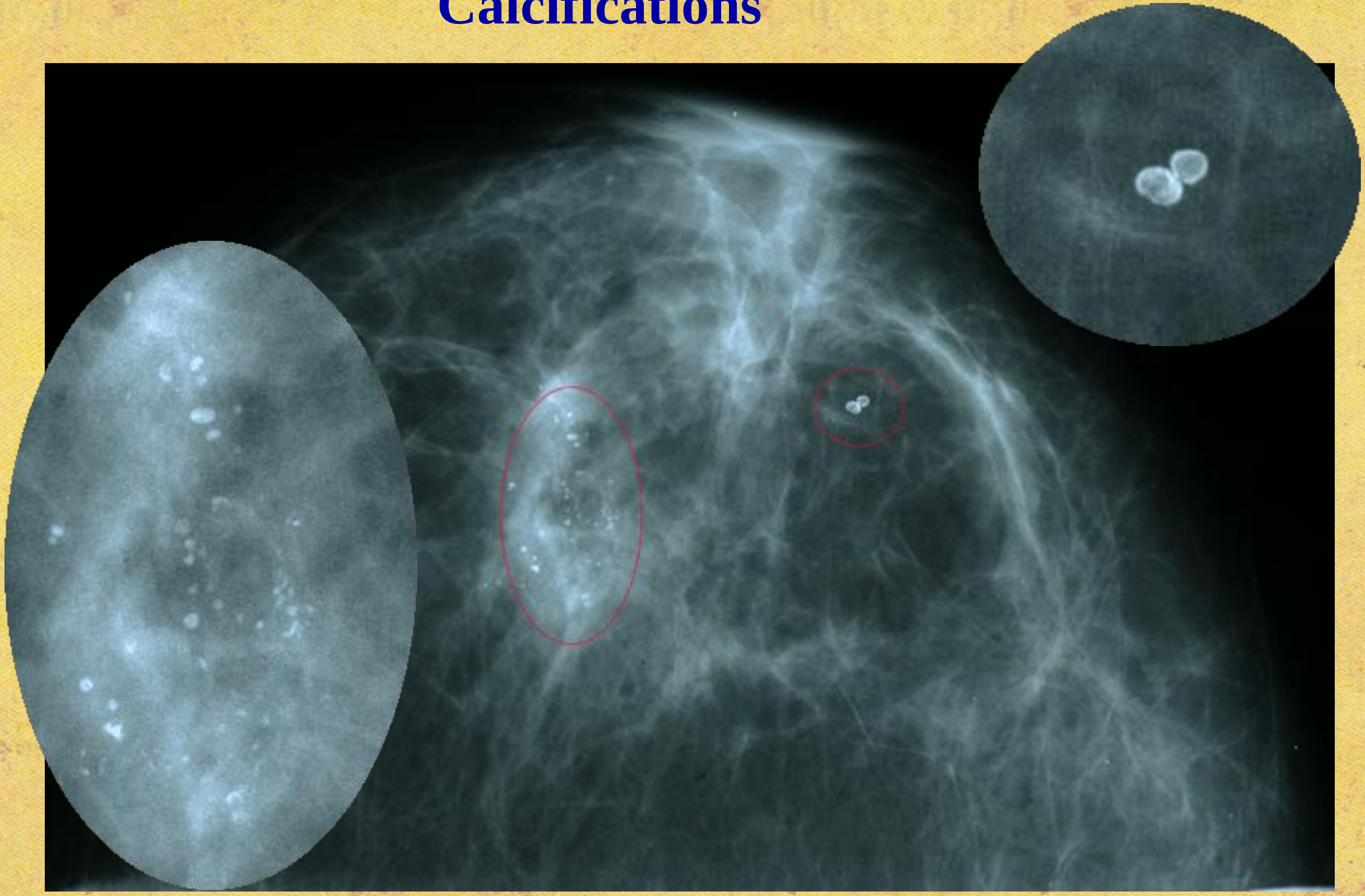
Breast carcinoma

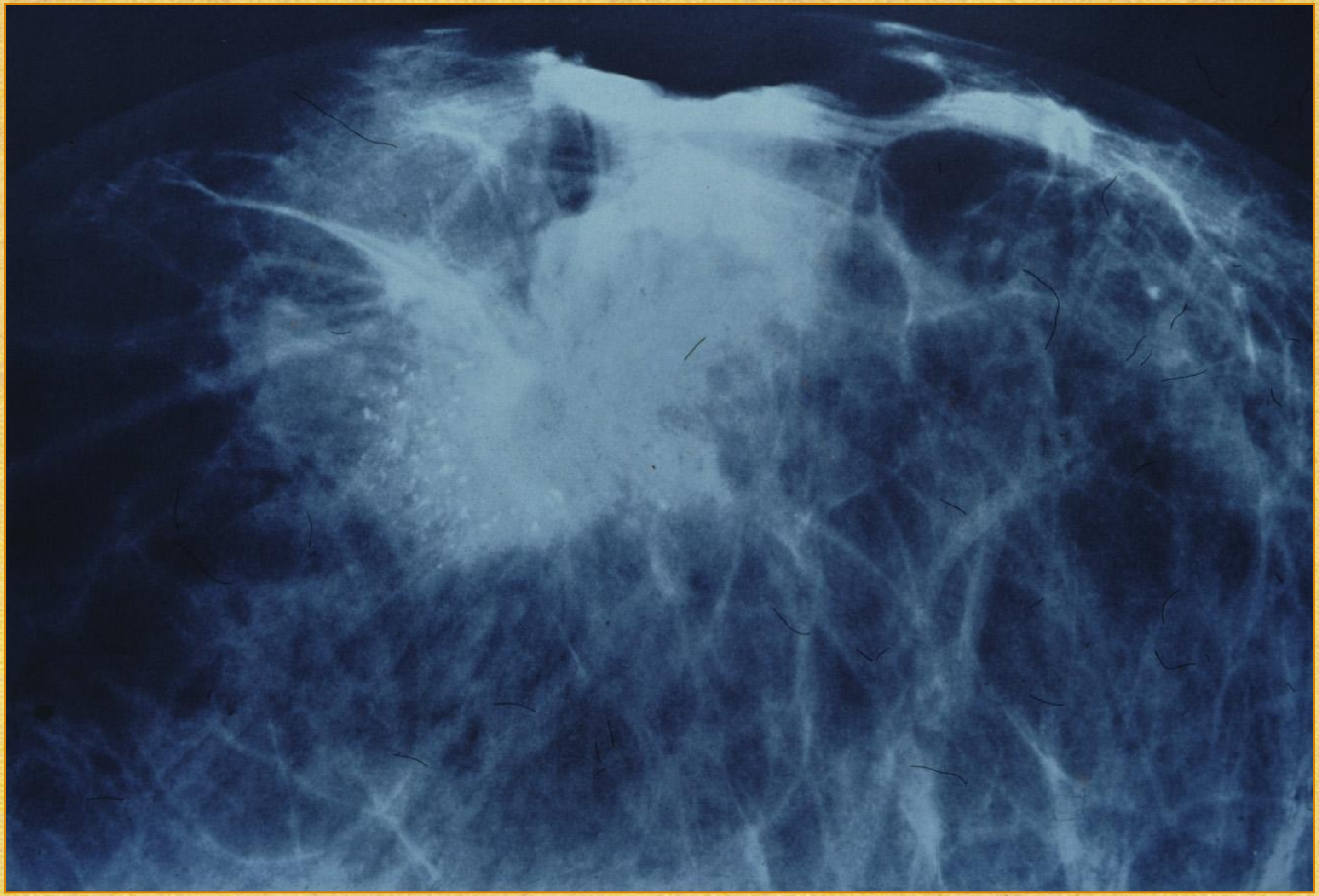


Breast carcinoma



Calcifications





Ultrasonography

The indications for ultrasonography are

(1) a mammographically detected mass, the nature of which is indeterminate

(2) a palpable mass that is not seen on mammography

(3) a palpable mass in a patient below the age recommended for routine mammography

(4) guidance for intervention

Ultrasonography

Ultrasonography is a highly reliable technique for differentiating cystic from solid masses.

If criteria for a simple cyst are met, the diagnosis is over 99% accurate. Although certain features have been described as indicative of benign or malignant solid masses, this determination is more difficult to make and less accurate than the determination of the cystic nature of a mass.

A ***limitation*** of ultrasonography is that it is very operator dependent. Also, it images only a small part of the breast at any one moment.

Ultrasonography

Normal Structures

The skin, premammary and retromammary fasciae, trabeculae, walls of ducts and vessels, and pectoral fasciae are well seen as linear structures.

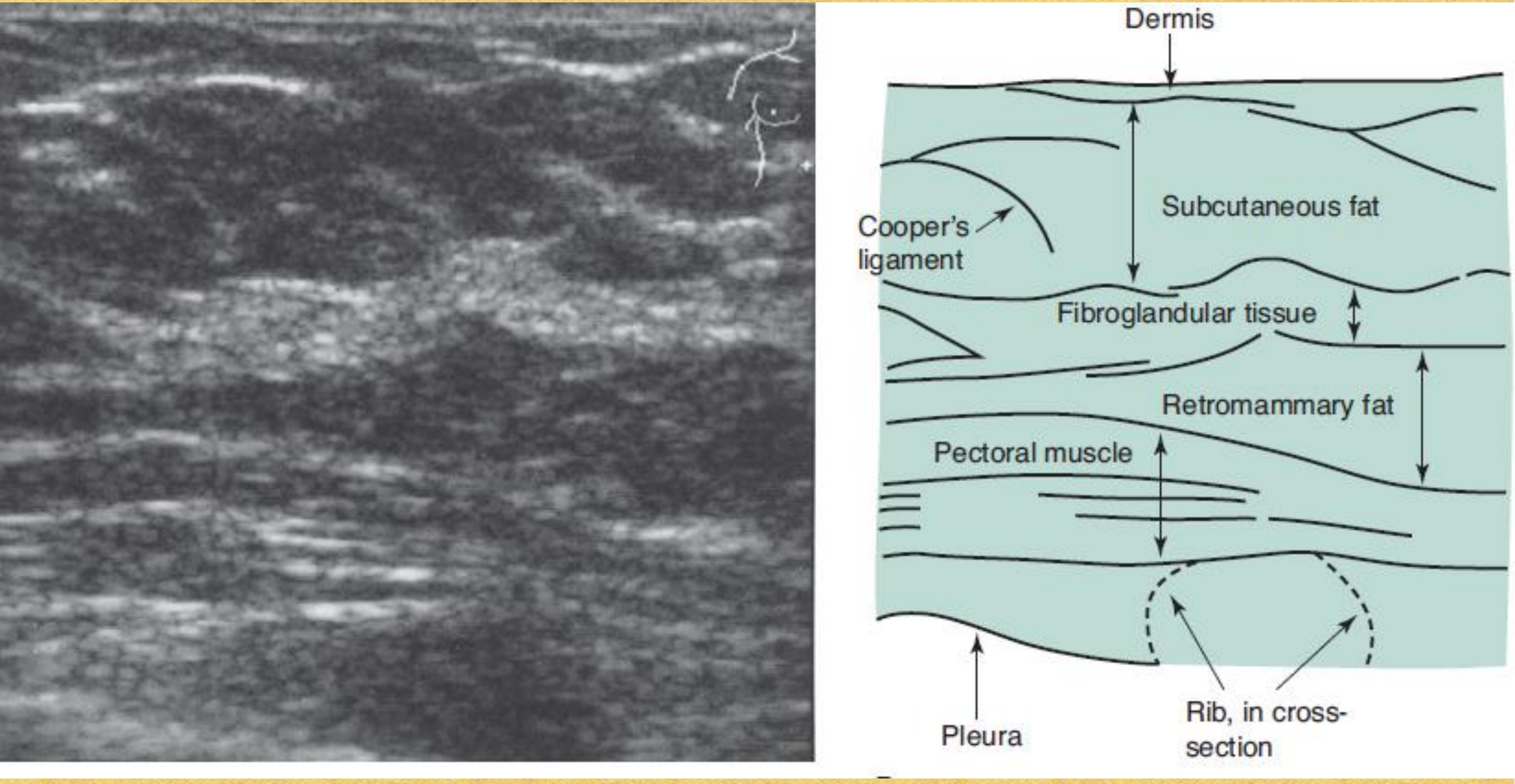
The glandular and fat lobules are oval, of varying sizes, and hypoechoic relative to the surrounding connective tissue

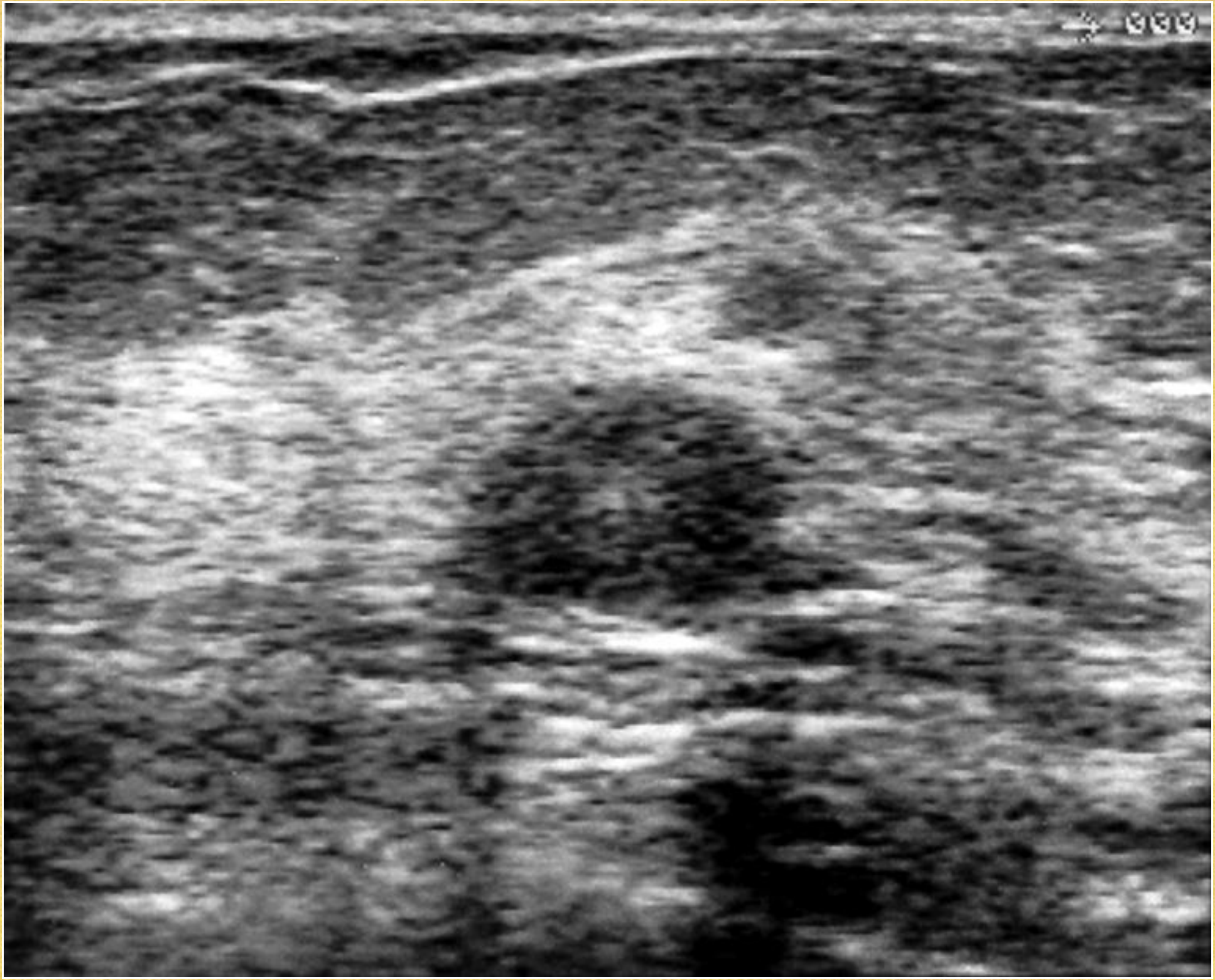
Simple cysts are anechoic (echo-free) and have thin, smooth walls. Increased echogenicity is seen deep to cysts (enhanced through-transmission).

Most solid masses are hypoechoic relative to surrounding breast tissue.

Ultrasonography

Normal Structures





Fibroadenoma

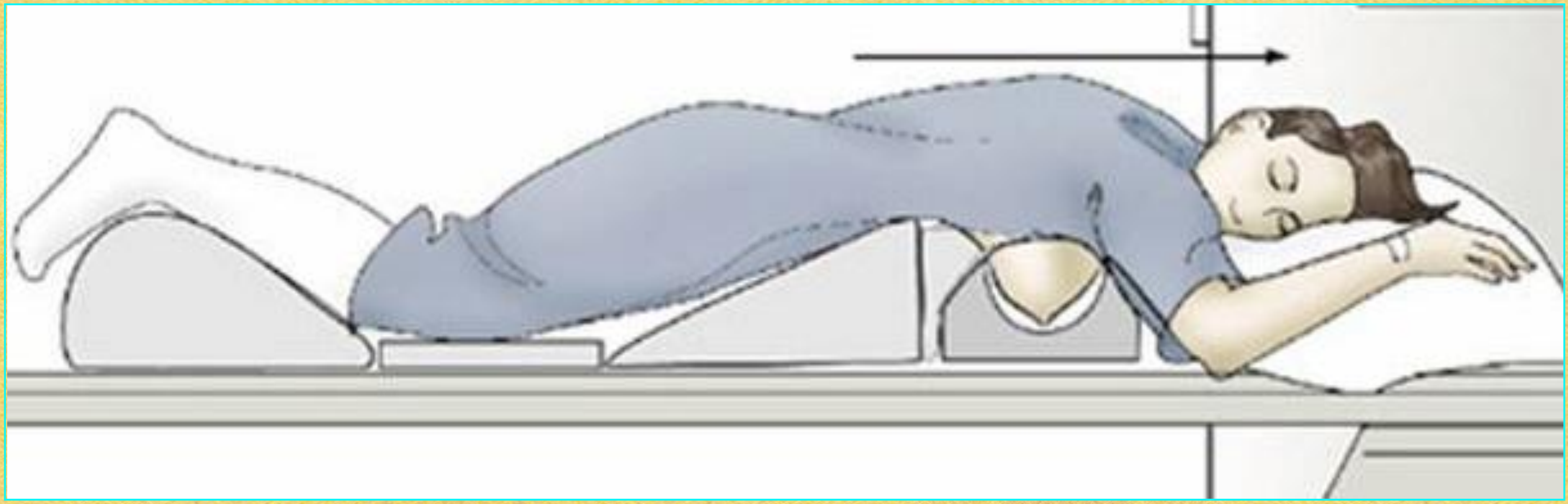
Magnetic Resonance Imaging

The role of MRI continues to expand

Common applications including
(1) staging of and surgical planning for breast tumors
(2) searching for a primary tumor in patients who present with cancerous axillary lymph nodes
(3) evaluating tumor response to neoadjuvant chemotherapy
(4) differentiating tumor recurrence from posttreatment changes in patients with previous breast-conserving surgery and radiation
(5) screening of high-risk patients
(6) Evaluating implants
(7) evaluating difficult (dense or fibrous) breasts.
(8) the technology for MR-guided breast biopsies is increasingly available.

Magnetic Resonance Imaging

The patient lies prone on the scanner table, and a specialized coil surrounds the breasts.



Magnetic Resonance Imaging

Depending on the clinical question, a varying number of pulse sequences are performed to evaluate the breasts or the composition of a suspicious lesion. Scan times can range from 30 minutes to over an hour.

T2 - weighted sagital fat suppressed
T1 - weighted sagital non- fat suppressed 3D FSPGR
T1 - weighted fat suppressed sagital 3D FSPGR before and following contrast alternating imaging pf each breast (total 3 post contrast acquisitions per breast)

TR 17.1, TE 2.4 (in-phase), a = 350, BW 31.25
256 x 192, 1 NEX, time = 2 min, freq AP
2 – mm slice thickness, no gap
Substraction
Maximum intensiti projection.

Magnetic Resonance Imaging

Normal Structures

Tissues are differentiated by their pattern of change on different pulse sequences. The skin, nipple and areola, mammary fat, breast parenchyma, and connective tissue are normally seen, in addition to the anterior chest wall, including musculature, ribs and their cartilaginous portions, and portions of internal organs.

Small calcifications are not visible, and small solid nodules may not be detected.
Cystic structures are well seen.
Normal implants appear as cystic structures with well-defined walls. Their location is deep to the breast parenchyma or subpectoral, depending on the surgical technique that was used to place the implants.

Magnetic Resonance Imaging

MRI can show whether a lesion is solid or contains fat or fluid. Dynamic scanning after administration of intravenous contrast shows whether structures enhance and at what rate.

Cancers classically enhance rapidly with subsequent “washout.”

For instance, a lesion that enhances relatively rapidly on dynamic exam (think neovascularity) is more concerning for malignancy.

The wide field of view allows staging by evaluating the axillary and internal mammary nodes

Magnetic Resonance Imaging

MASS

SHAPE
round
oval
lobulated
irregular
MARGIN
smooth
irregular
spiculated
INTERNAL ENHANCEMENT PATTERNS
homogeneous
heterogeneous
rim enhancement
dark internal septation
enhancing internal septation
central enhancement

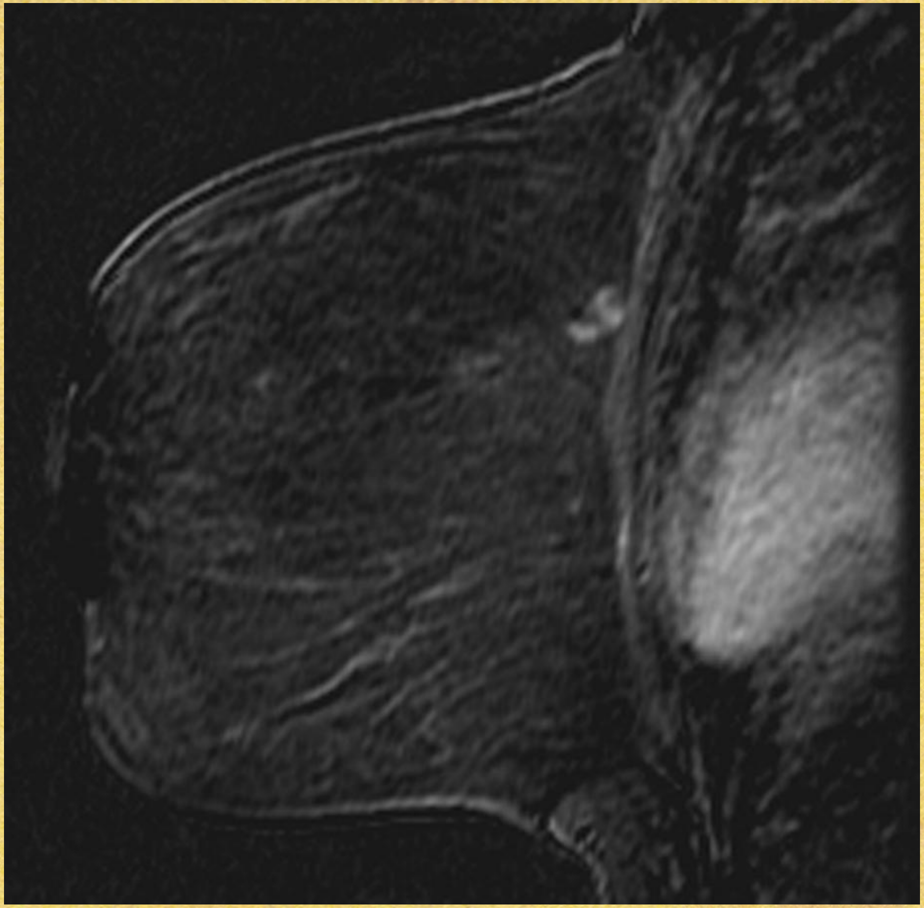
NON MASS LIKE ENHANCEMENT

DISTRIBUTION
focal area
linear
ductal
segmental
regional
multiple regions of enhancement
diffuse
INTERNAL ENHANCEMENT PATTERNS
homogeneous
heterogeneous
stippled/punctate
clumped
reticular

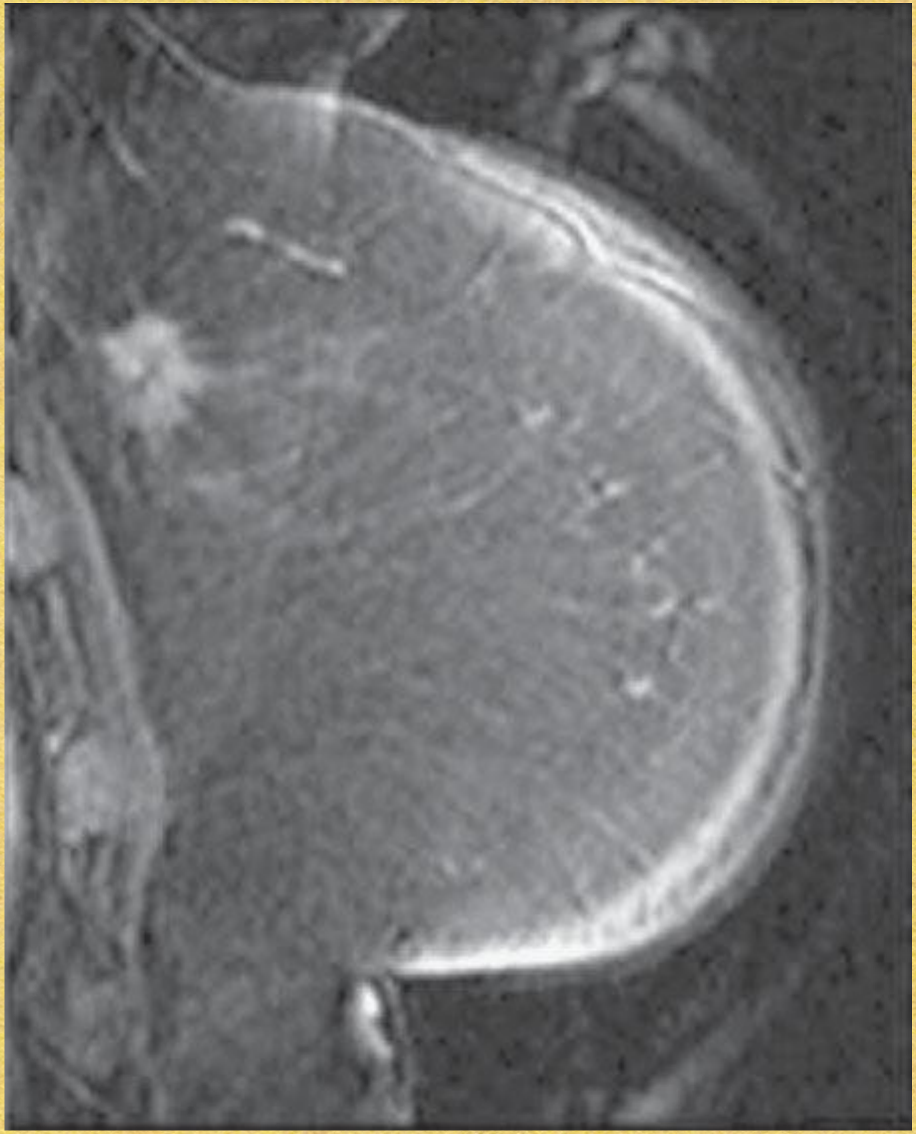
CLUMPED ENHANCEMENT

- Clumped: non-mass enhancement
  - Cobblestone like enhancement with occasional confluent area
  - May look like grapes in in a focal area
  - Beaded or like string of pearls if in a line

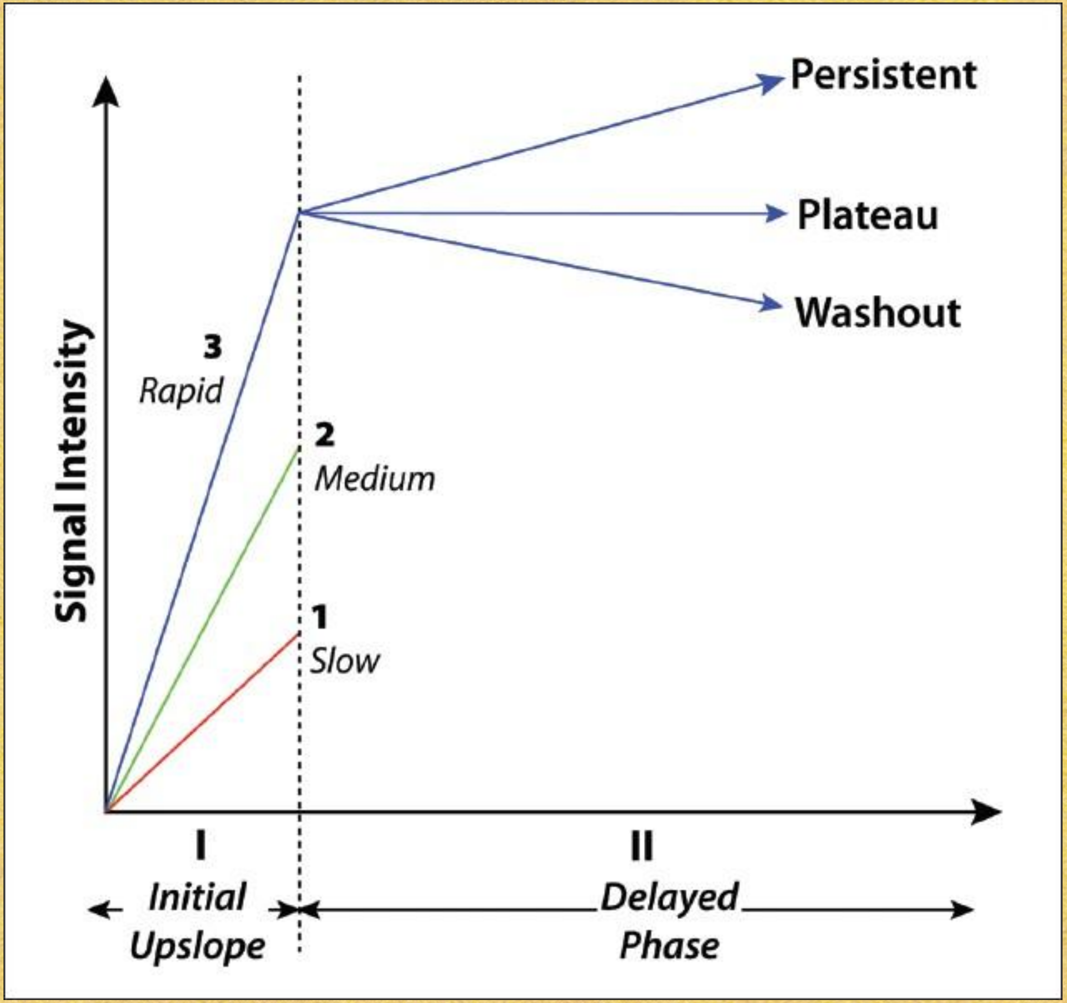
Histology: Fibrosis



Histology: IDC



Kinetic characteristic



Magnetic Resonance Imaging

Although MRI is quite sensitive (good for detecting disease), it is relatively nonspecific.

This is due to the overlapping imaging characteristics of both benign and malignant processes. Like cancer, some benign breast structures show enhancement, although usually with a slower rate.

Because of the relatively low specificity, screening with MRI is best used in patients with a higher probability of disease.

BI-RADS is an acronym for Breast Imaging-Reporting and Data System

The system is designed to standardize reporting, and is used by medical professionals to communicate a patient's risk of developing breast cancer

0: Incomplete
1: Negative
2: Benign finding(s)
3: Probably benign
4: Suspicious abnormality
5: Highly suggestive of malignancy
6: Known biopsy – proven malignancy

Ductography

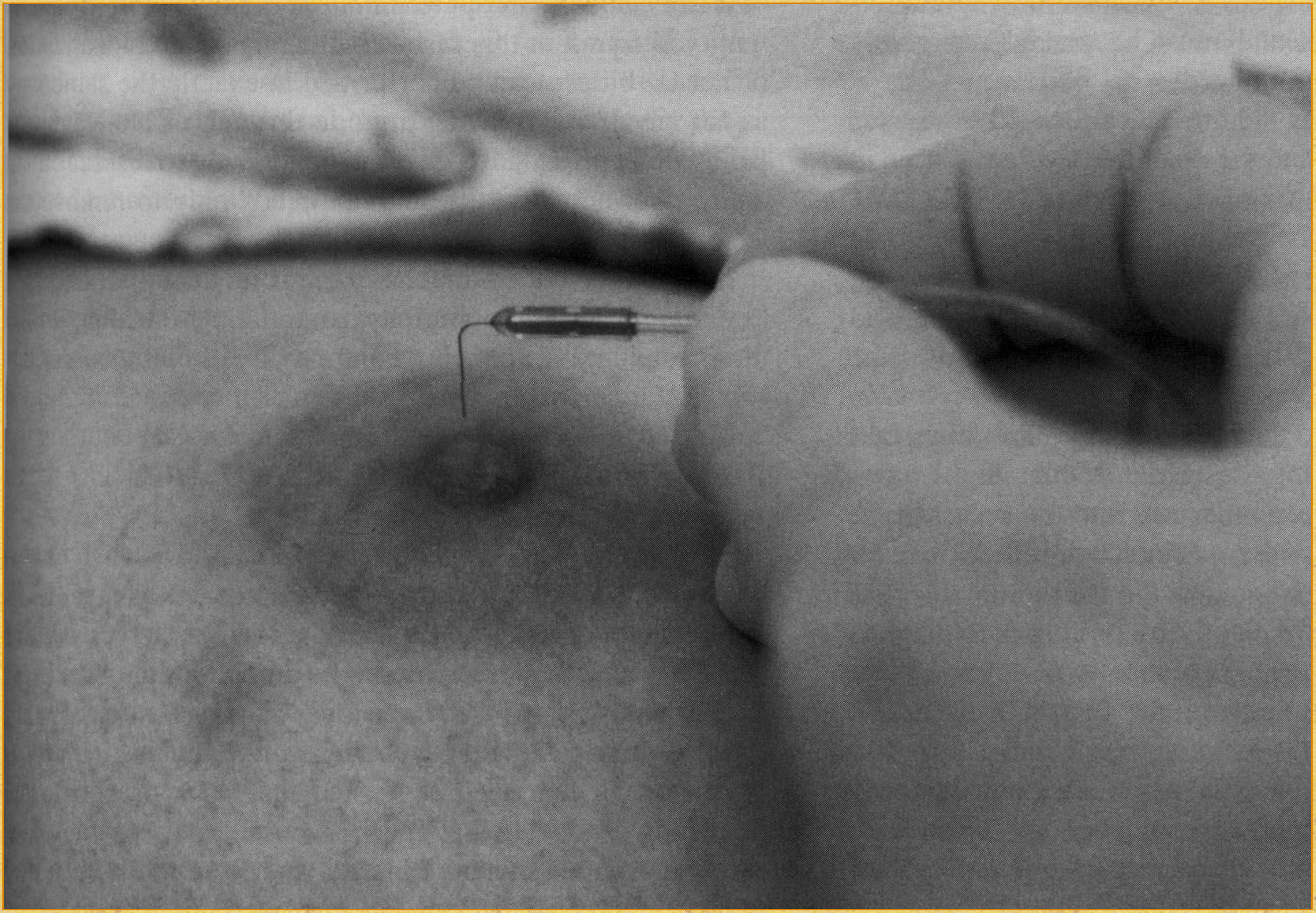
Ductography, or galactography, uses mammographic imaging with contrast injection into the breast ducts.

The indication for use is a profuse, spontaneous, nonmilky nipple discharge from a single duct orifice.

If these conditions are not present, the ductogram is likely to be of little help.

The purpose is to reveal the location of the ductal system involved.

The cause of the discharge is frequently not identified.



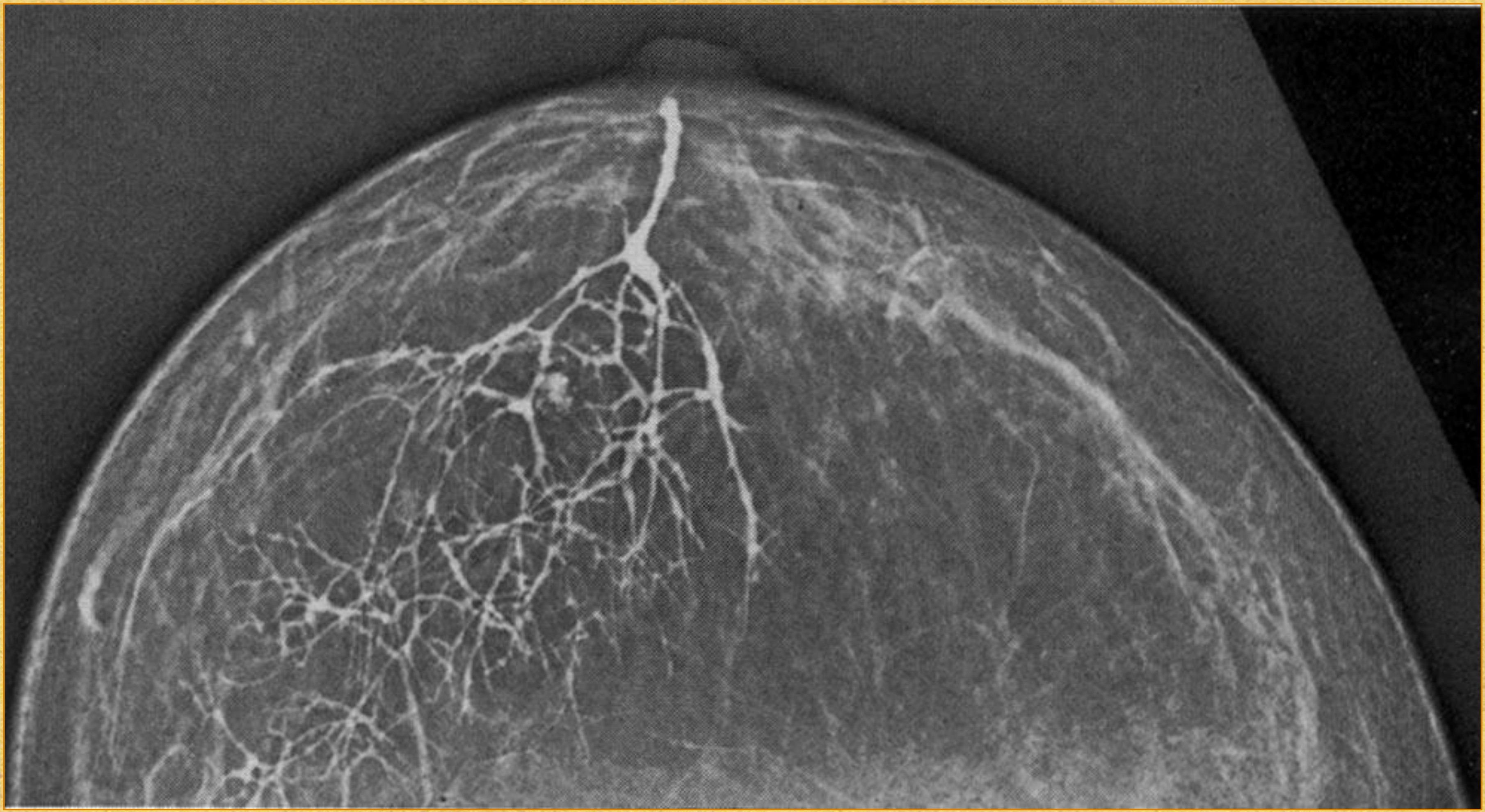


Image-Guided Needle Aspiration and Biopsy

The indications for needle aspiration and biopsy of breast lesions are varied and are variably interpreted by radiologists and referring physicians. Two categories are discussed here:

The first indication is aspiration of cystic lesions to confirm diagnosis, to relieve pain, or both.
Nonpalpable cysts require either ultrasound or mammography to be seen. A fine needle (20- to 25-gauge) usually suffices to extract the fluid. The cystic fluid is not routinely sent for cytology unless it is bloody.

Image-Guided Needle Aspiration and Biopsy

The second indication concerns solid lesions. Needle biopsy is used in this case:

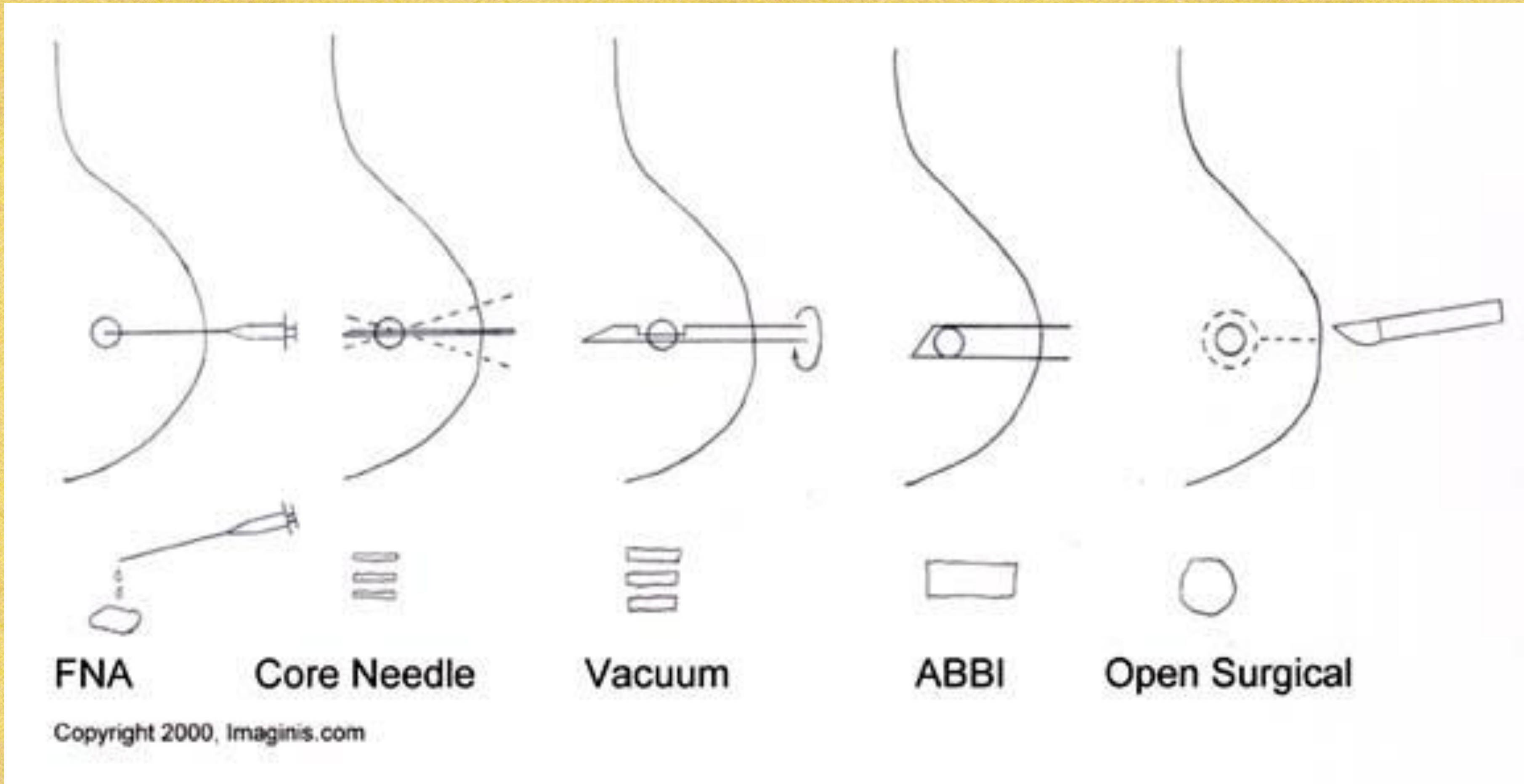
(1) to confirm benignity of a lesion carrying a low suspicion of malignancy mammographically,

(2) to confirm malignancy in a highly suspicious lesion prior to initiating further surgical planning and treatment

(3) to evaluate any other relevant mammographic lesion for which either follow-up imaging or surgical excision is a less desirable option for further evaluation.

metode tkivne dijagnostike bolesti dojke

- **Citološka punkcija** - ***fine needle aspiration (FNA)***
- **Biopsija širokom iglom** - ***core needle biopsy***
- **Vakuum asistirana biopsija** – ***vacuum assisted biopsy (MAMMOTOME ili MIBB)***
- **Velika širokoiglena biopsija dojke** – ***large core biopsy (ABBI)***
- **Otvorena kirurška biopsija** - ***open surgical biopsy***


FNA
Core Needle
Vacuum
ABBI
Open Surgical
Copyright 2000, Imaginis.com


MAMMOMAT
3000 Nova
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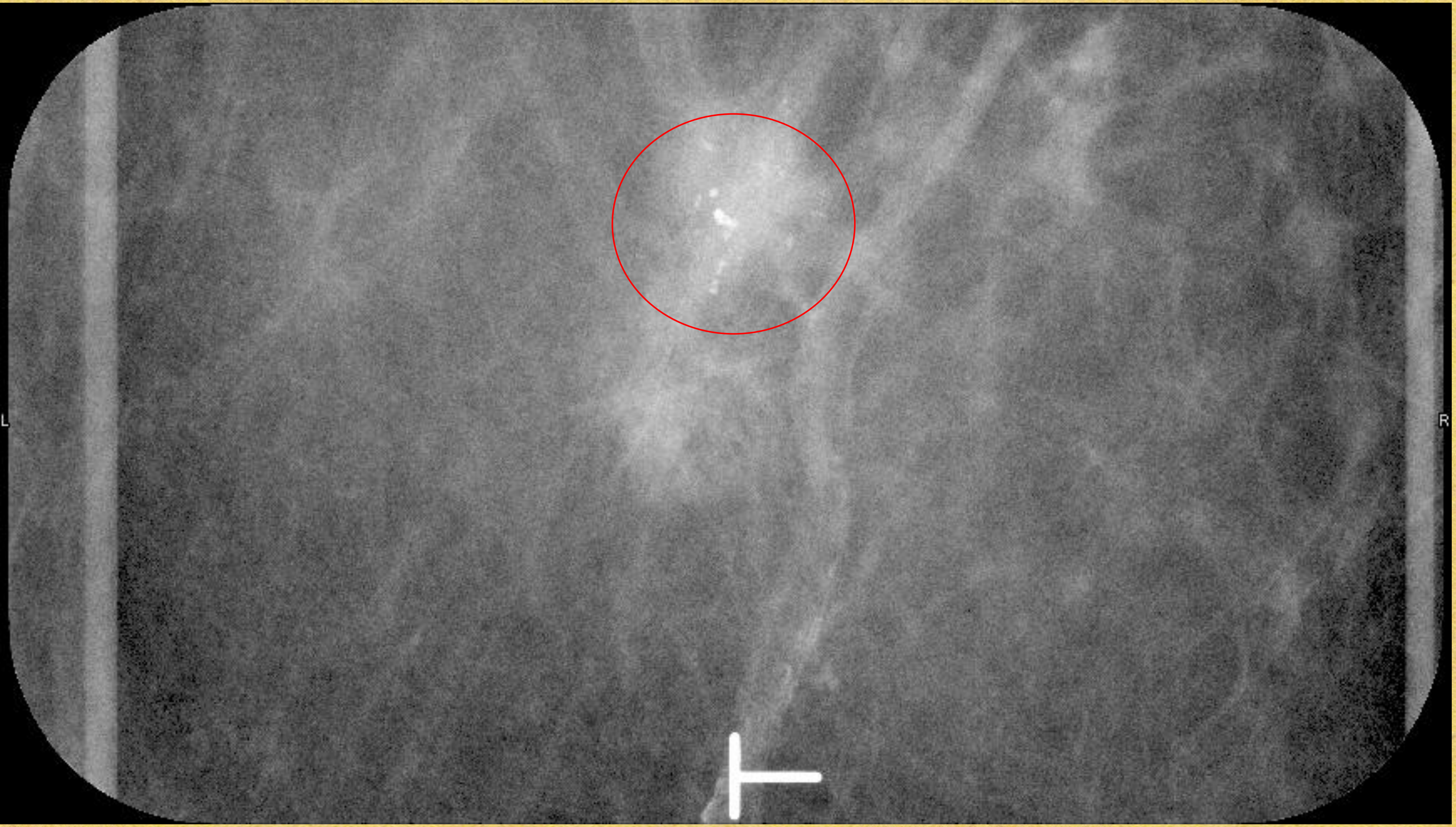
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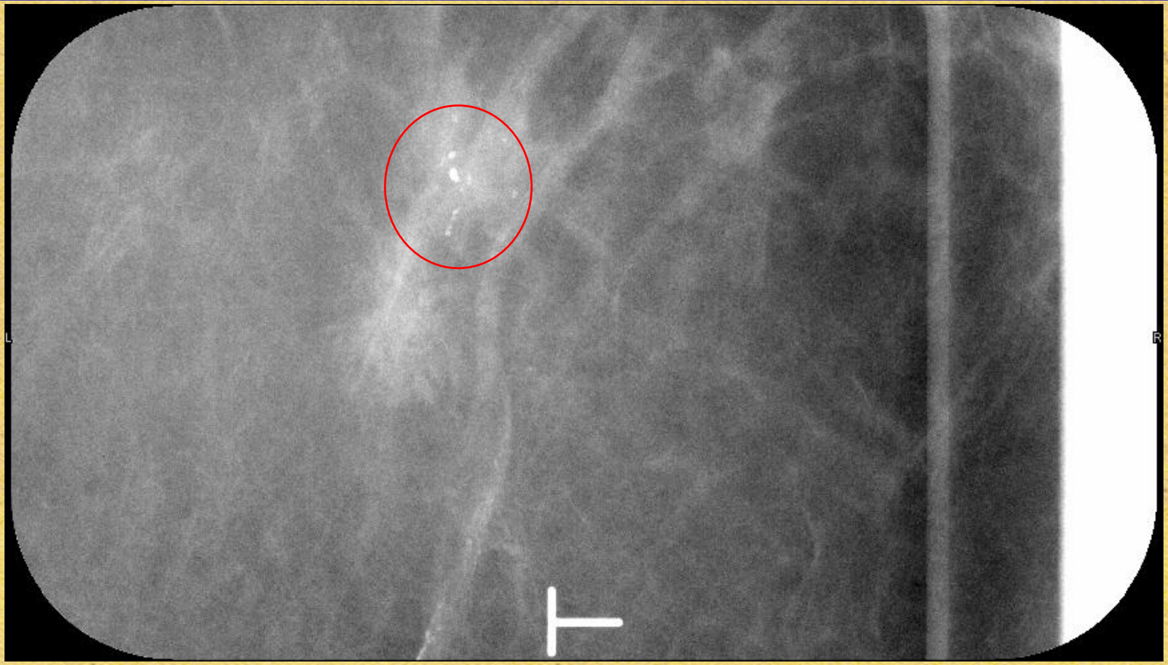

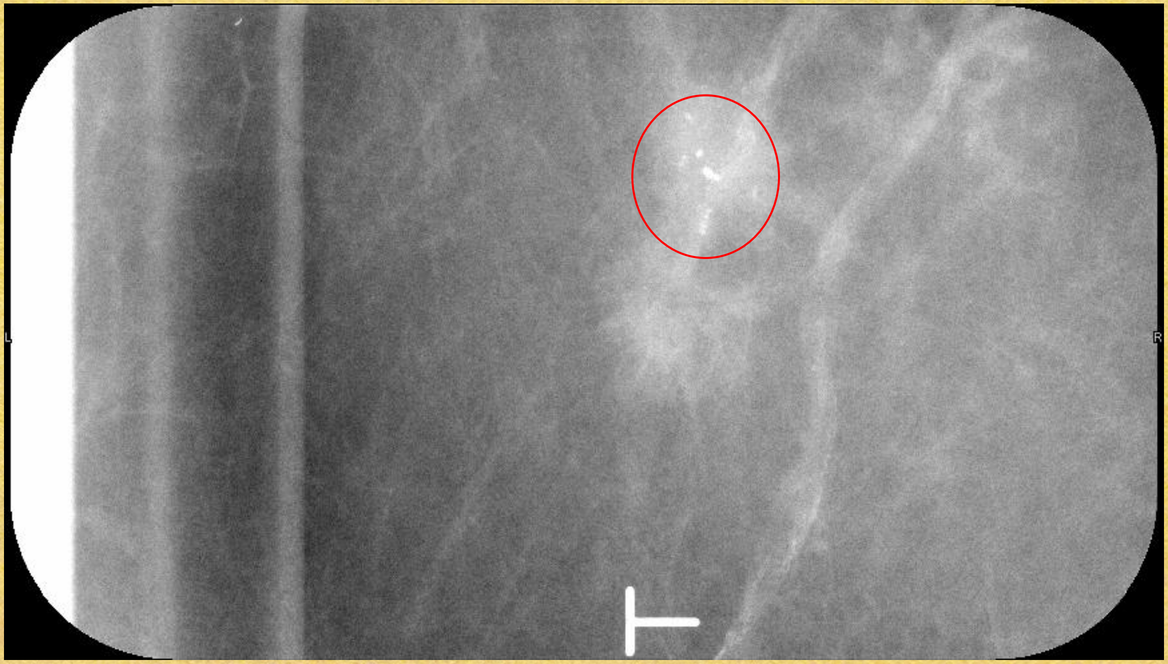

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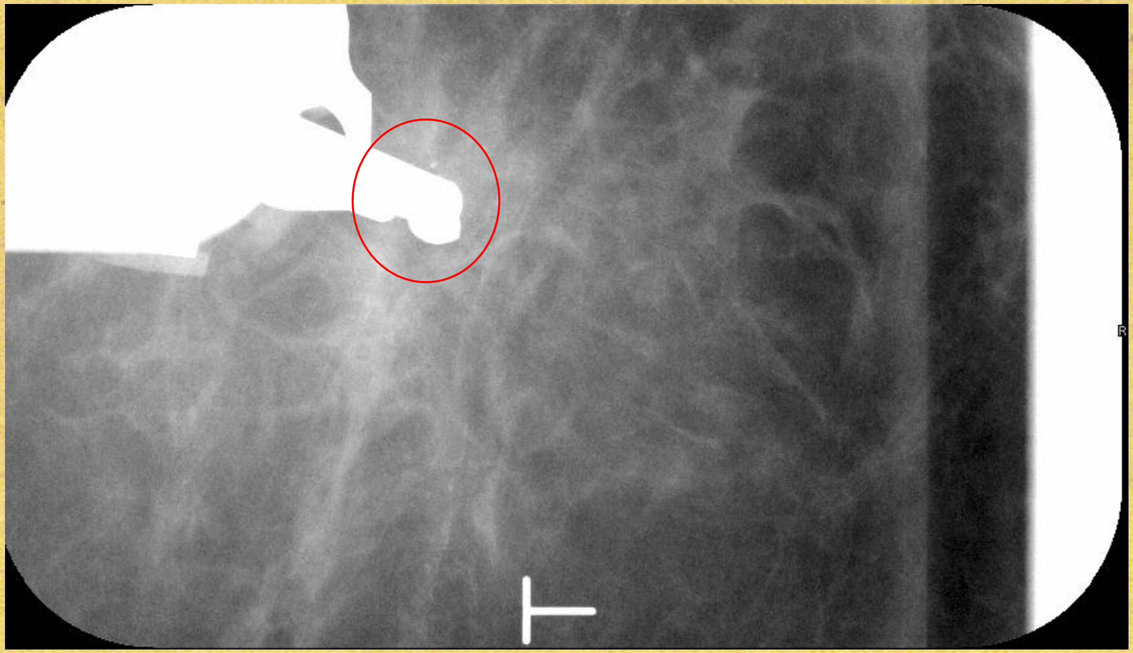
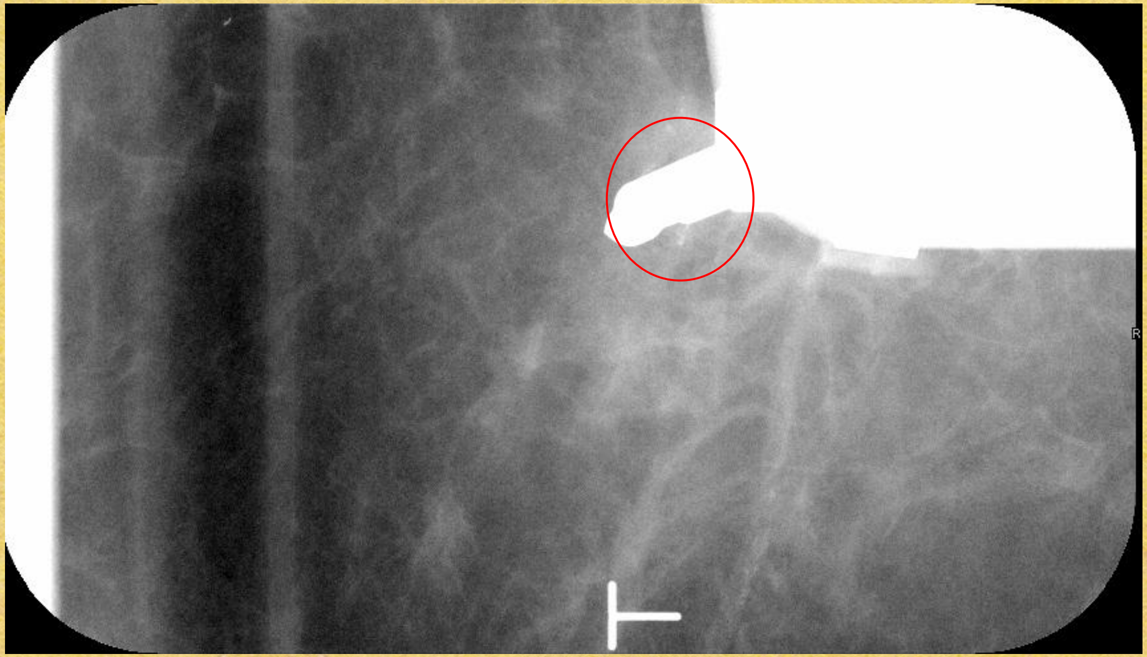
-10°





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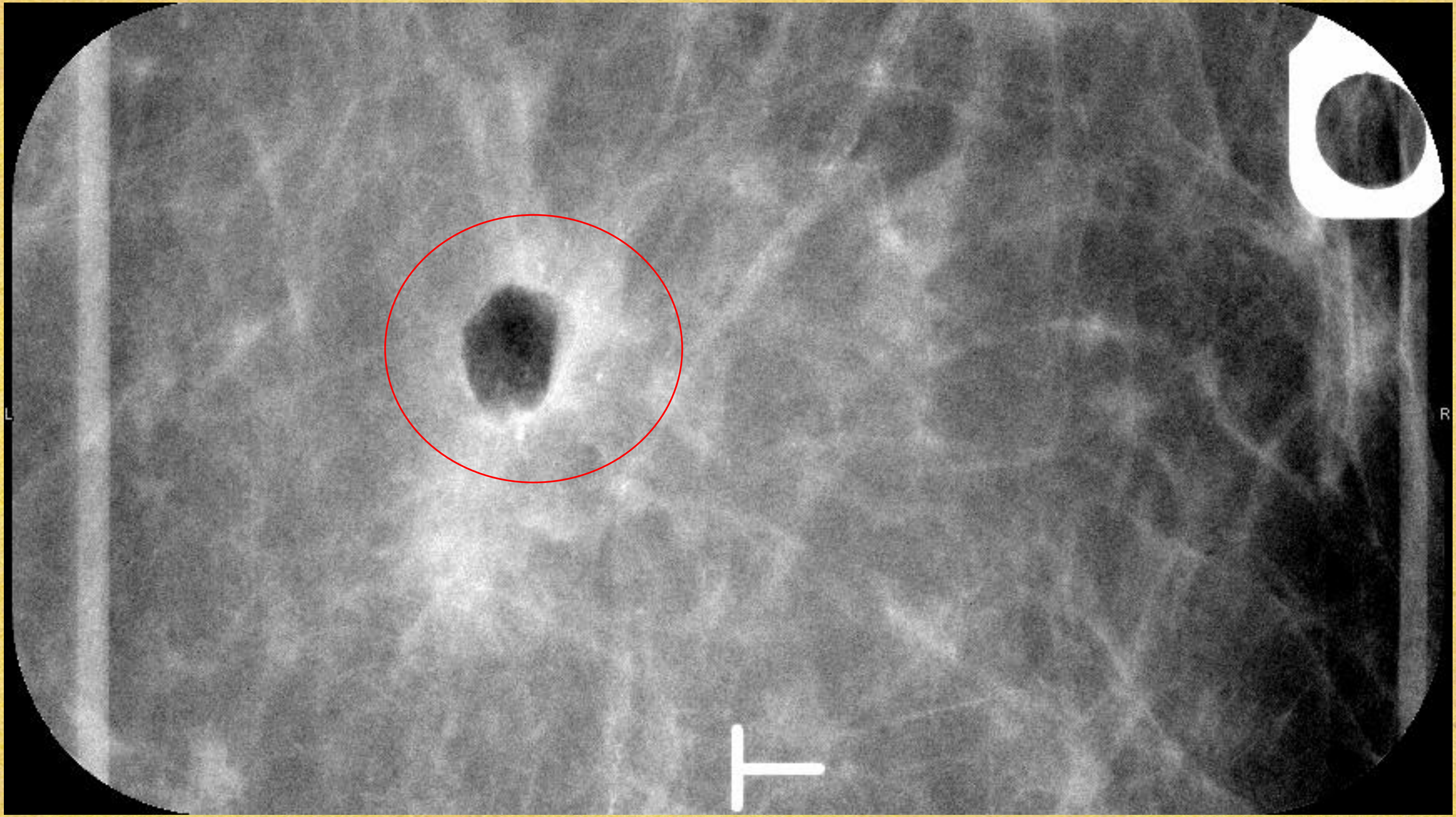
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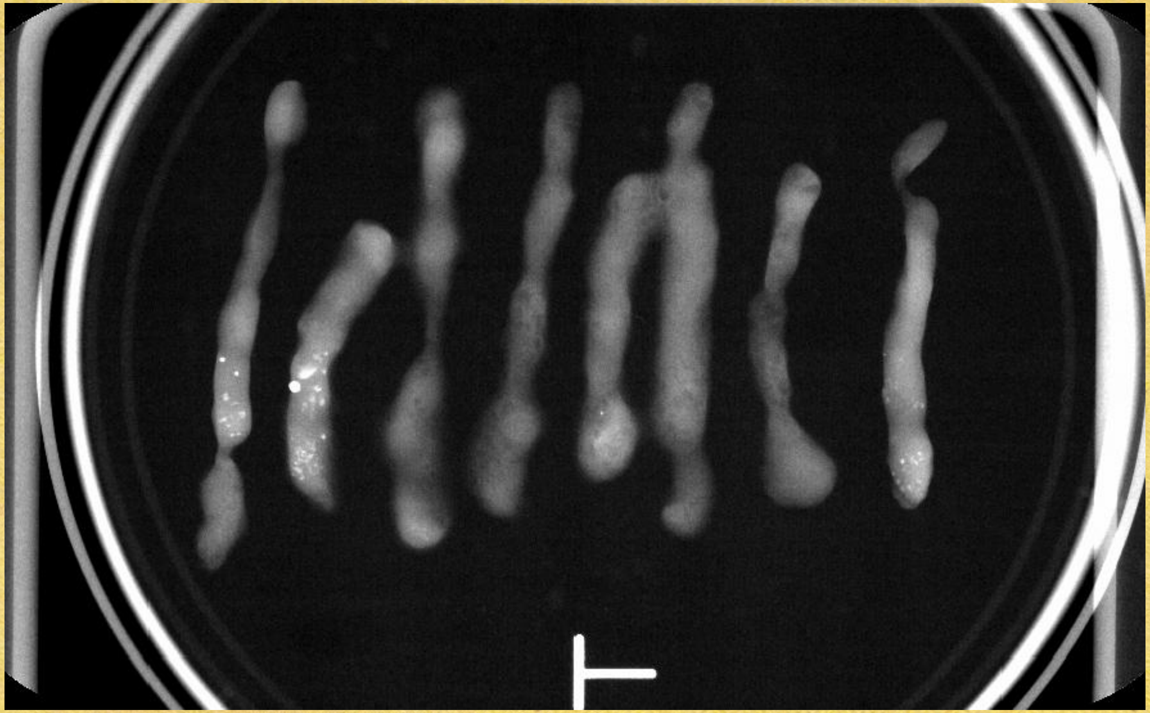

Radiografija uzetih uzoraka

THE END

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