Reflections

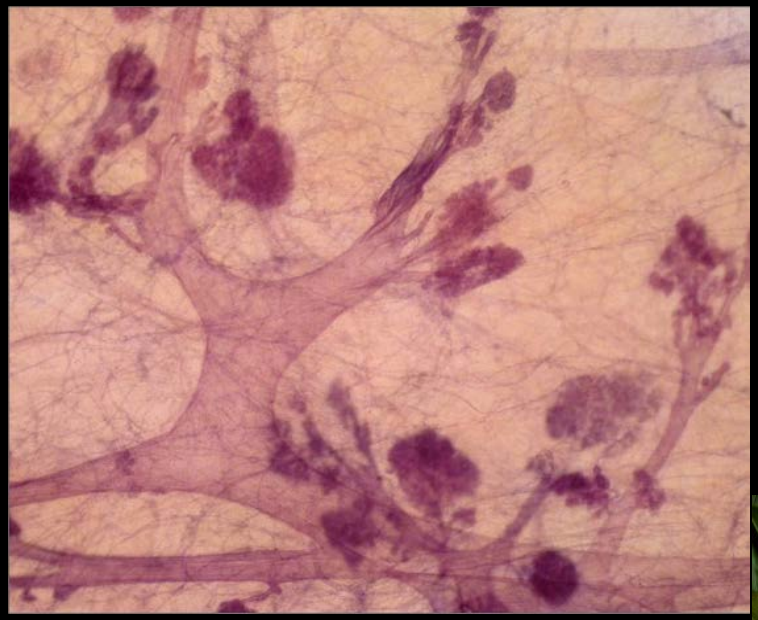
3-D automated ultrasound (ABUS)

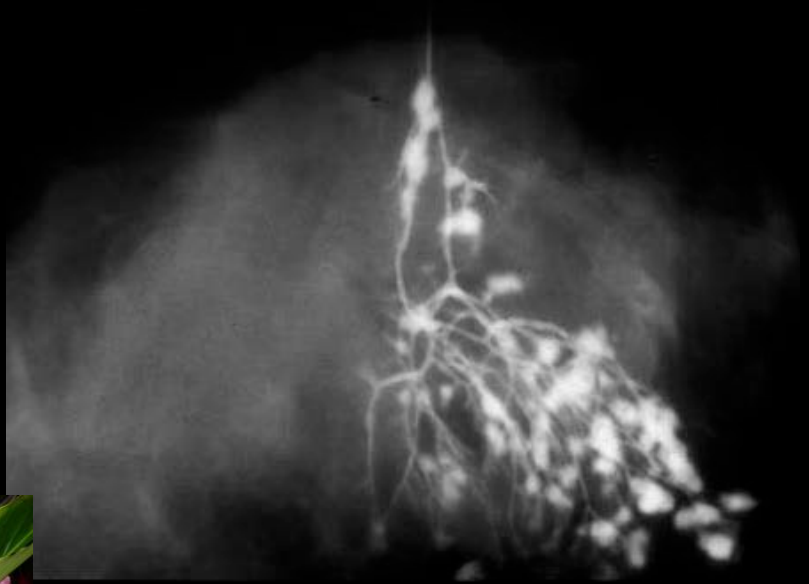
László Tabár, M.D., F.A.C.R. (Hon)

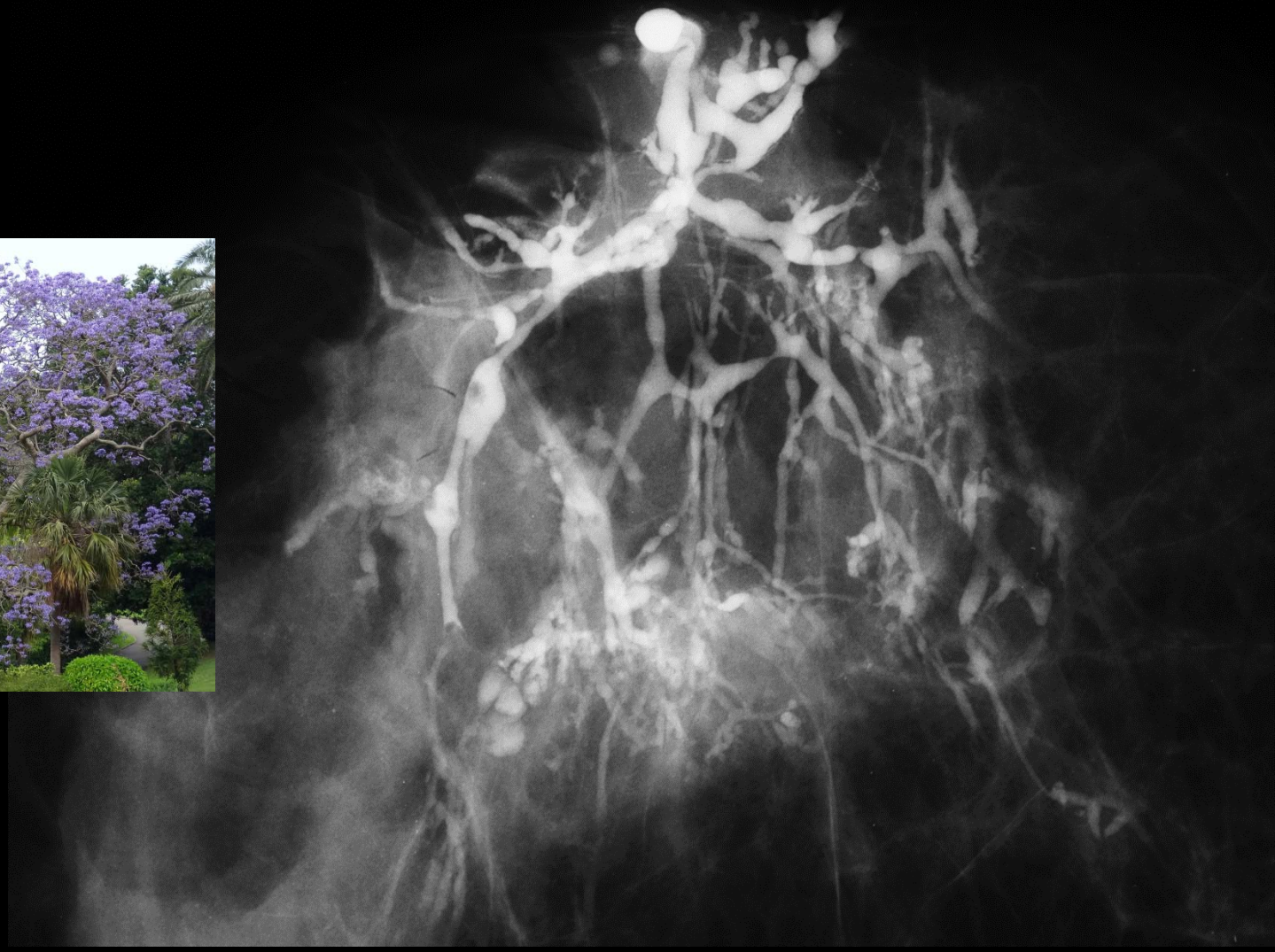
Department of Mammography, Falun Central Hospital, Falun, Sweden

INTRODUCTION

The 3D image of the four basic building blocks in the breast

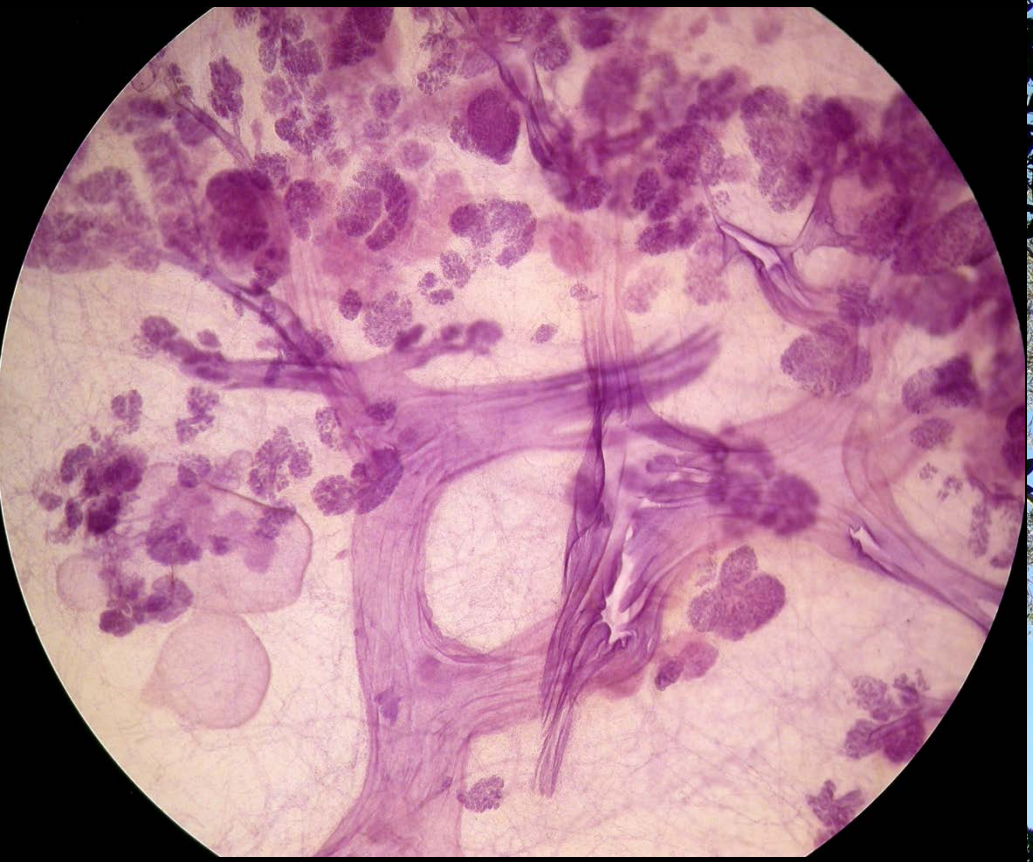




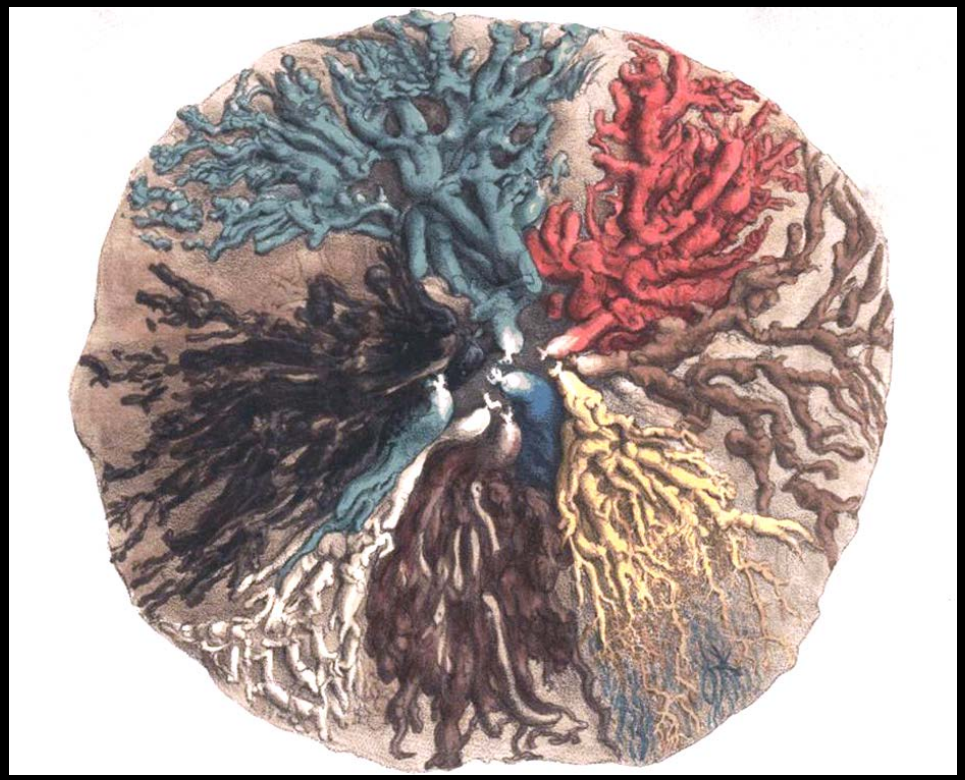


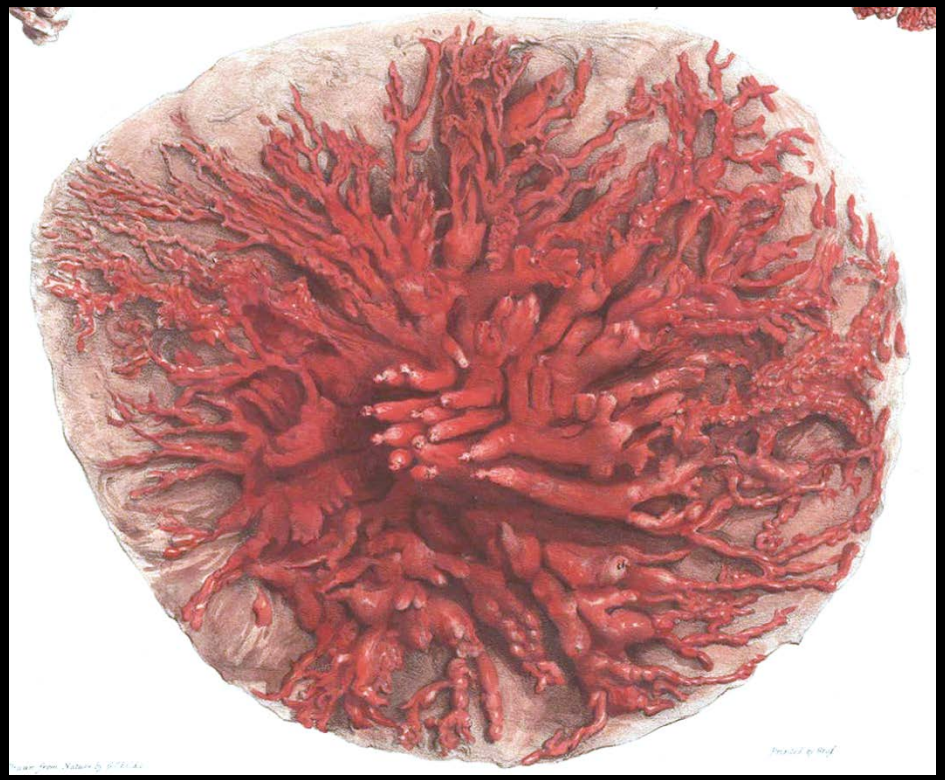
The normal breast contains 12-15 lobes, each composed of a main duct and its branches (as in a tree), terminating in the lobules (like leaves on a tree), all surrounded by supporting fibrous or fatty connective tissue.

3D histology of the basic building blocks

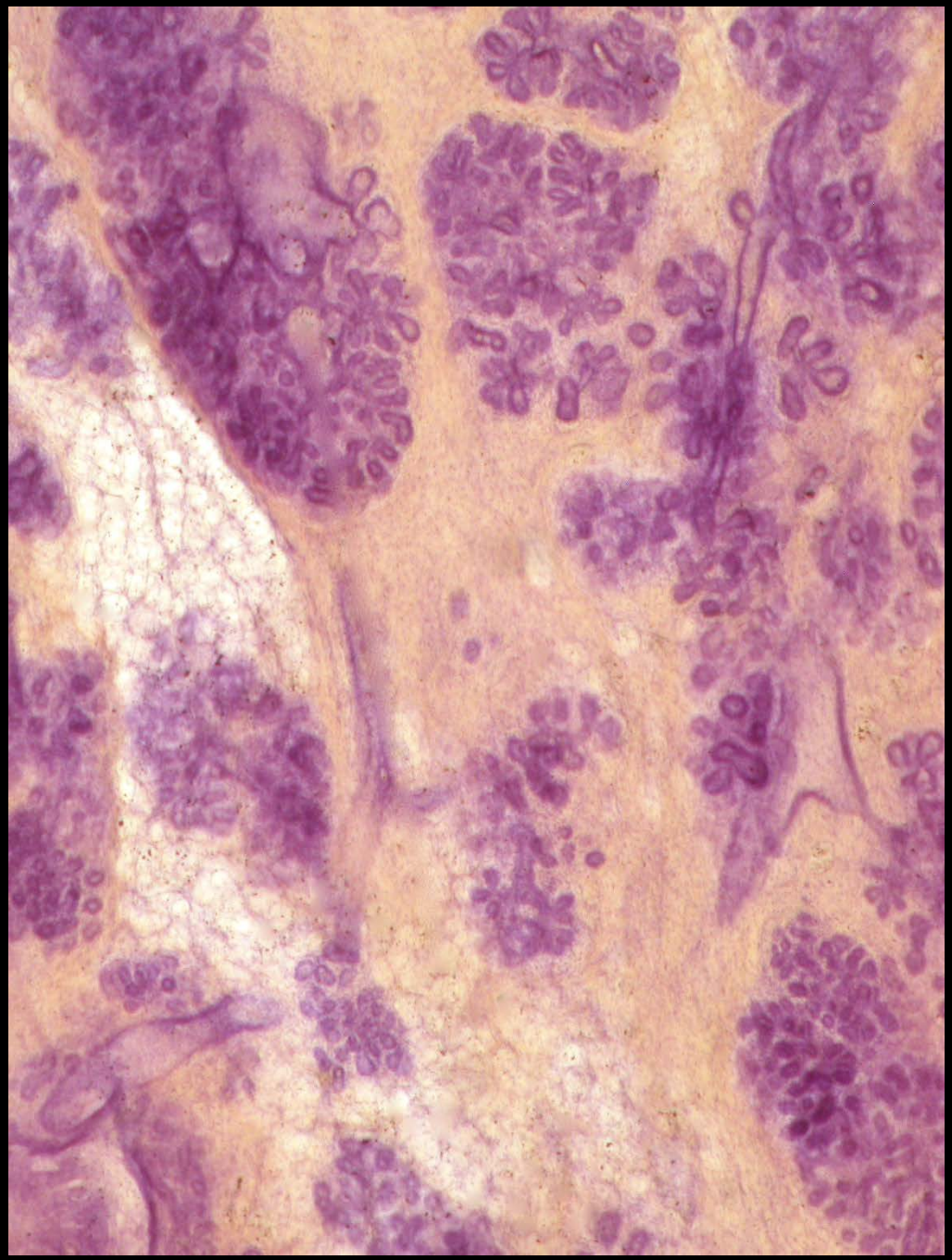


12-18 lobes



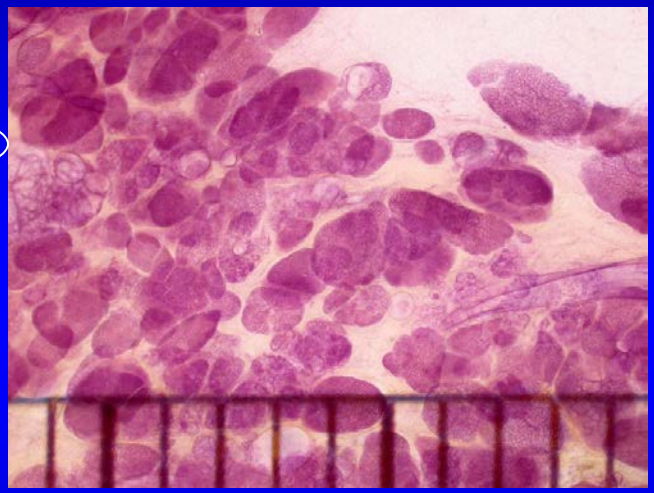


Cooper was the pioneering researcher of breast anatomy, who published (in 1840 !) the classic work, *On the Anatomy of the Breast*.



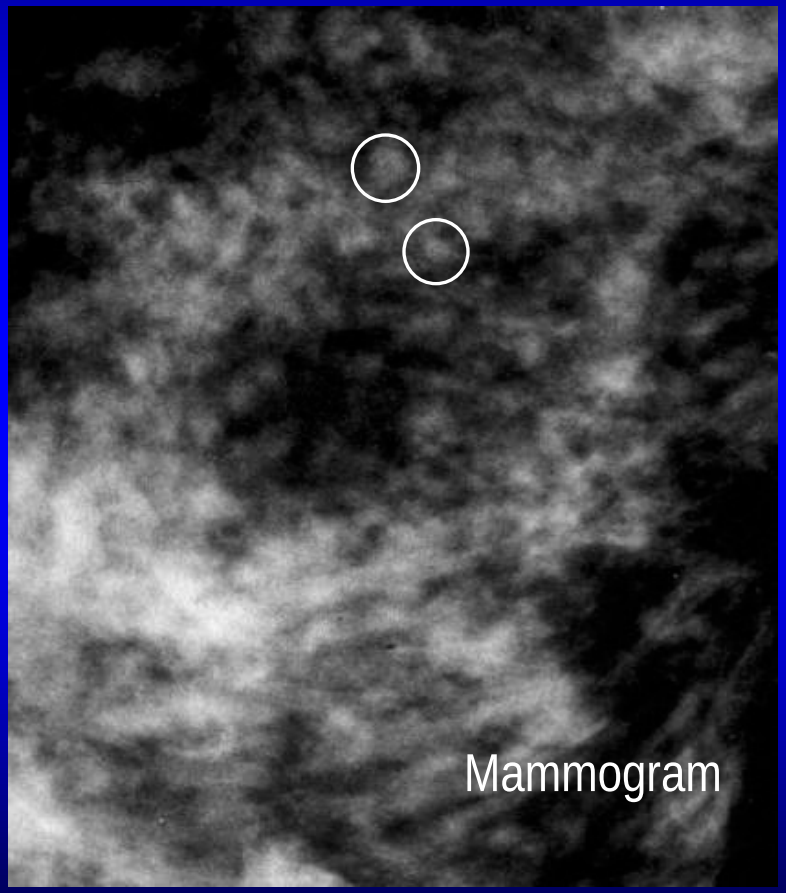
The *four "building blocks"* of the normal fibroglandular tissue can be well demonstrated individually on the mammogram/breast ultrasound/MRI of the breast:

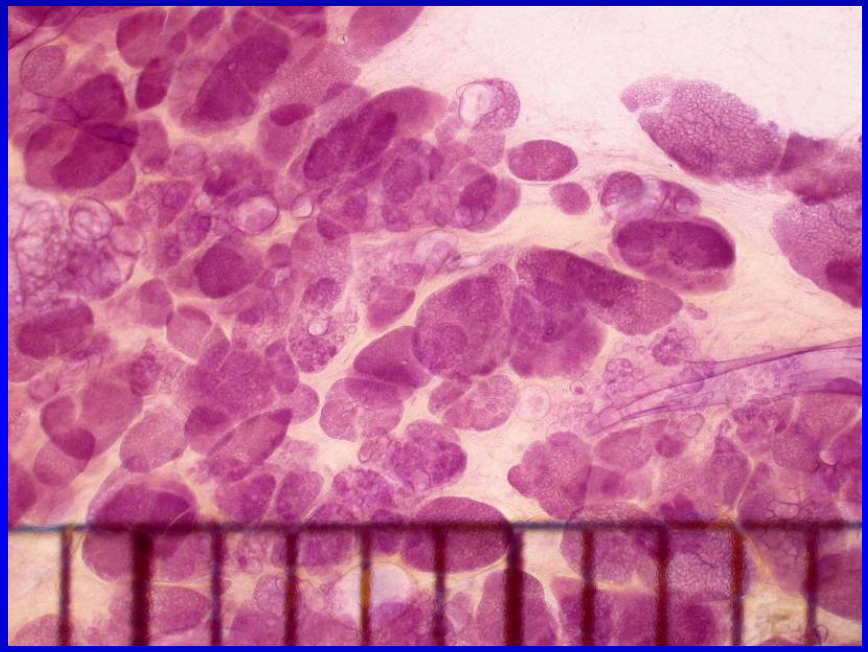
- Terminal ductal lobular unit (TDLUs)
- Ducts and their branches
- Fibrous tissue (collagen)
- Adipose tissue



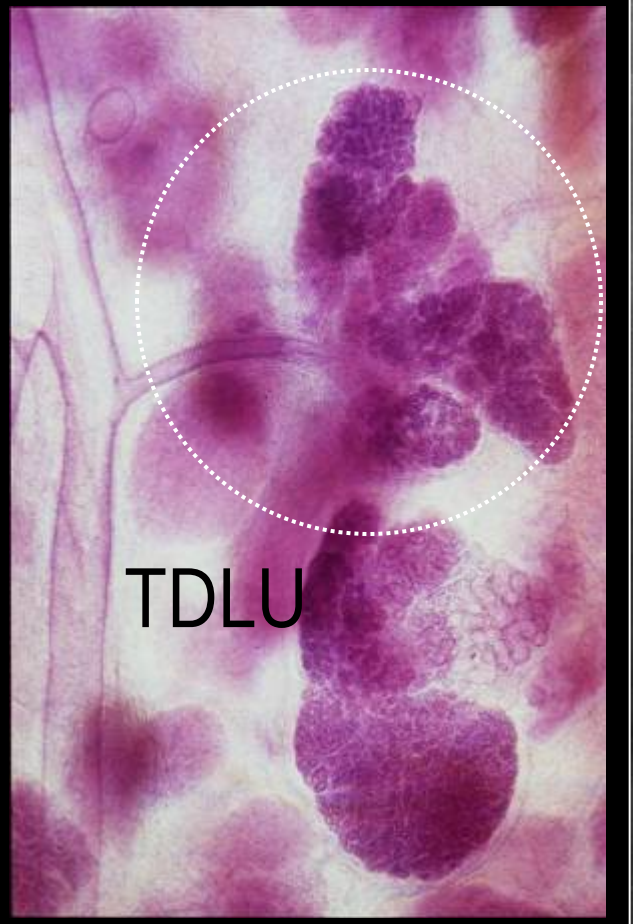
Together, they form a harmonious pattern that will be changed by any kind of pathologic lesion, benign or malignant.

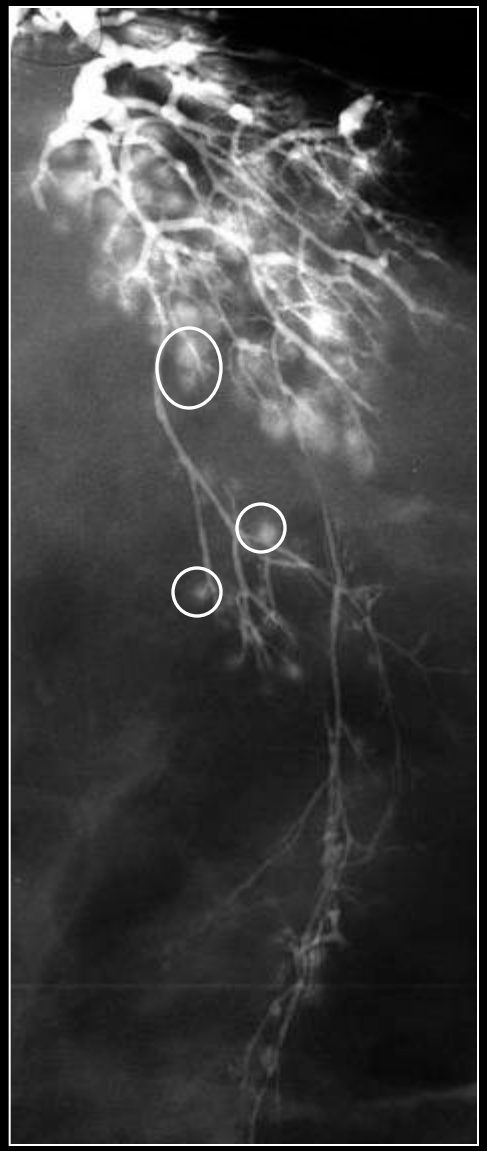
The *four "building blocks"* of the normal fibroglandular tissue can be well demonstrated individually on the mammogram/breast ultrasound/MRI of the breast:

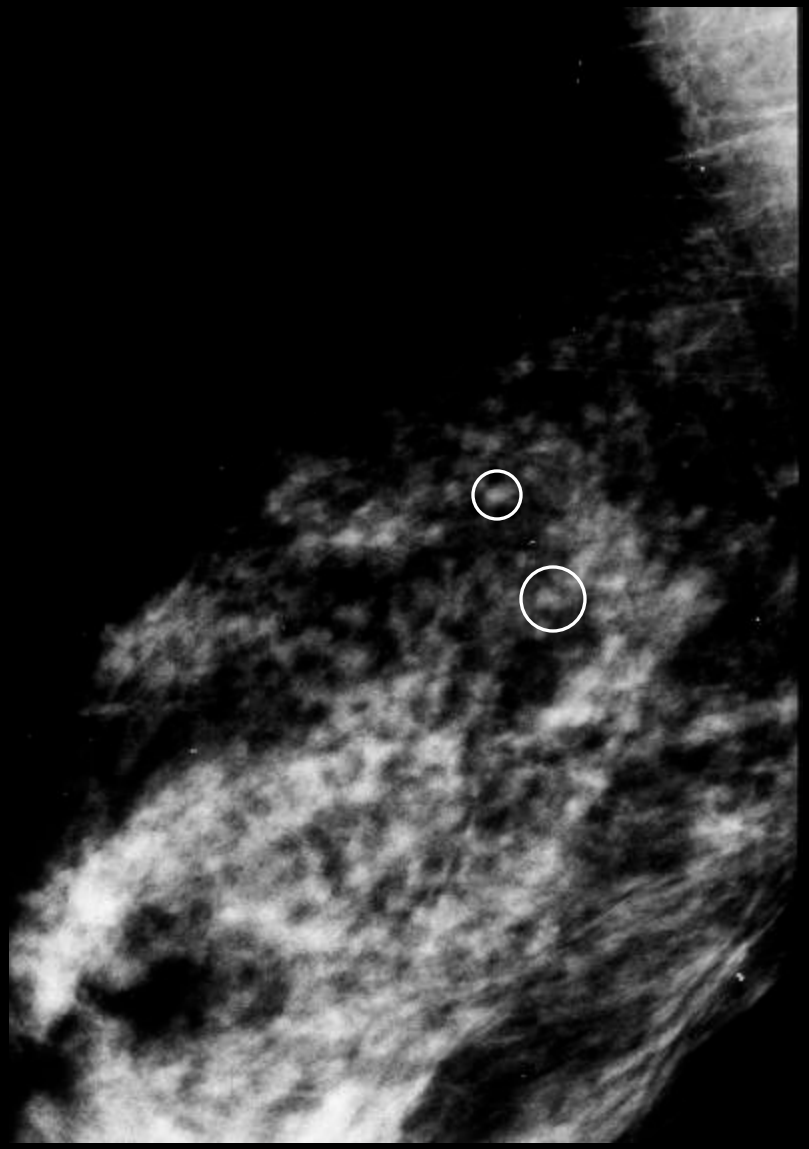




- Terminal ductal lobular unit (TDLUs).



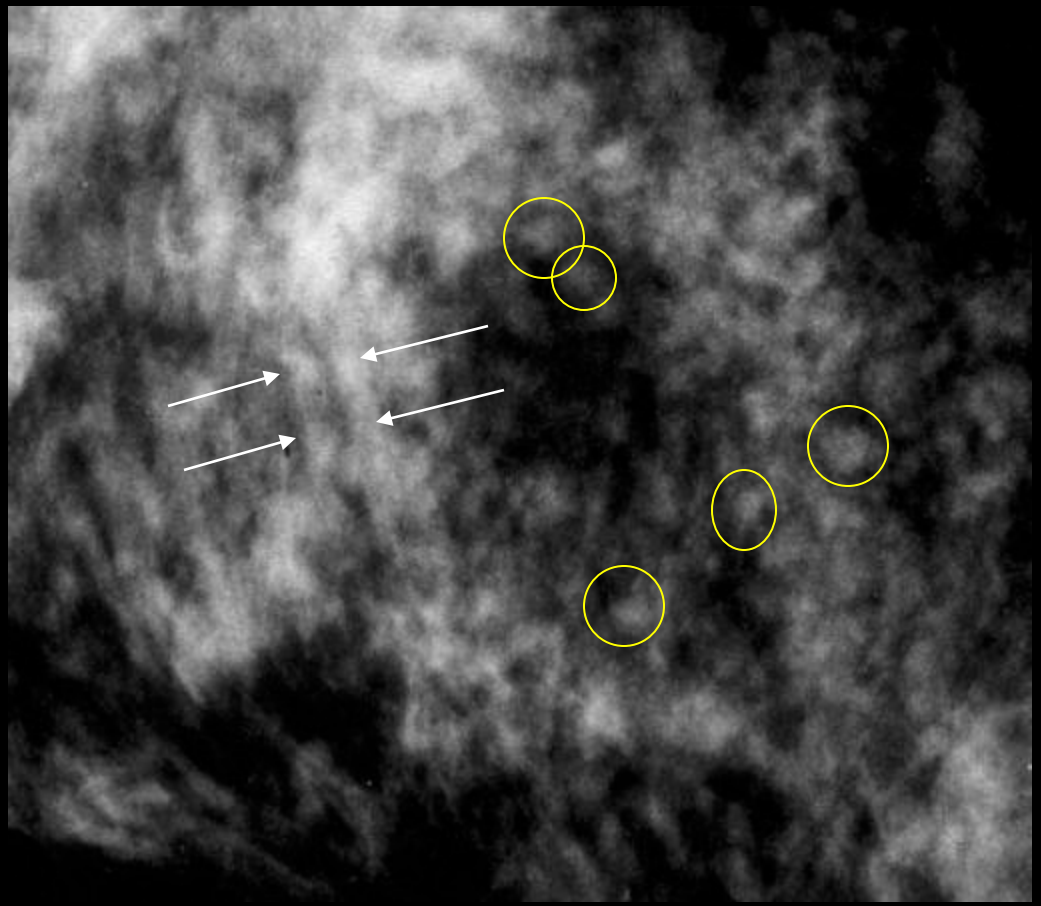


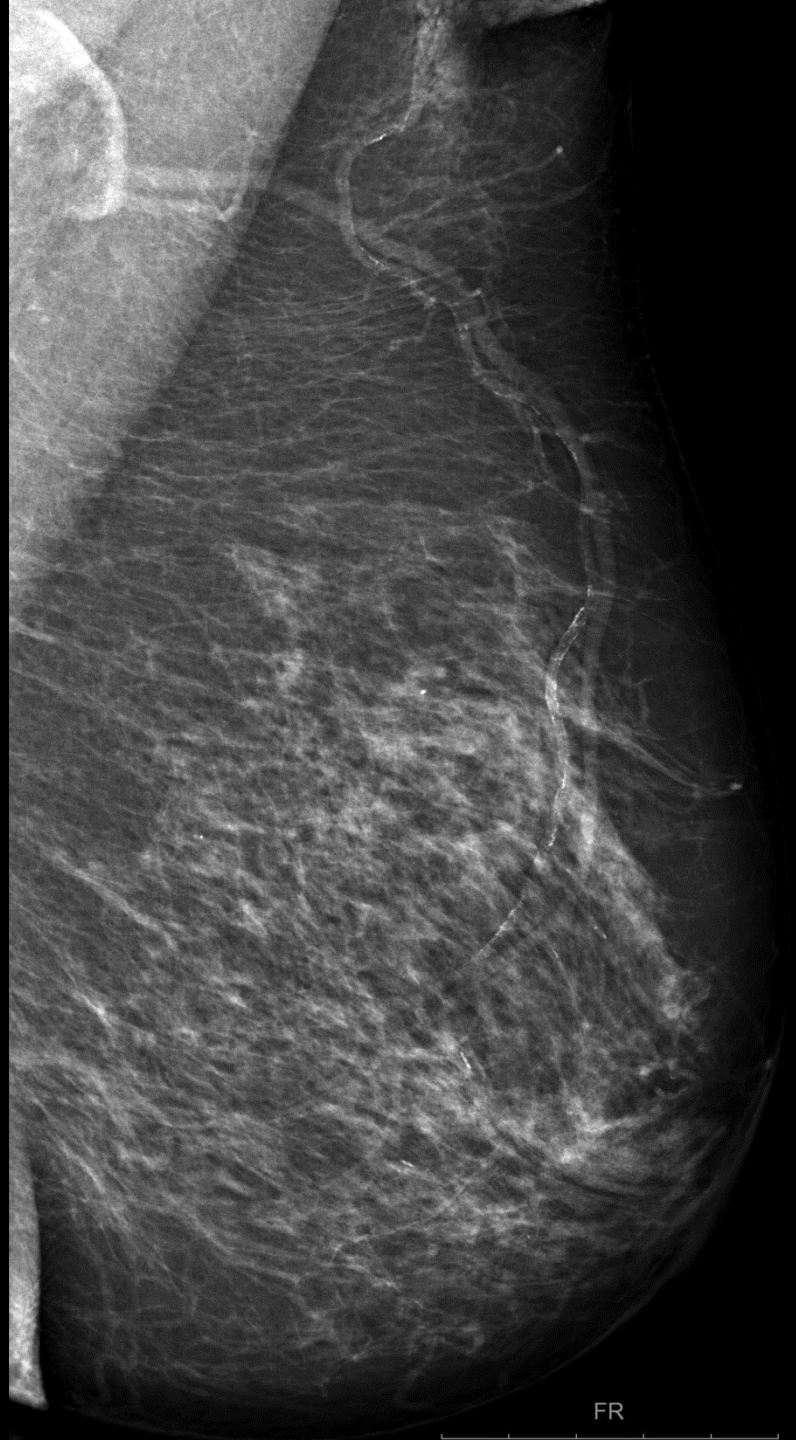


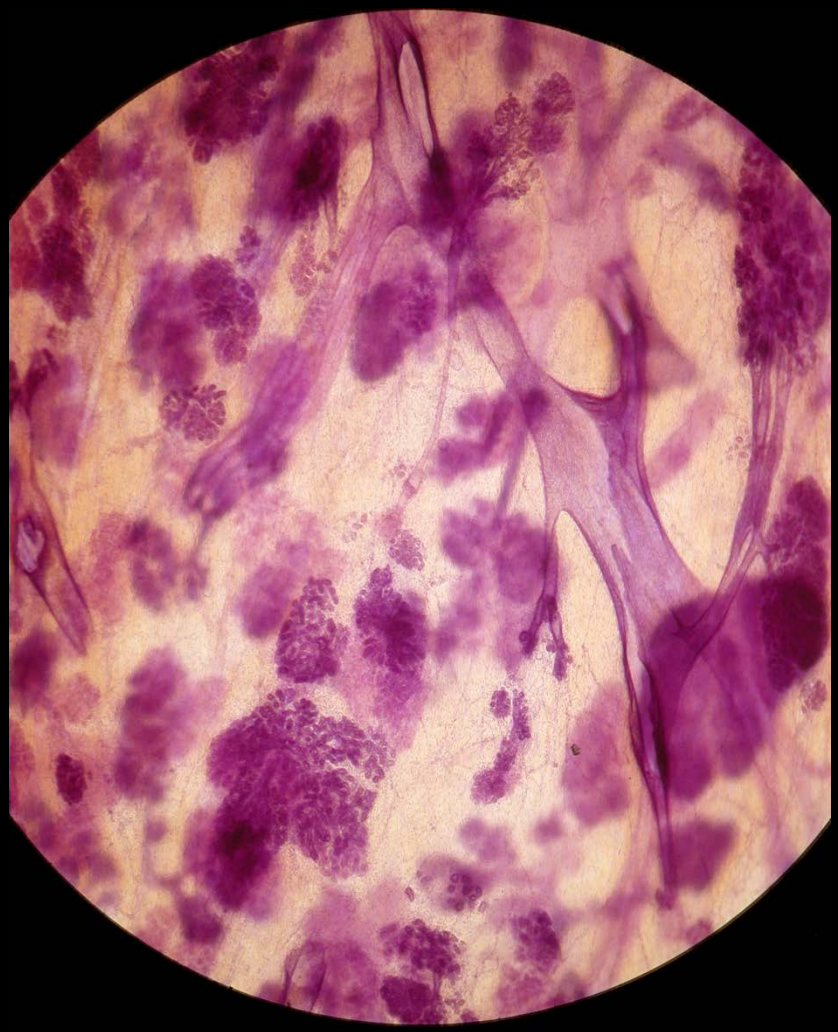
Building block # 1: Terminal Ductal Lobular Units

(nodular densities on the mammogram/3D ultrasound).


DUCT

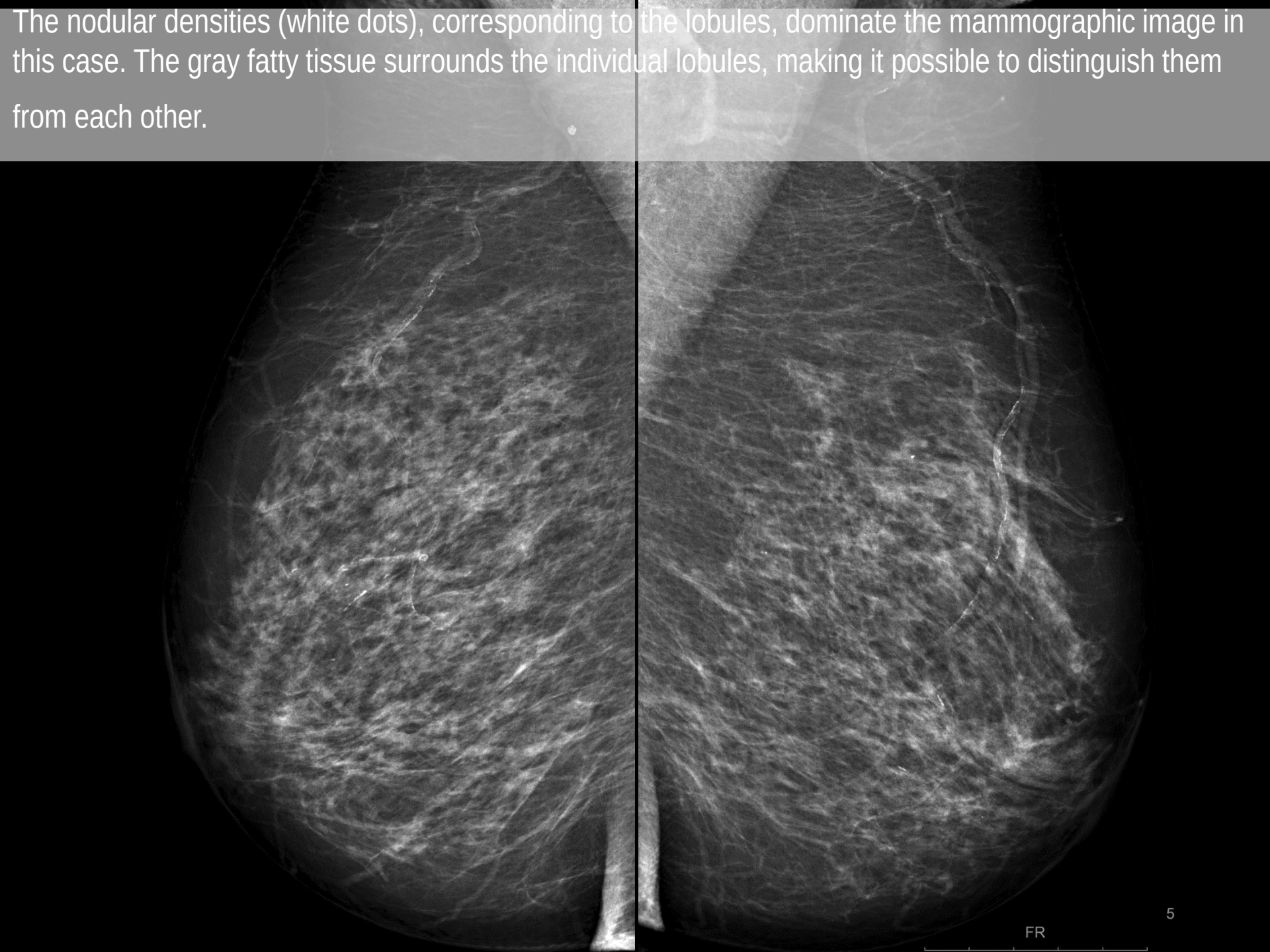


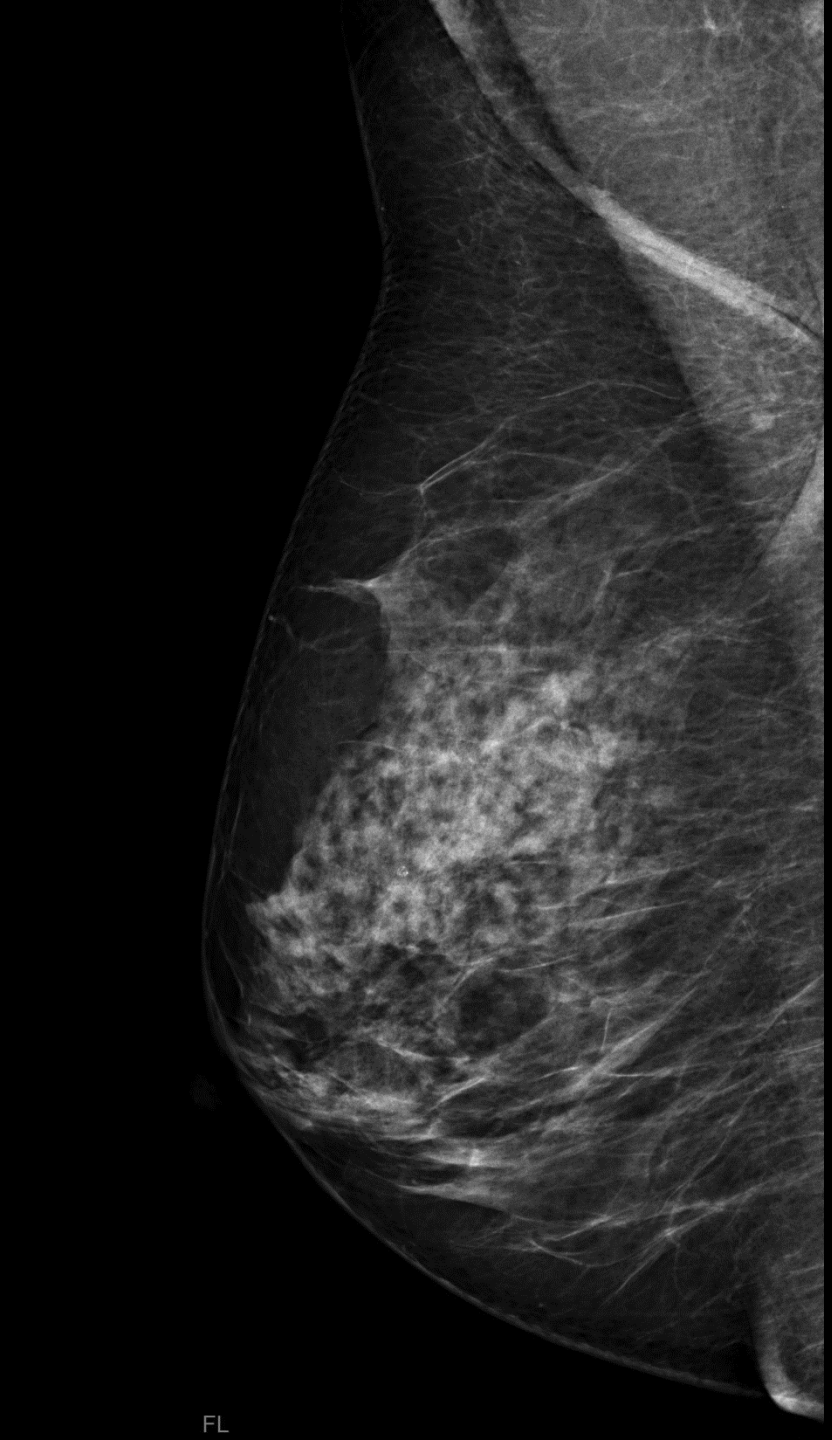


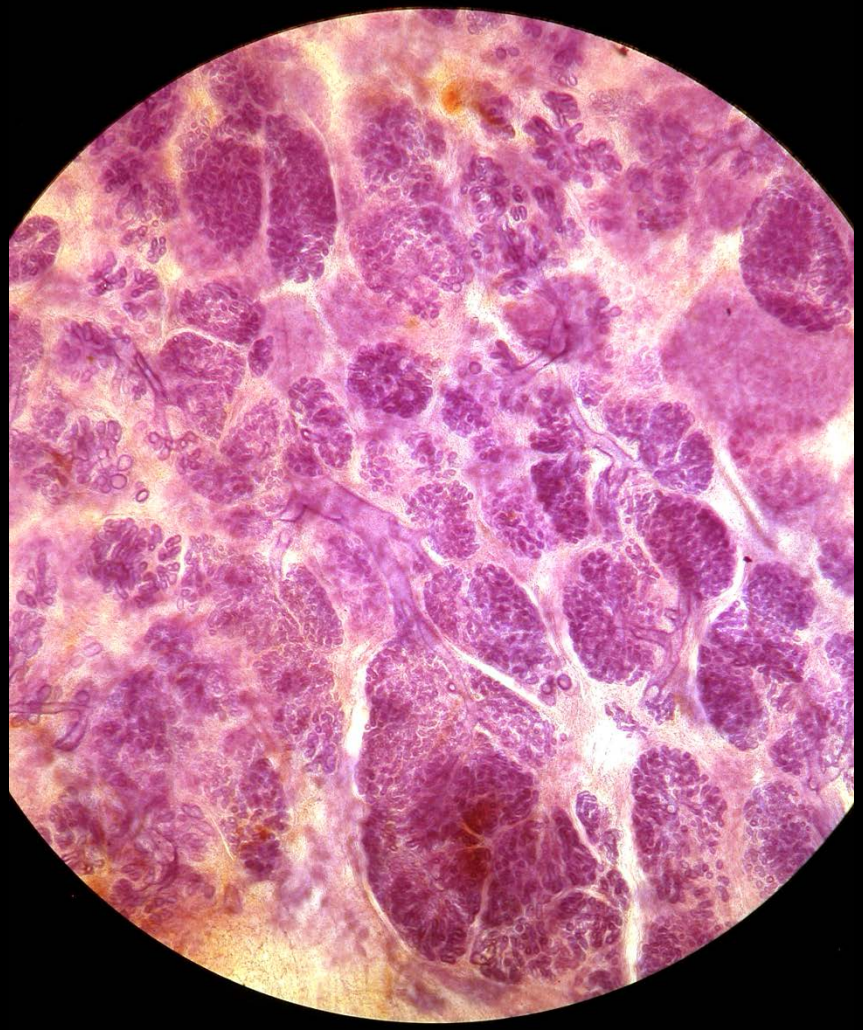


The modern breast imaging methods, mammography, breast MRI, automated and hand-held ultrasound, are able to demonstrate the normal ducts and lobules, so that the pathologic lesions developing from these structures can be detected early on in their development.

The nodular densities (white dots), corresponding to the lobules, dominate the mammographic image in this case. The gray fatty tissue surrounds the individual lobules, making it possible to distinguish them from each other.



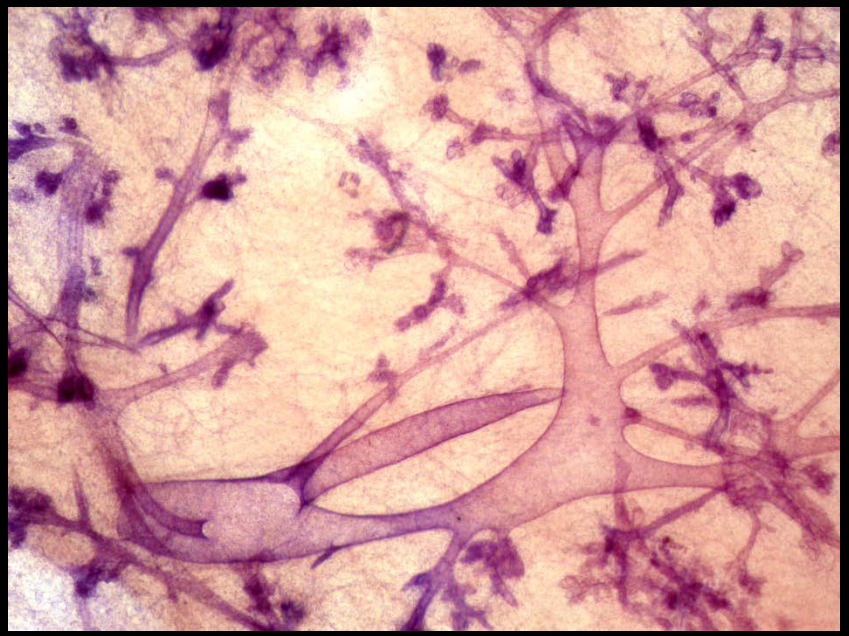


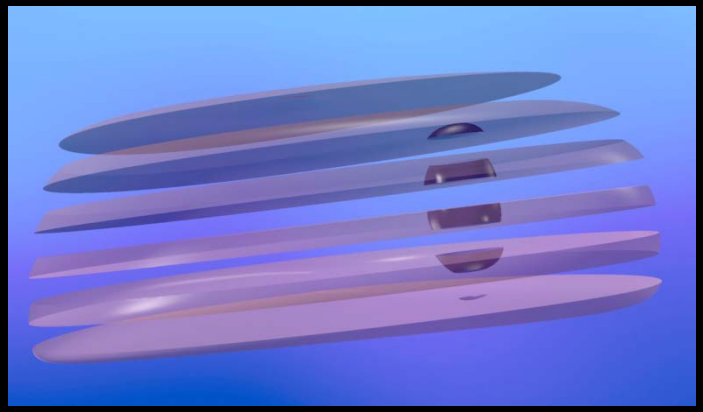


The TDLUs are larger, which is reflected on the mammograms as larger nodular densities.

Atrophic TDLUs (tiny nodular densities) and ducts (thin linear densities) are still visible in the upper portion of the breasts.

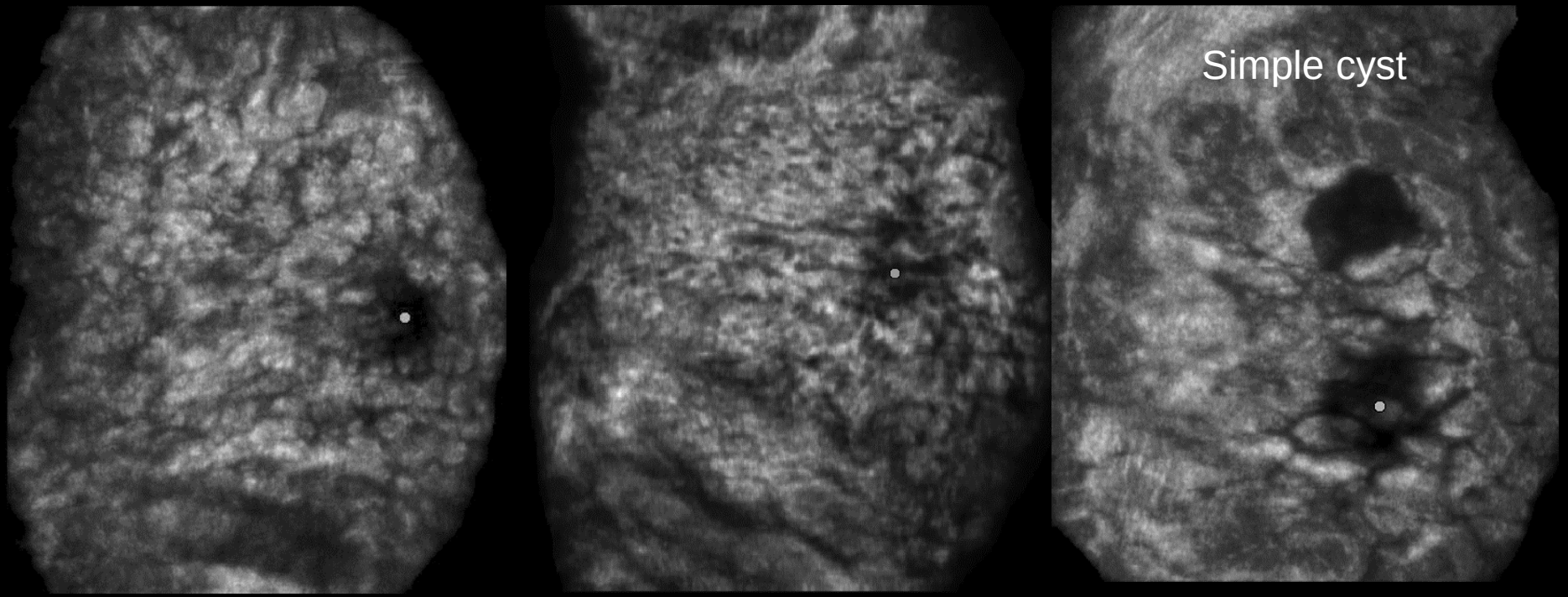
With declining hormonal influence, the TDLUs begin to atrophy while the fluid they produced remains in the duct system.



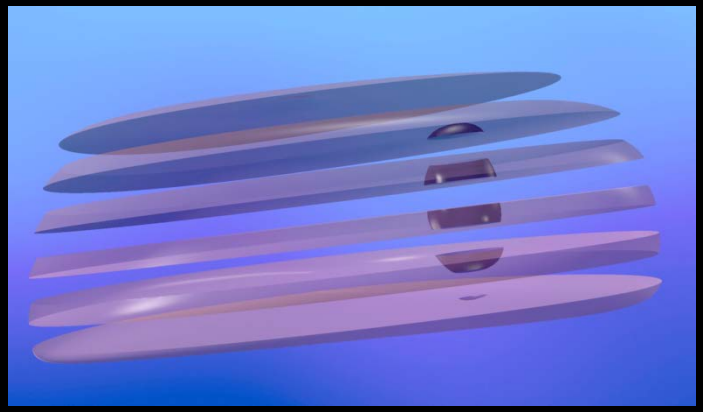


Automated Breast UltraSound (ABUS)

The automated breast ultrasound (ABUS) examination produces consecutive, 2 mm thick image slices from the skin to the chest wall.



A breast cancer or a fluid-filled cyst cause defects in the normal breast structure, enabling the detection of small lesions that might be hidden on the mammogram.



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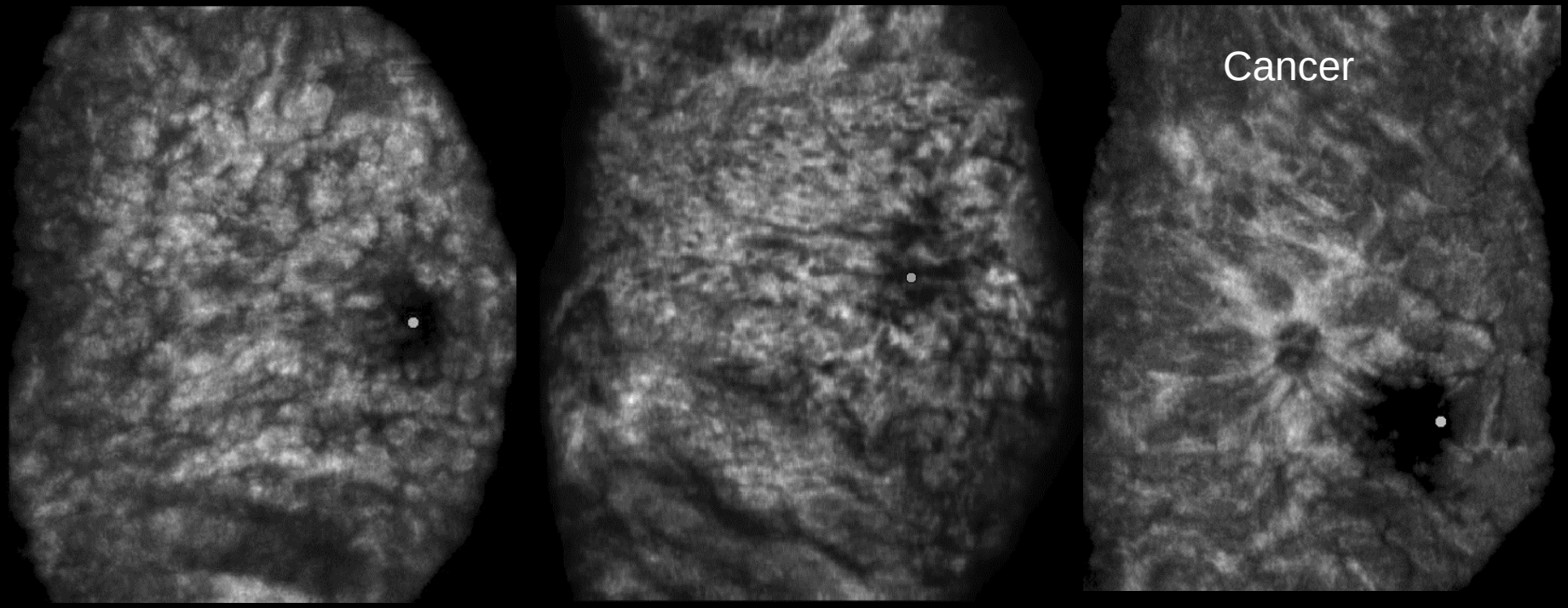

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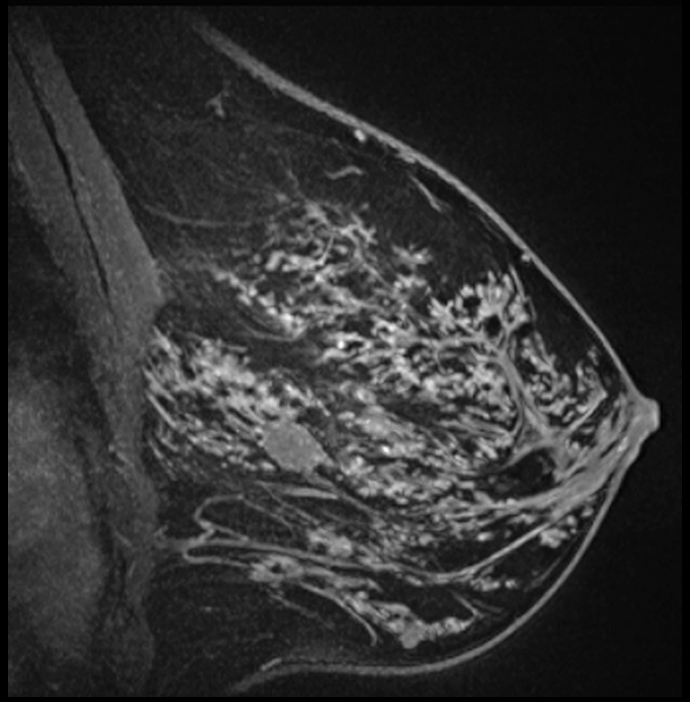
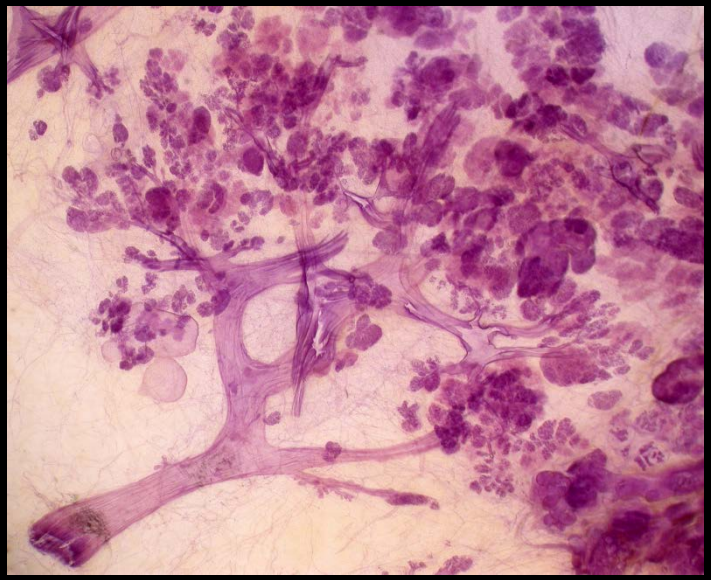
Breast MRI

MRI exam courtesy:
Bruce Porter, M.D., Seattle





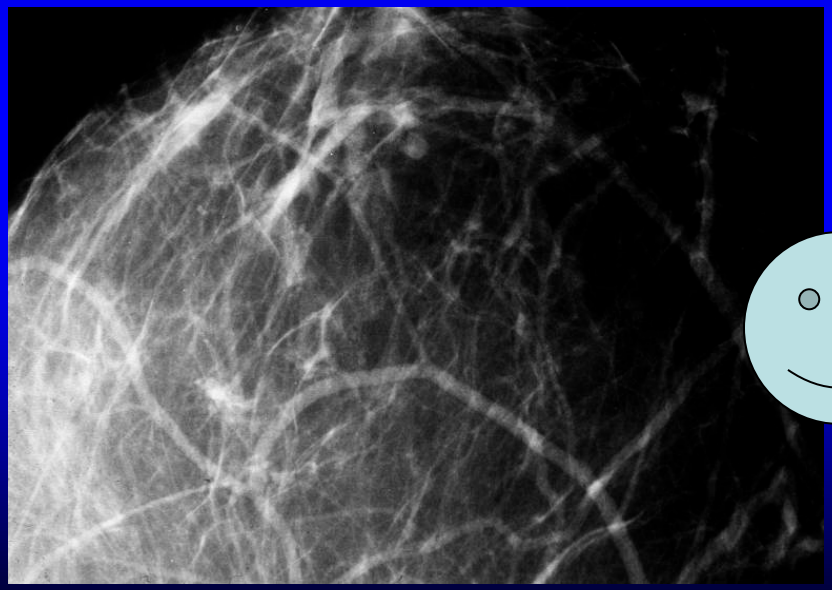
Each of these breast imaging methods has its own strengths and weaknesses, which is why evaluation of breast lesions usually calls for their use in combination.

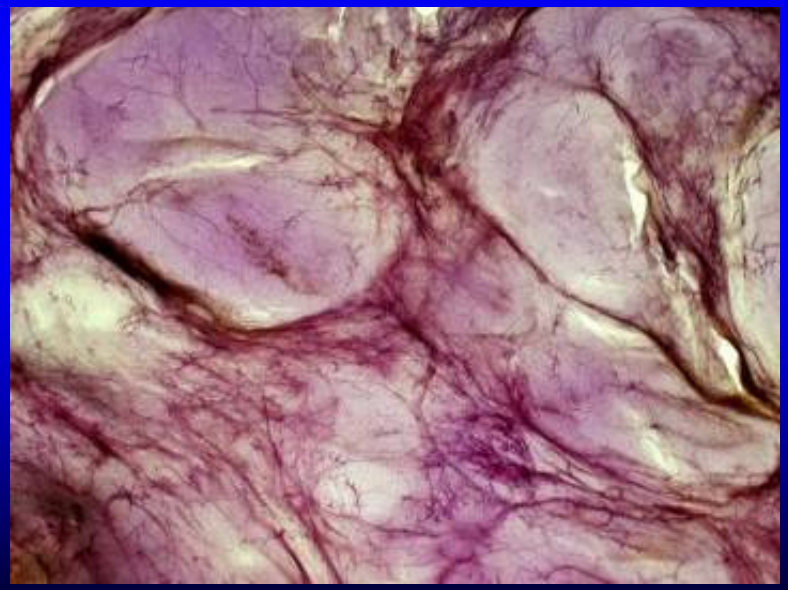
The lobule and the terminal duct, which drains it, form an integrated functional entity, called the

terminal ductal lobular unit (TDLU)

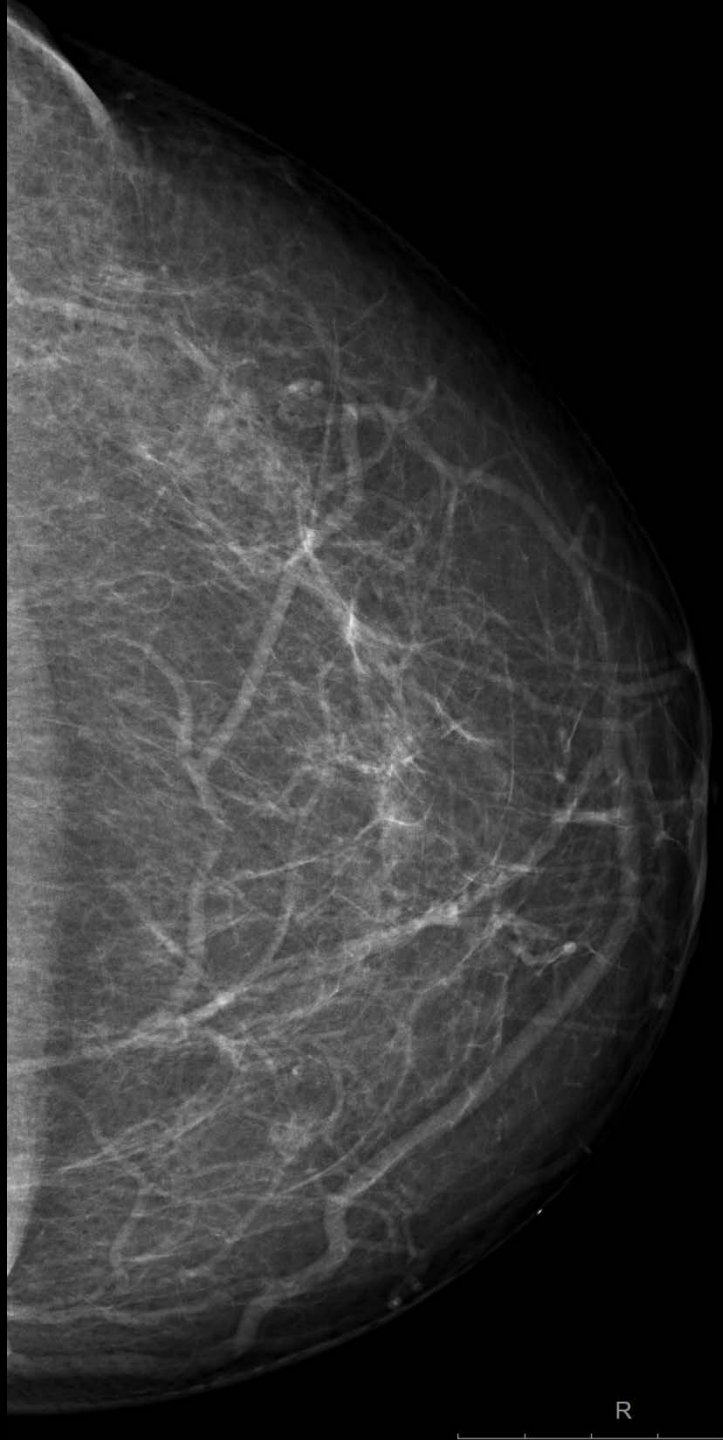
Most benign and malignant breast diseases originate from the TDLU, not from the ducts.

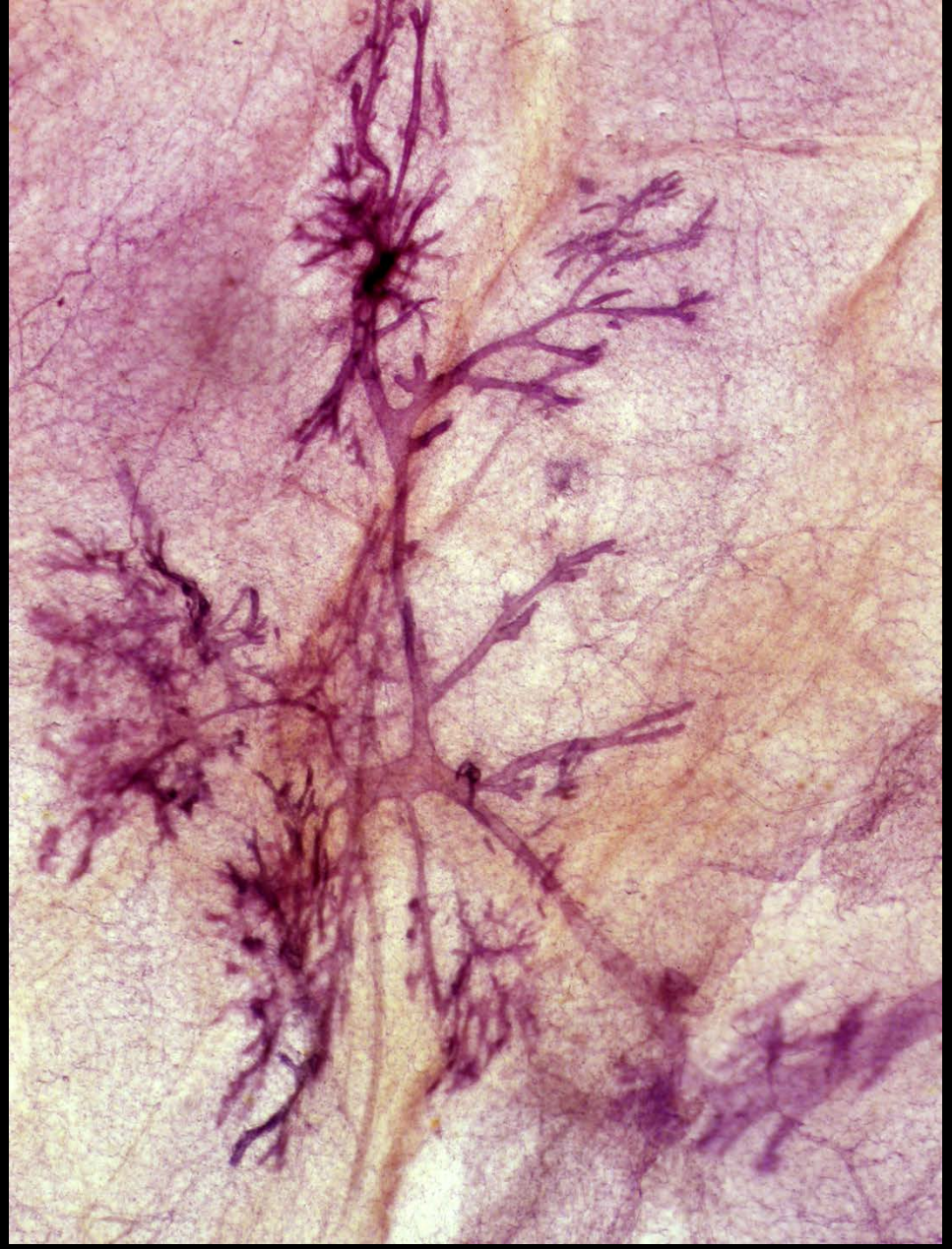
The *four "building blocks"* of the normal breast tissue can be well demonstrated individually on the mammogram/breast ultrasound/MRI of the breast:



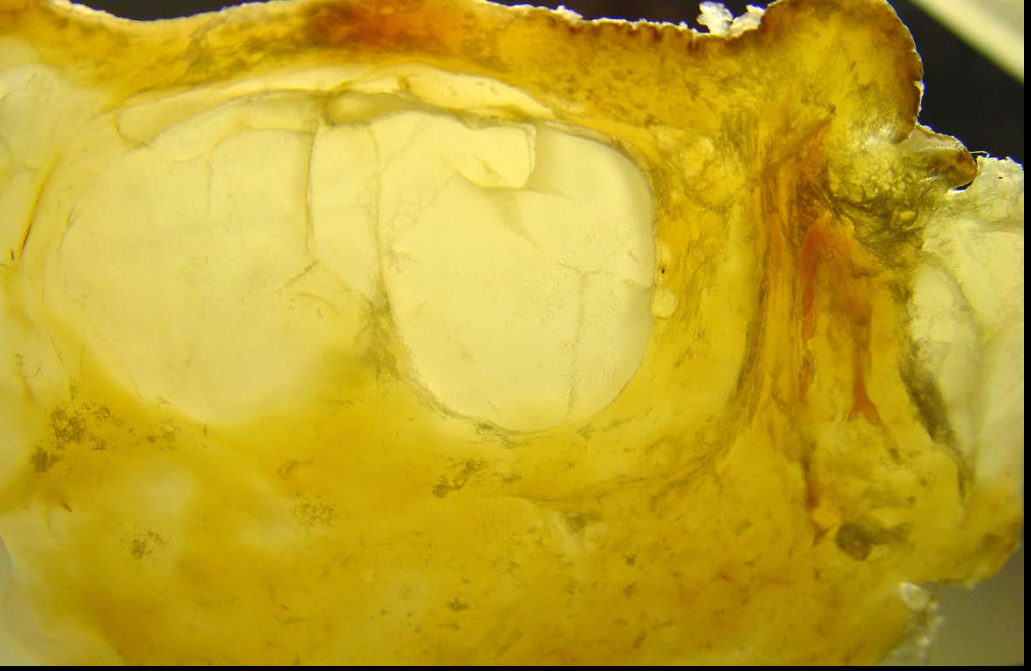


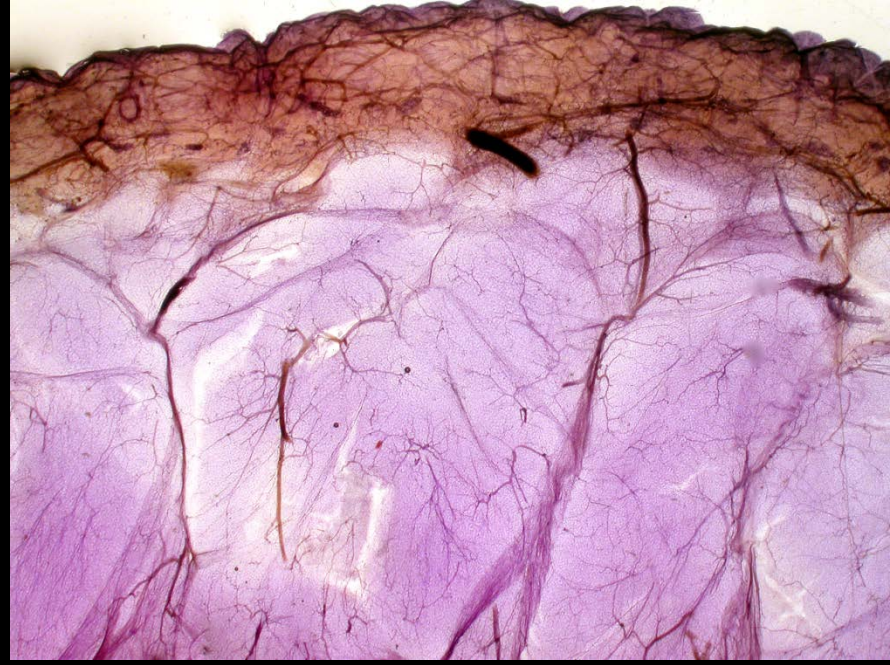
Building block # 2: Adipose tissue



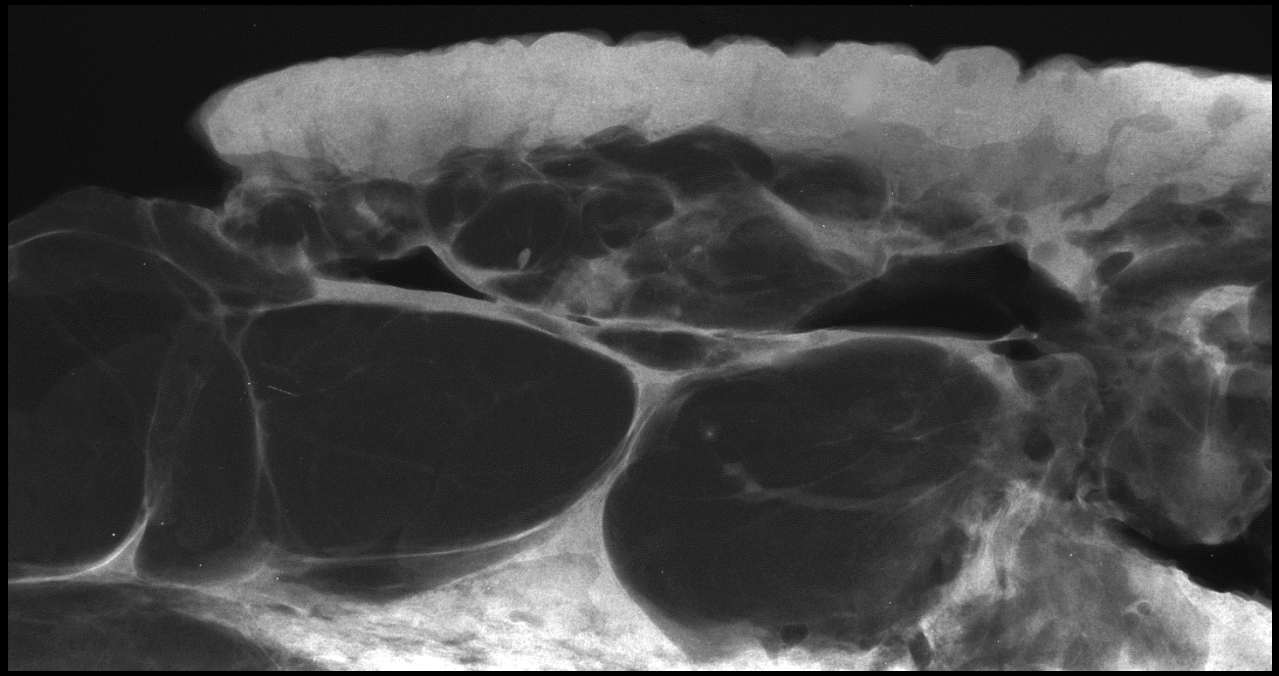


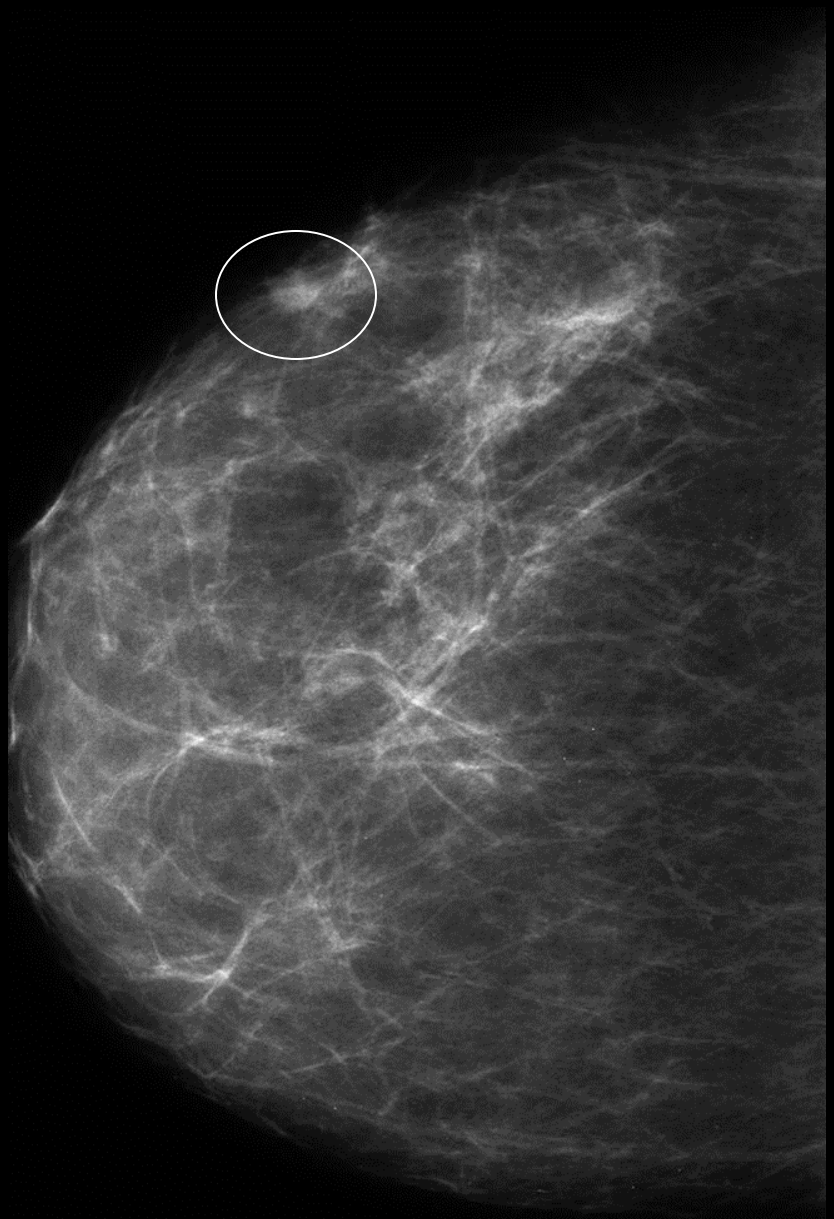
Complete atrophy of the TDLUs with an increase in the amount of fatty connective tissue.

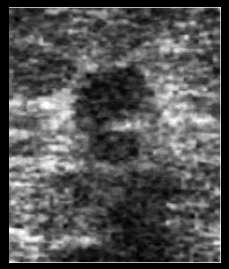


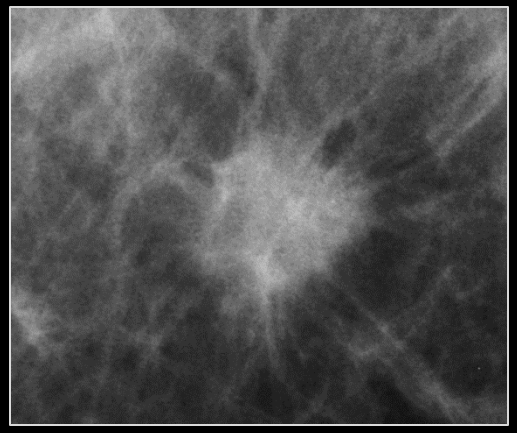


Normal skin of the breast and the fatty connective tissue beneath it.

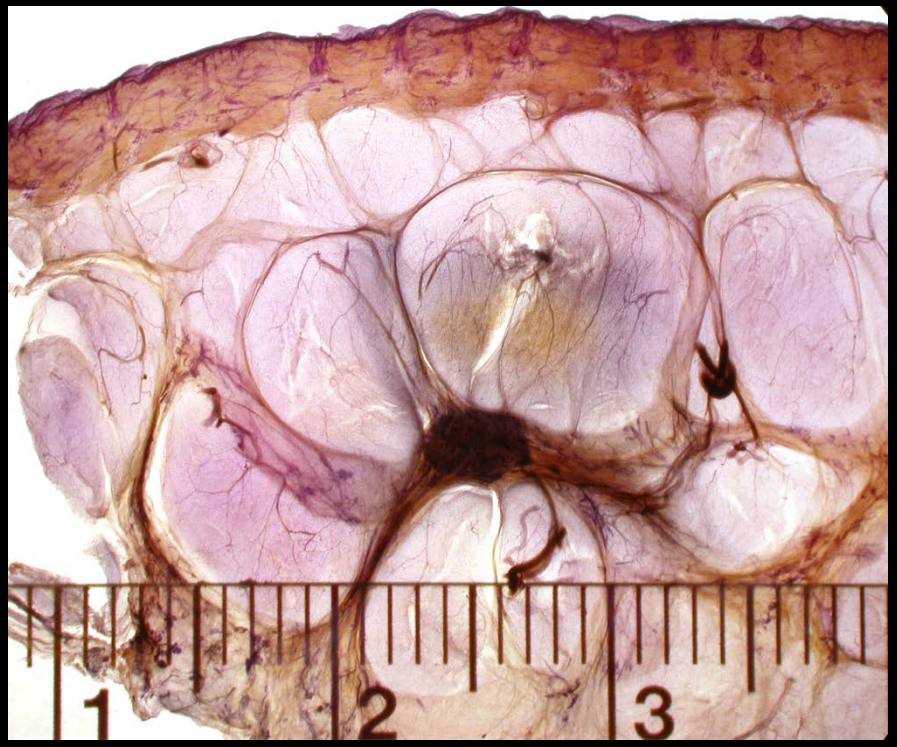


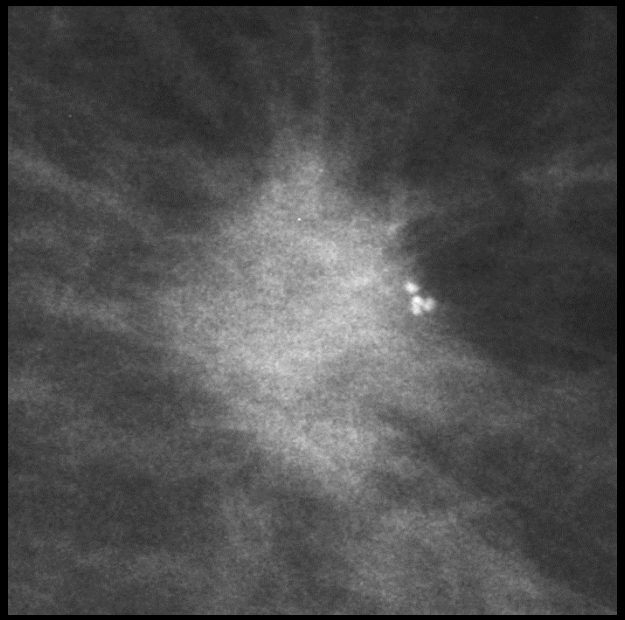


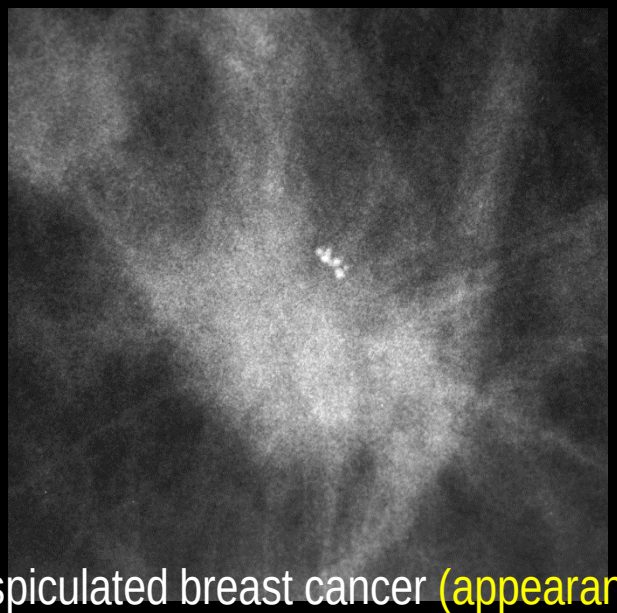




Most malignant breast diseases originate from the TDLU, not from the ducts.

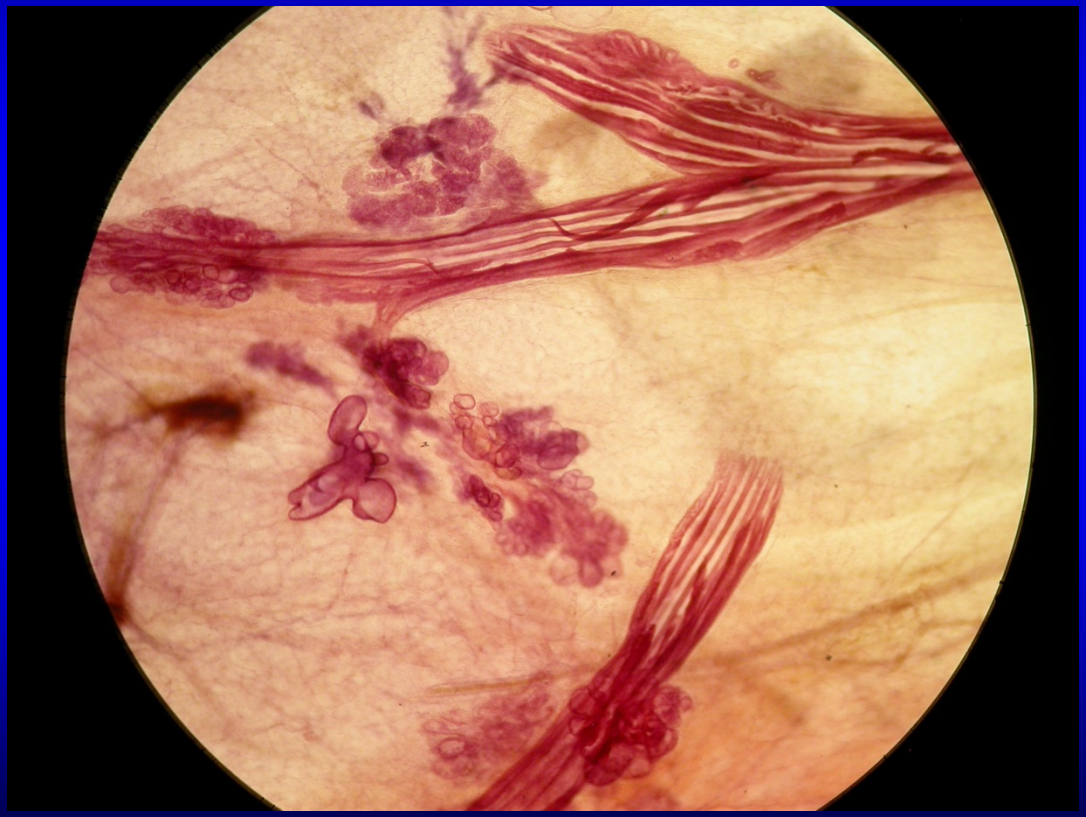






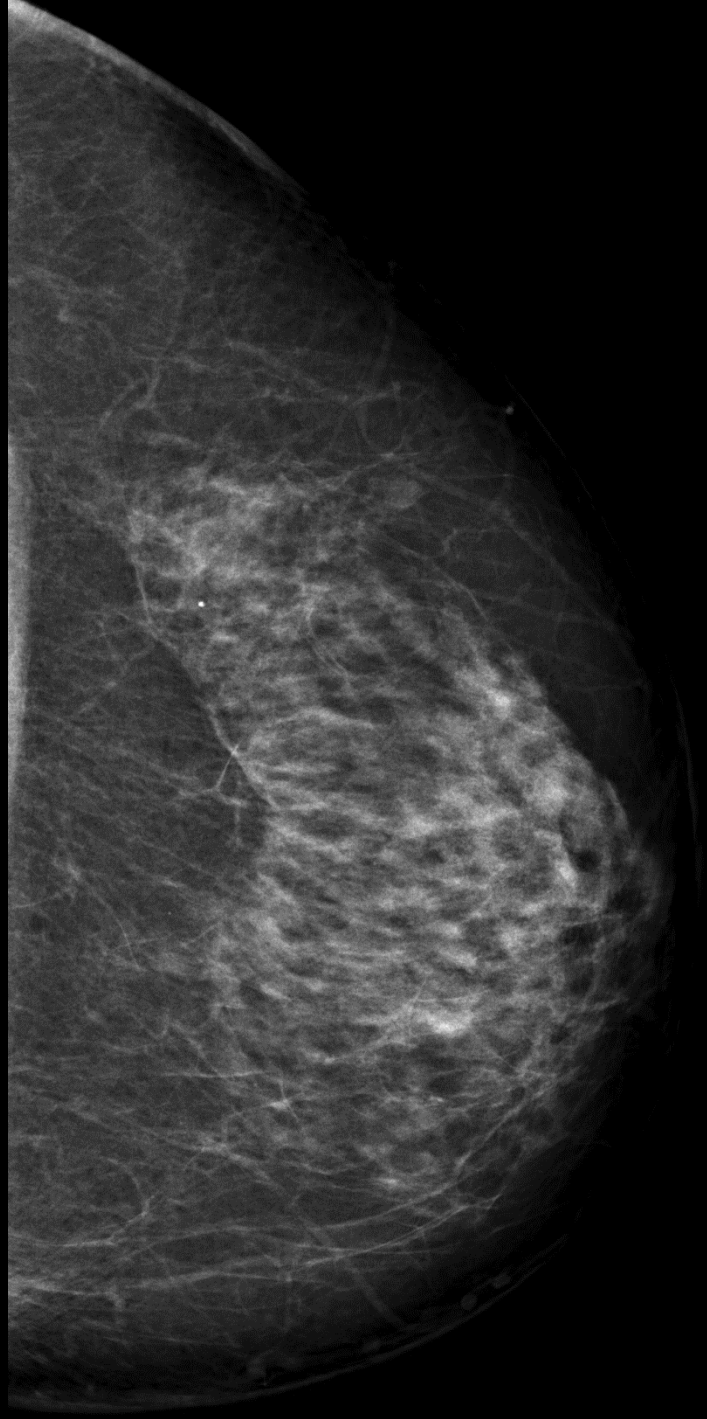
A 6 mm spiculated breast cancer (appearance similar to a sea urchin) arising in the TDLU is shown on mammographic images, on an automated ultrasound image in the coronal projection and on a thick section (3D) histologic image.

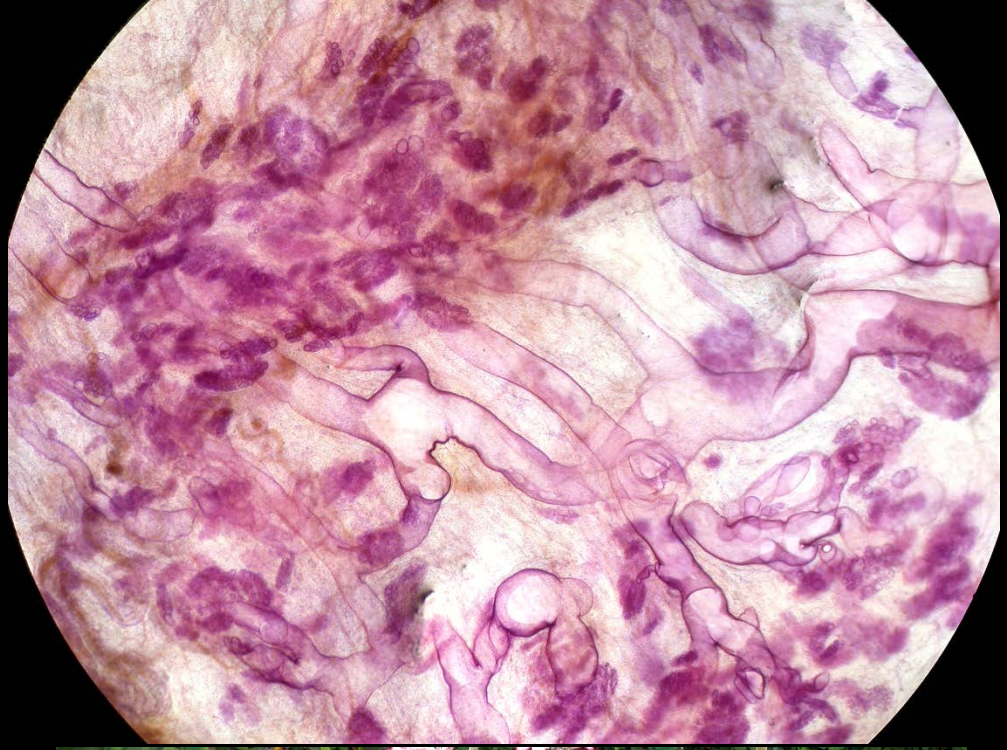
The *four "building blocks"* of the normal breast tissue can be well demonstrated individually on the mammogram/breast ultrasound/MRI of the breast:

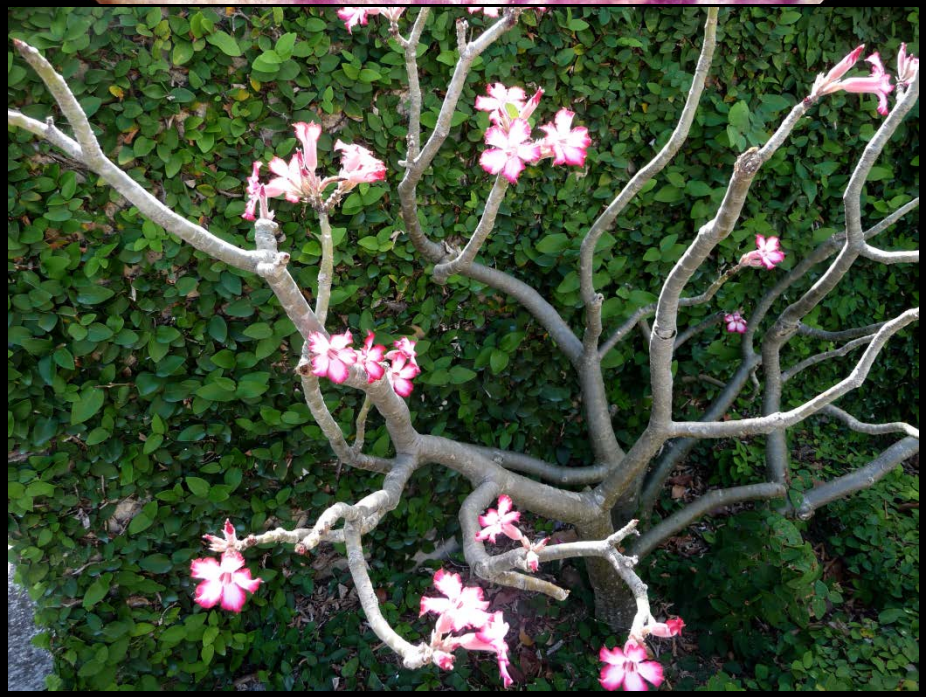


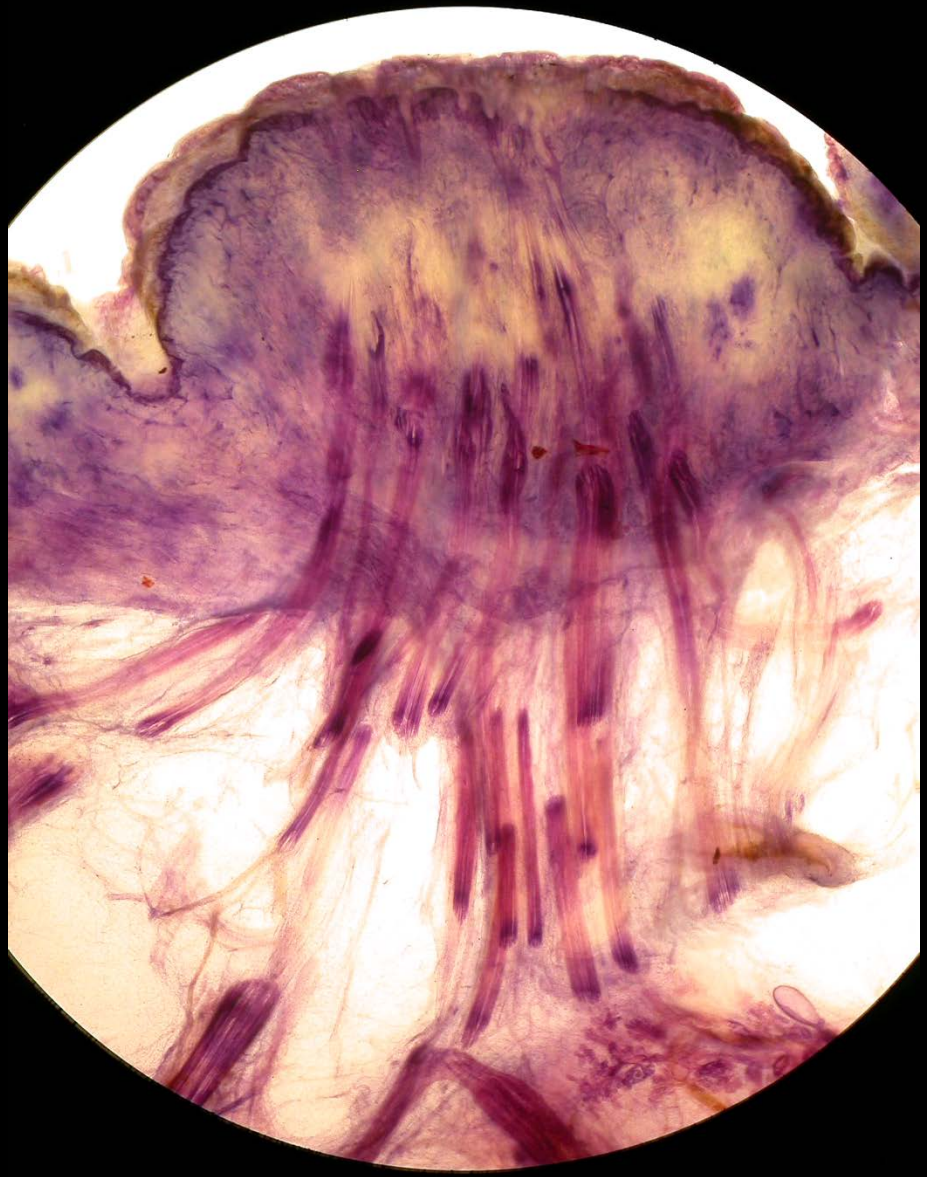
- Ducts and their branches

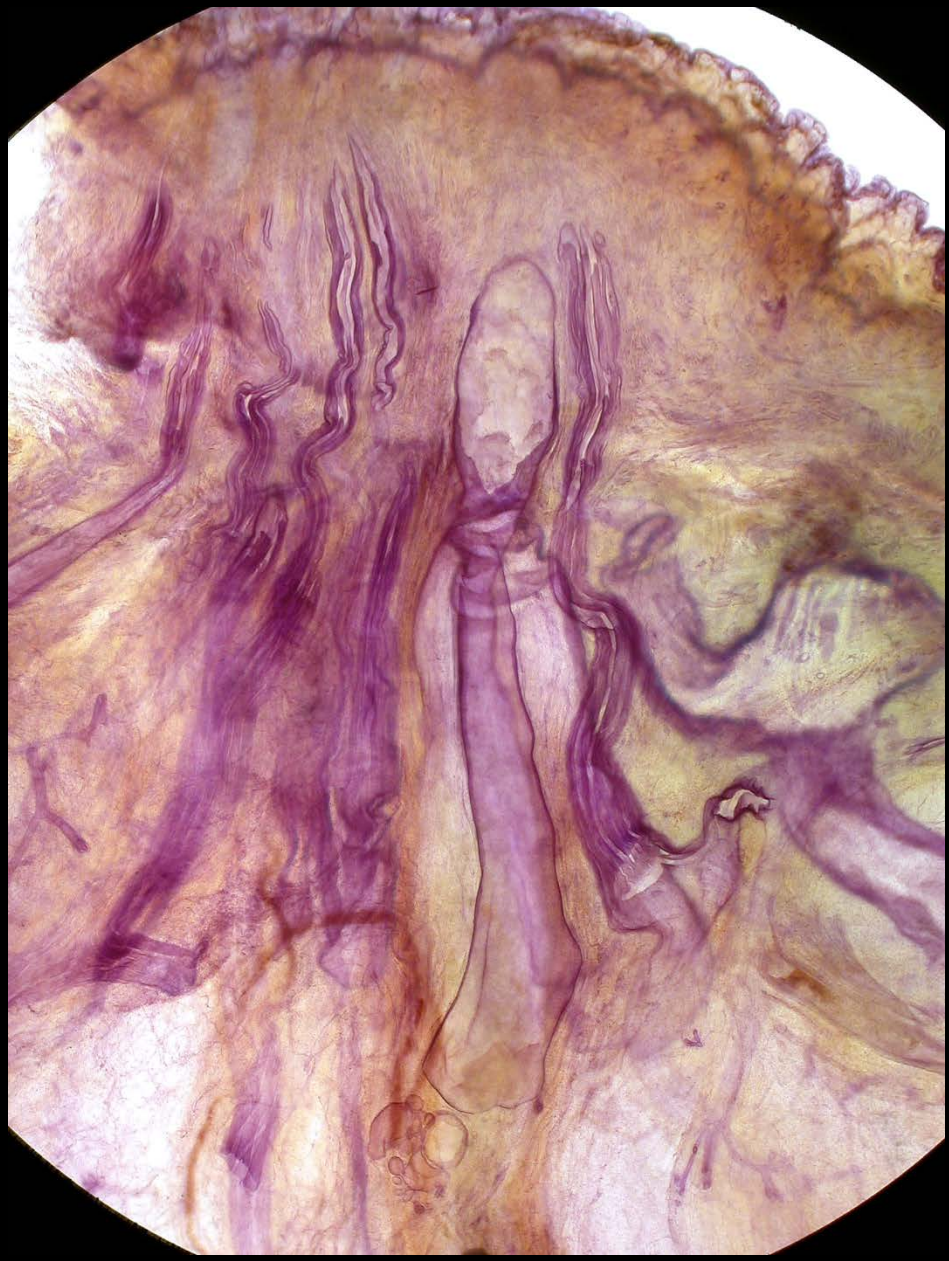
Building block # 3: ducts and their branches
(linear densities on the mammogram).





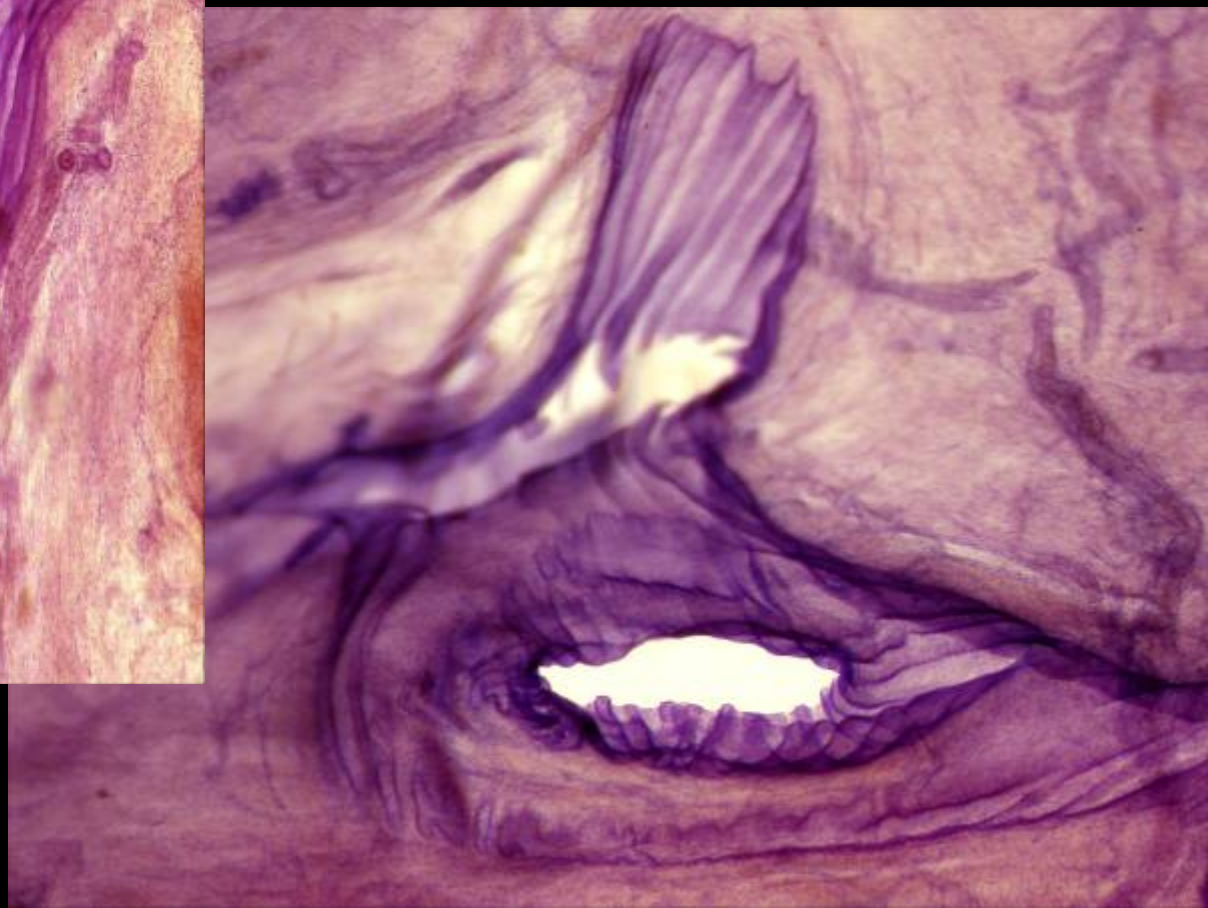






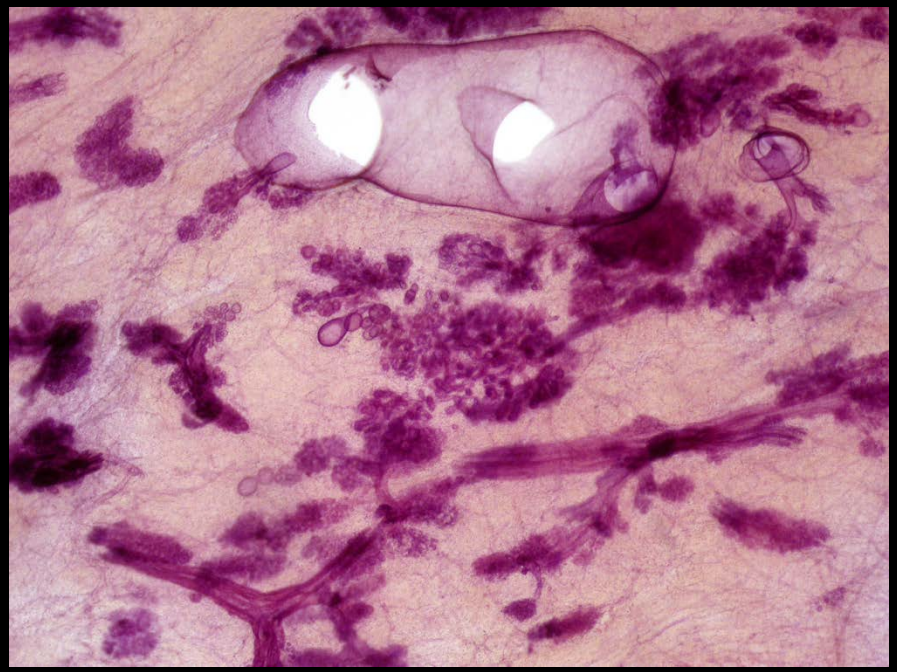
The major ducts converge on the nipple.

When not distended, the normal ducts are pleated and are about 0.1 mm in diameter.

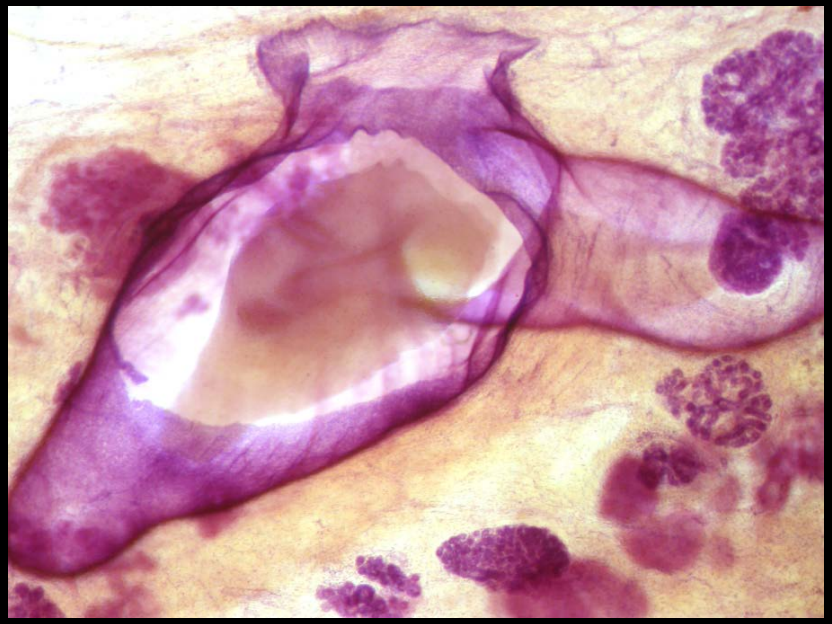


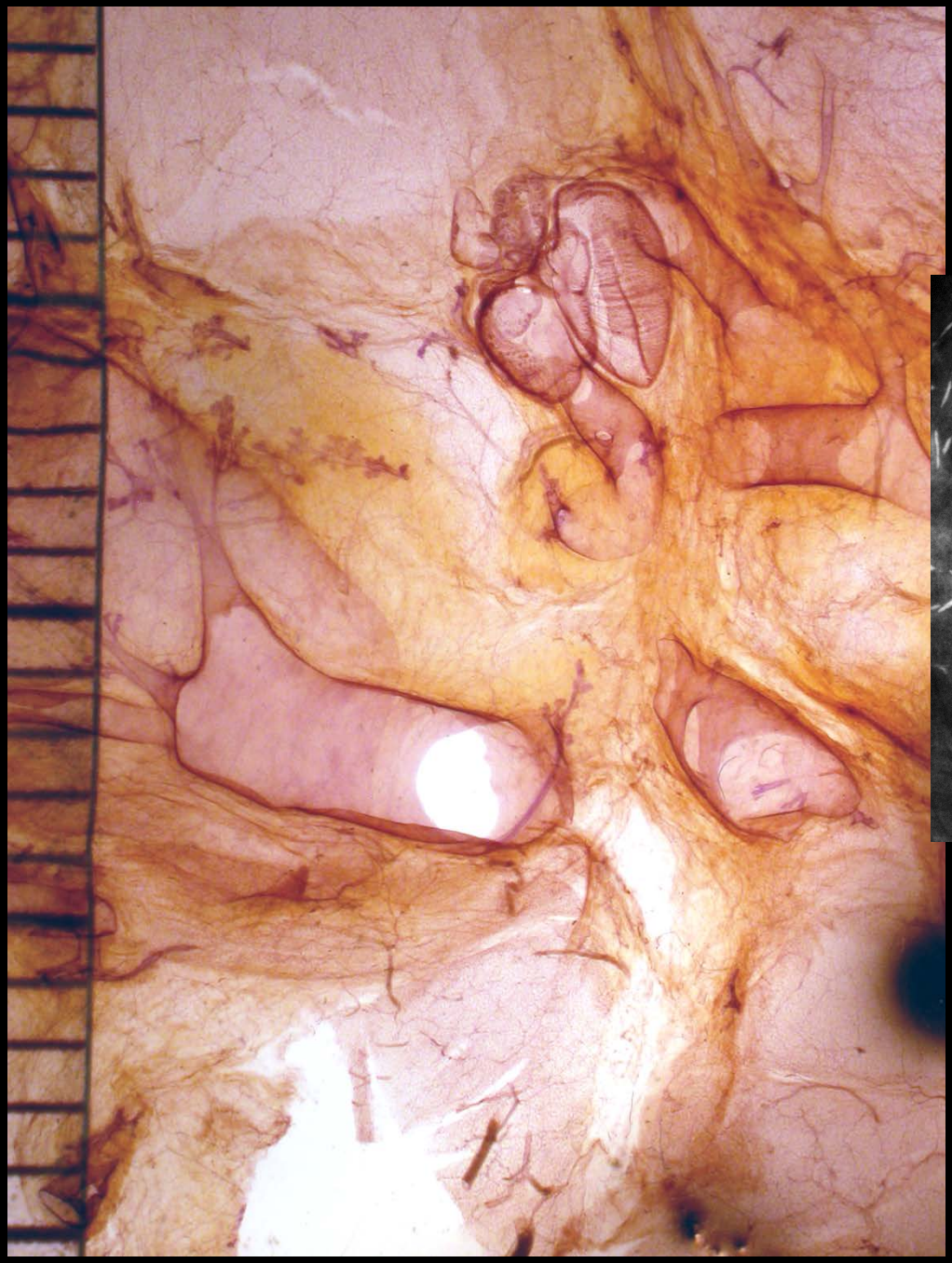
The pleats follow the twists in the major ducts.

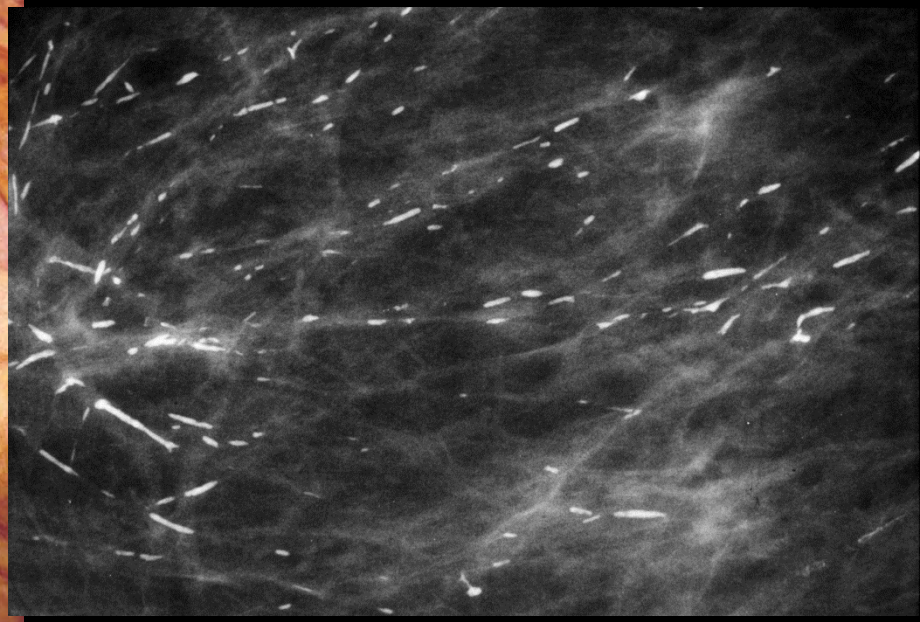
The pleats will disappear when the duct is distended by accumulating fluid or cancer cells.



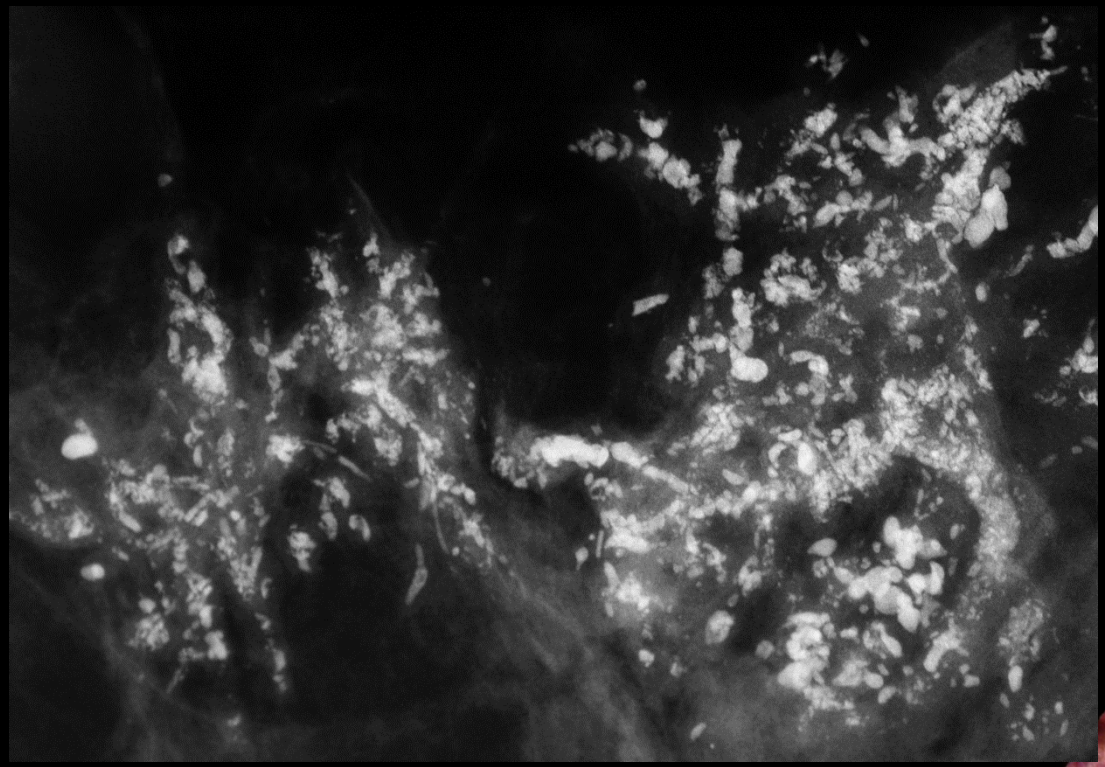
Over time, as the protein-rich fluid accumulates and distends the ducts and their branches, the pleats will disappear entirely and the fluid becomes concentrated (yellow on the image).



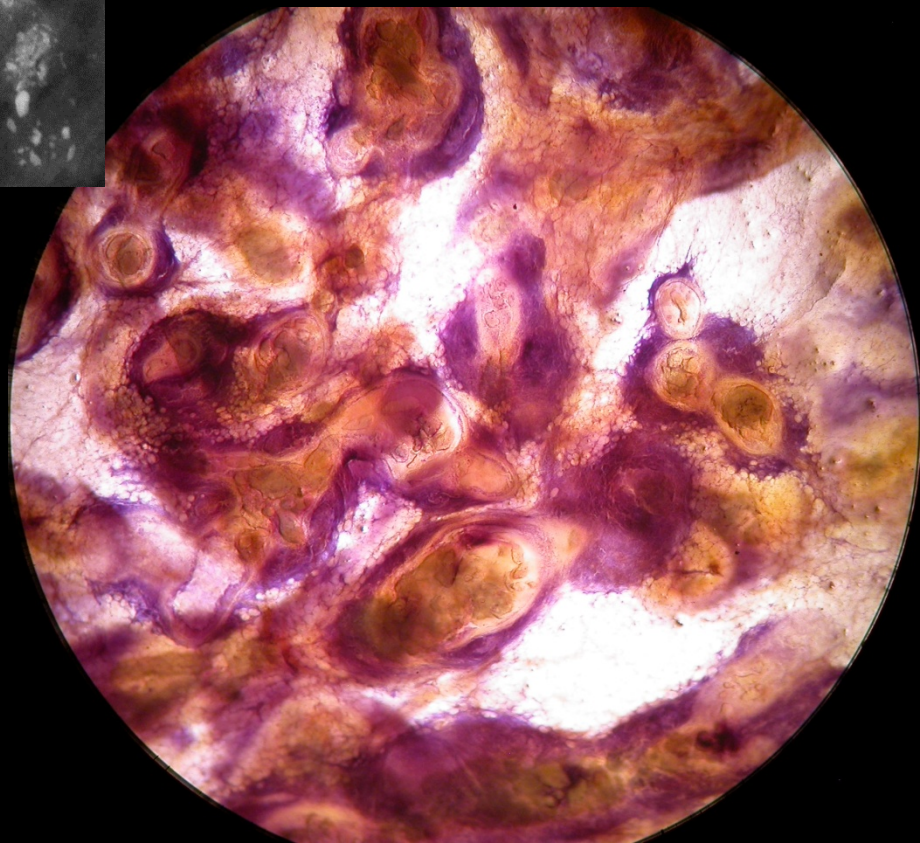




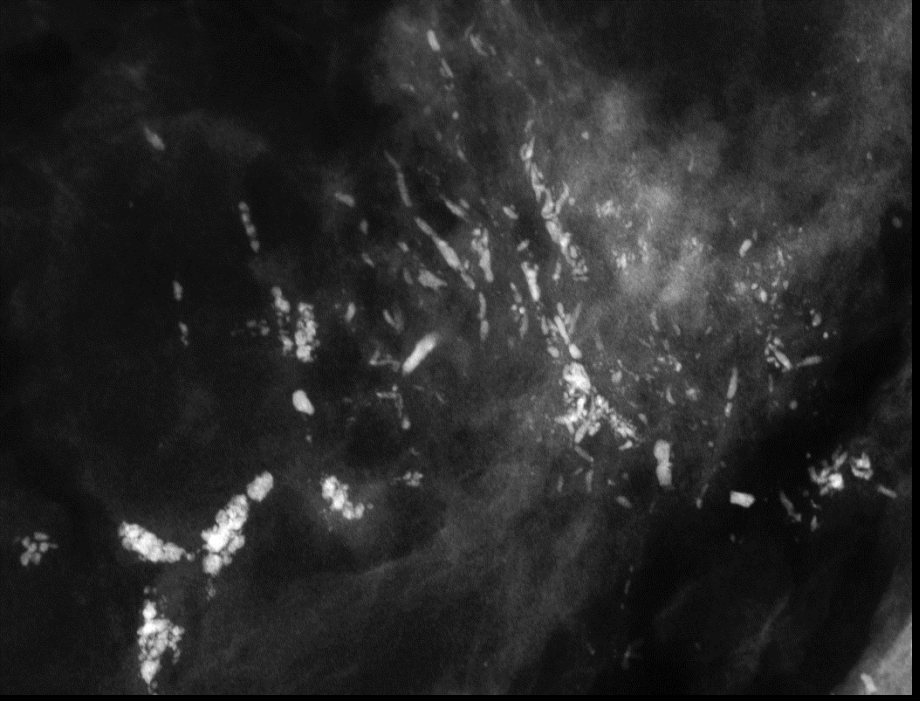
The highly proteinaceous, concentrated fluid may calcify and outline the ducts and their branches (secretory “disease” type calcifications).

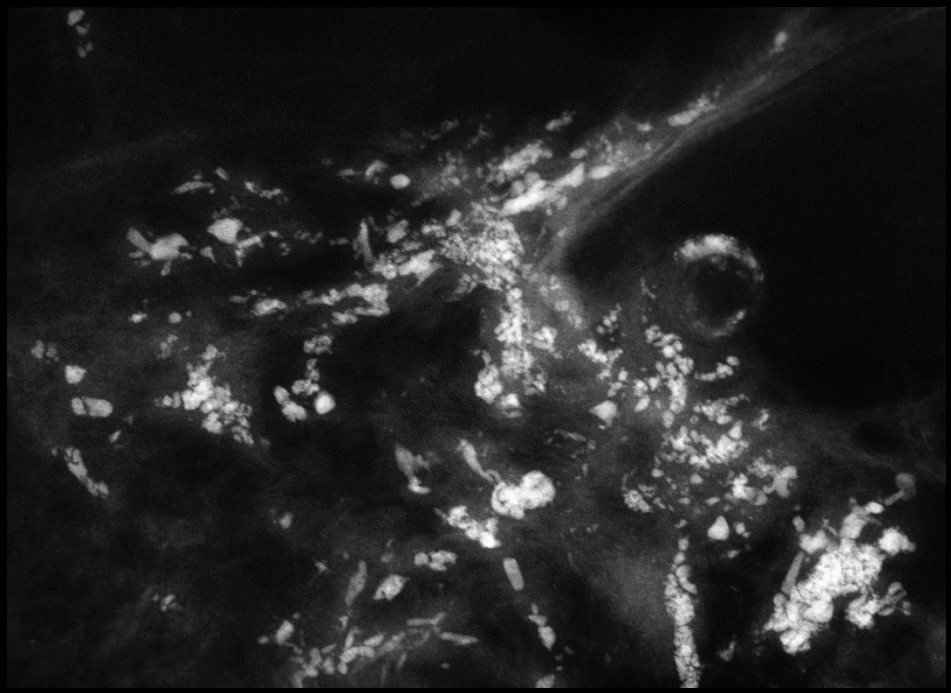


One type of breast cancer that develops in the larger ducts may produce long, irregular, branching calcifications, which are easily seen on the mammograms.

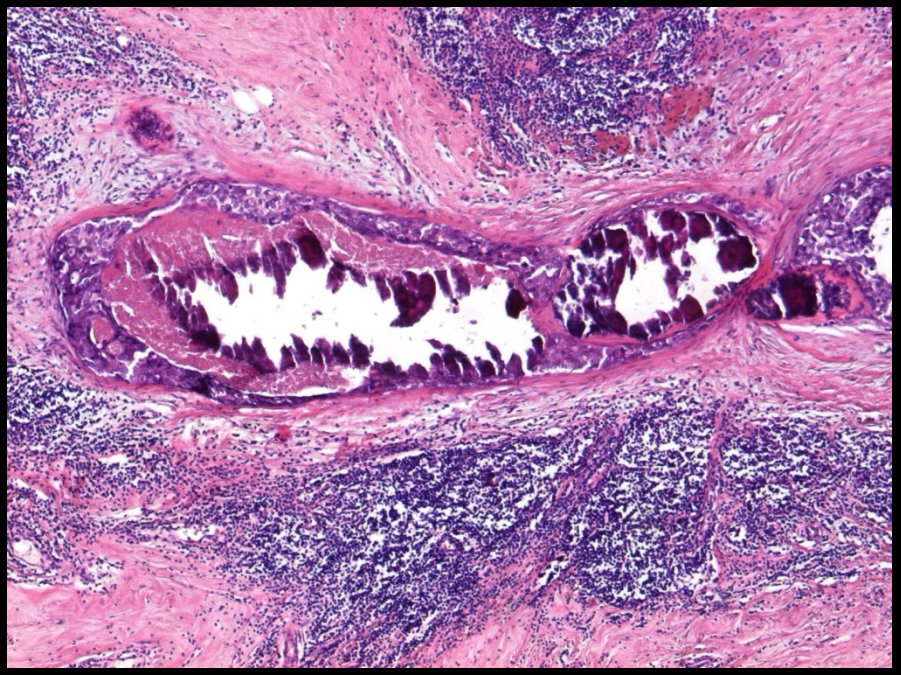


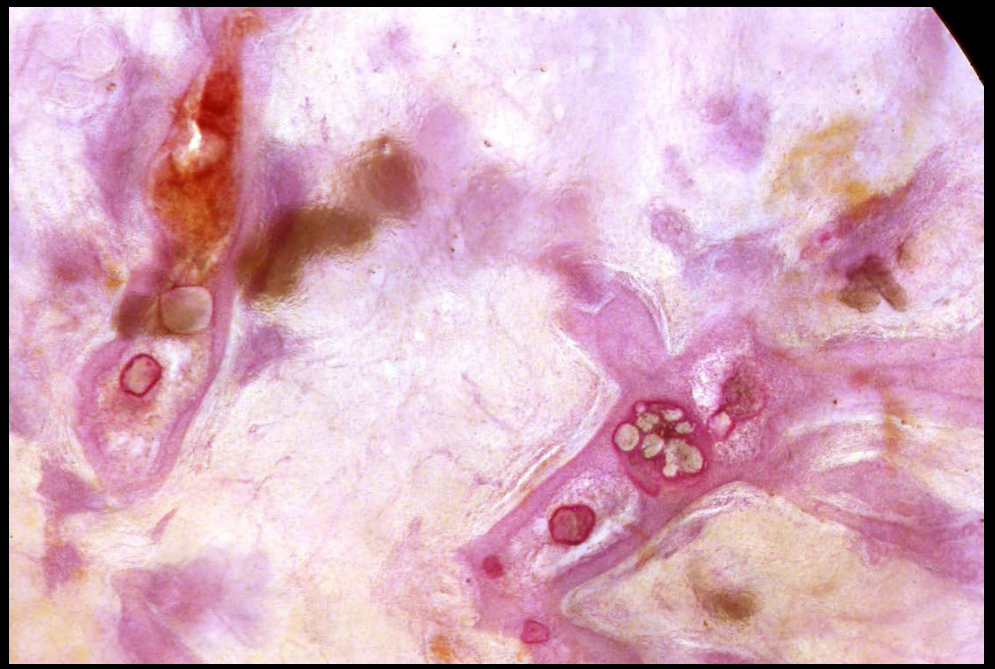
Ducts distended by tumor cells, debris and amorphous calcifications.

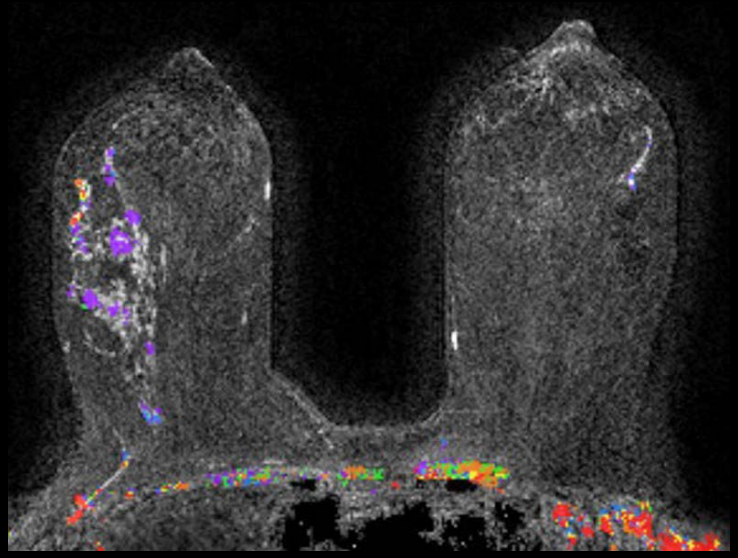


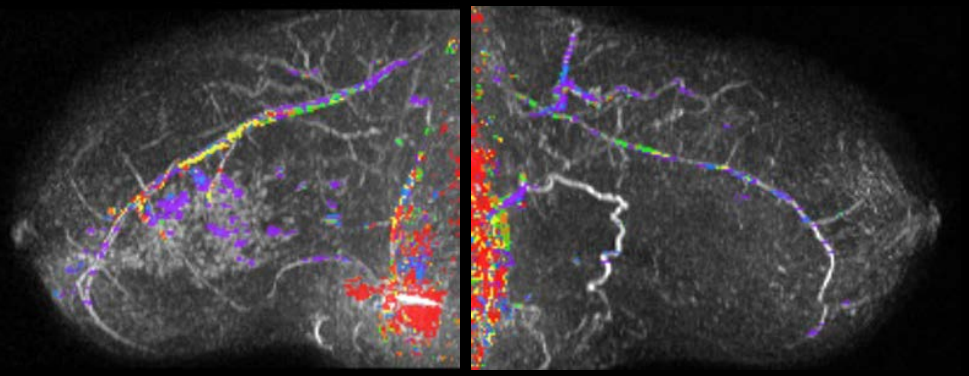


Mammographic-histologic correlation of ducts distended by tumor cells, debris and calcifications.



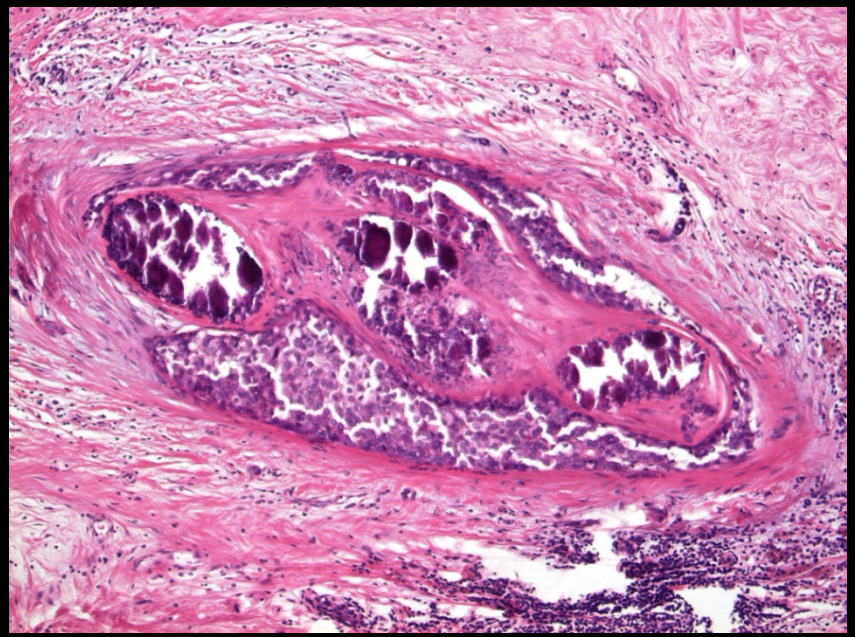


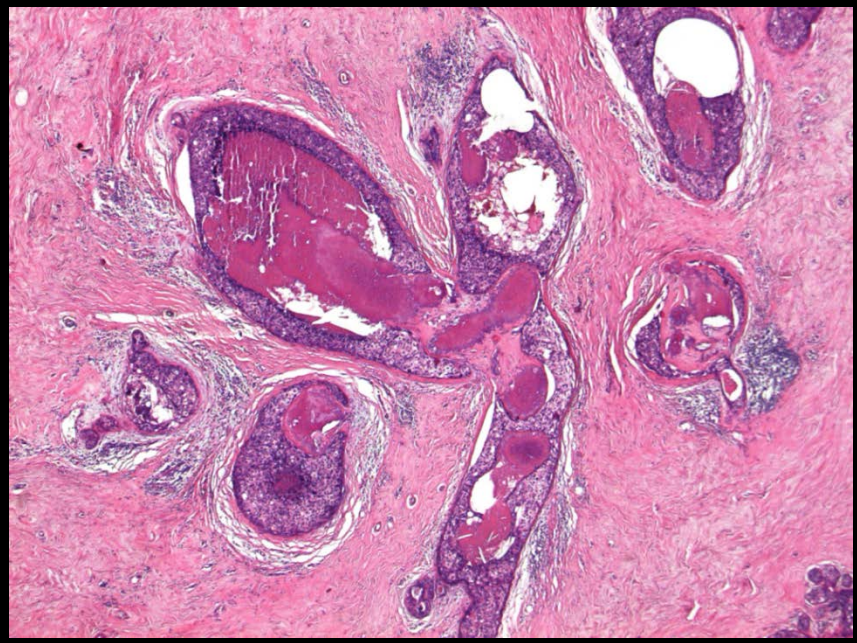




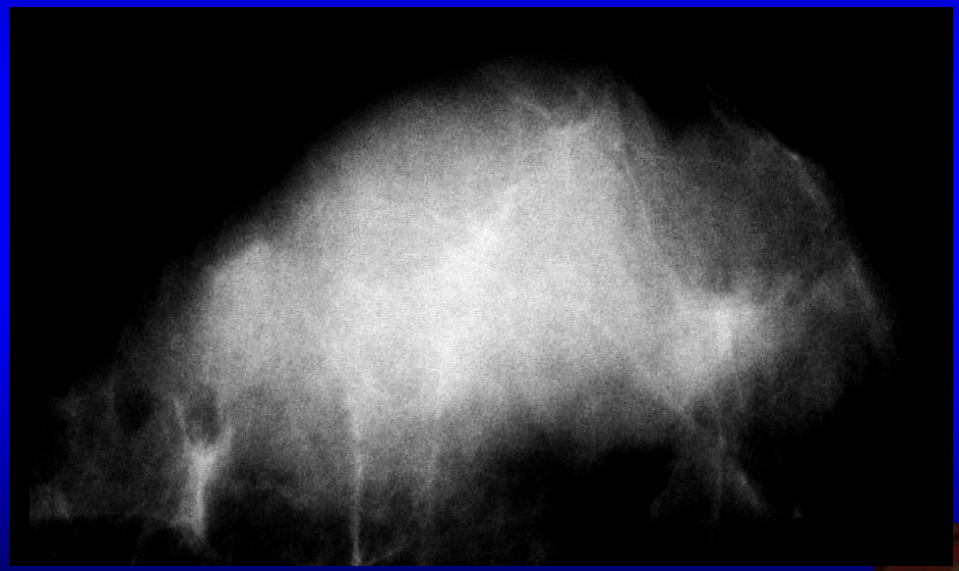
MRI of the breast: Corresponding to the malignant type calcifications found at mammography,

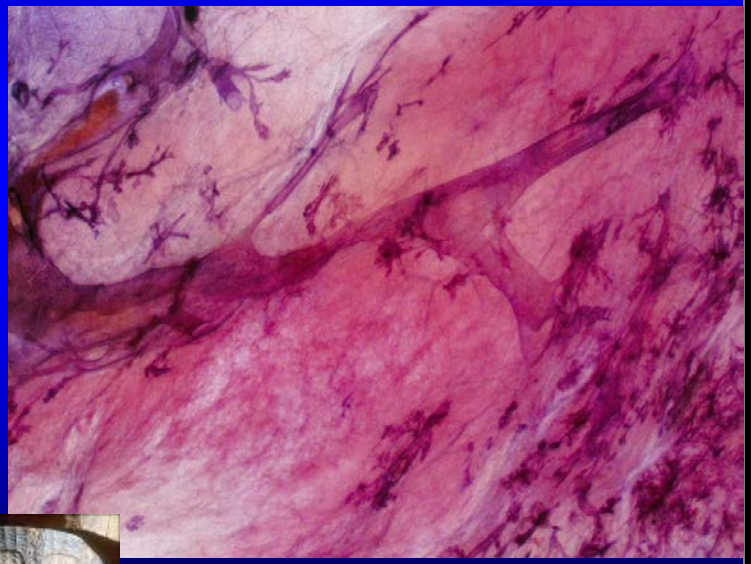
MRI demonstrates malignant breast disease covering a region measuring 11x5x3 cm





The *four "building blocks"* of the normal breast tissue can be well demonstrated individually on the mammogram/breast ultrasound/MRI of the breast:



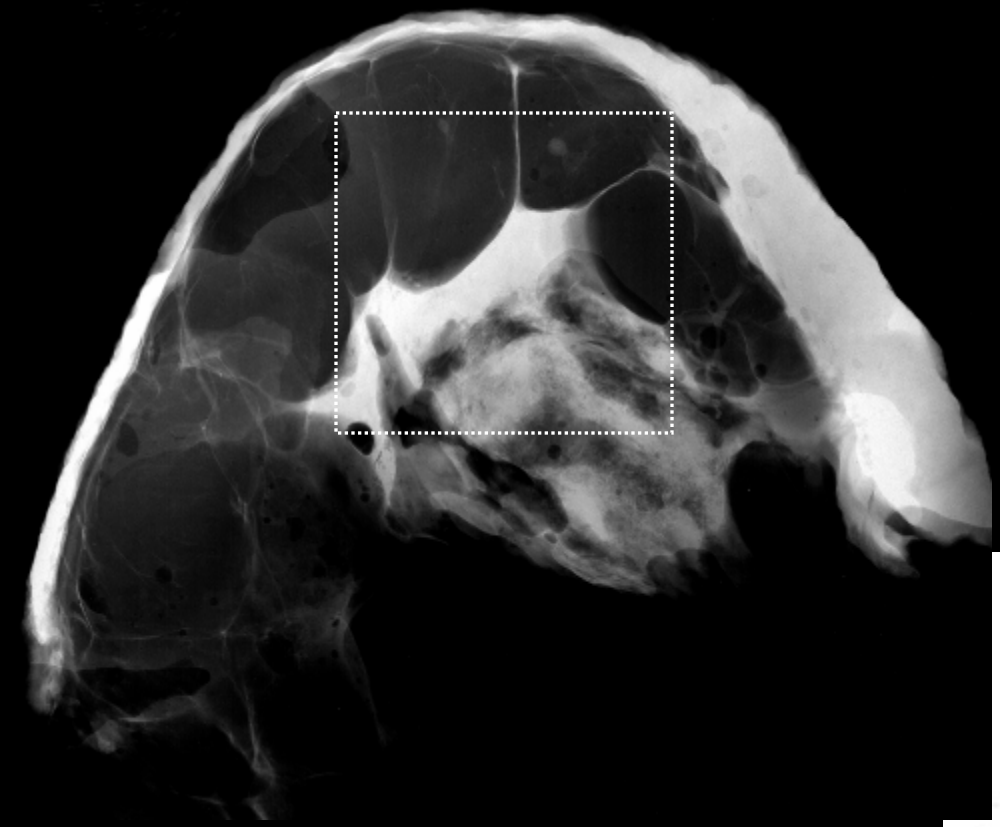


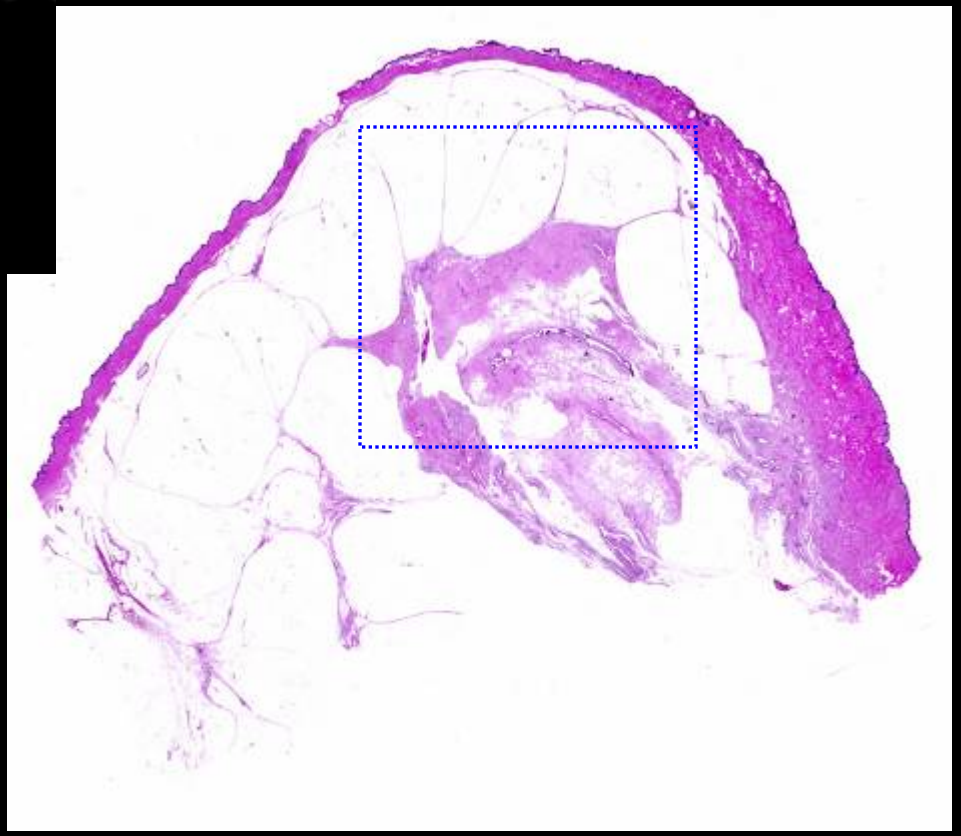
- Fibrous tissue (collagen)

Building block # 4:

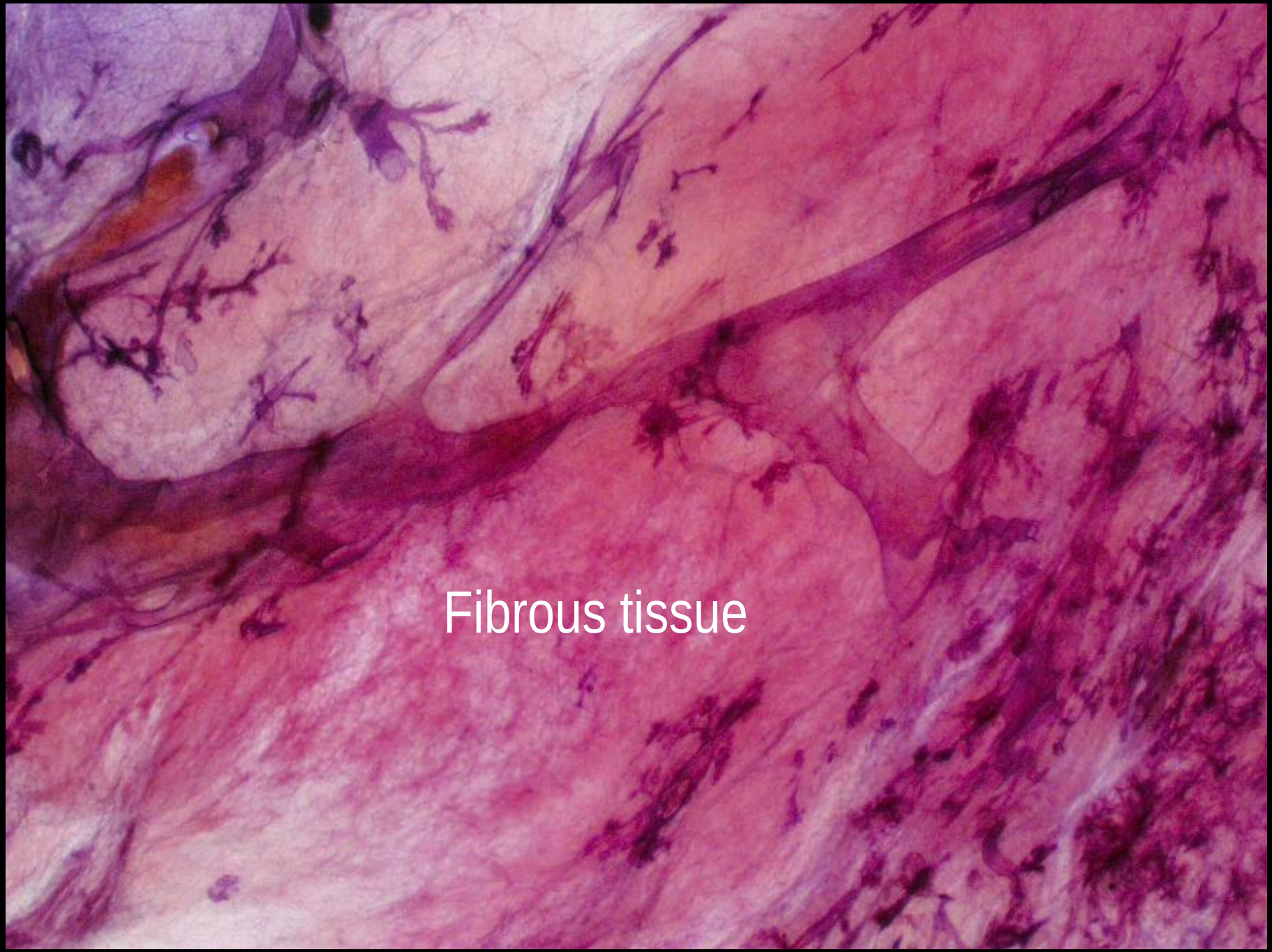
Collagen (connective tissue)

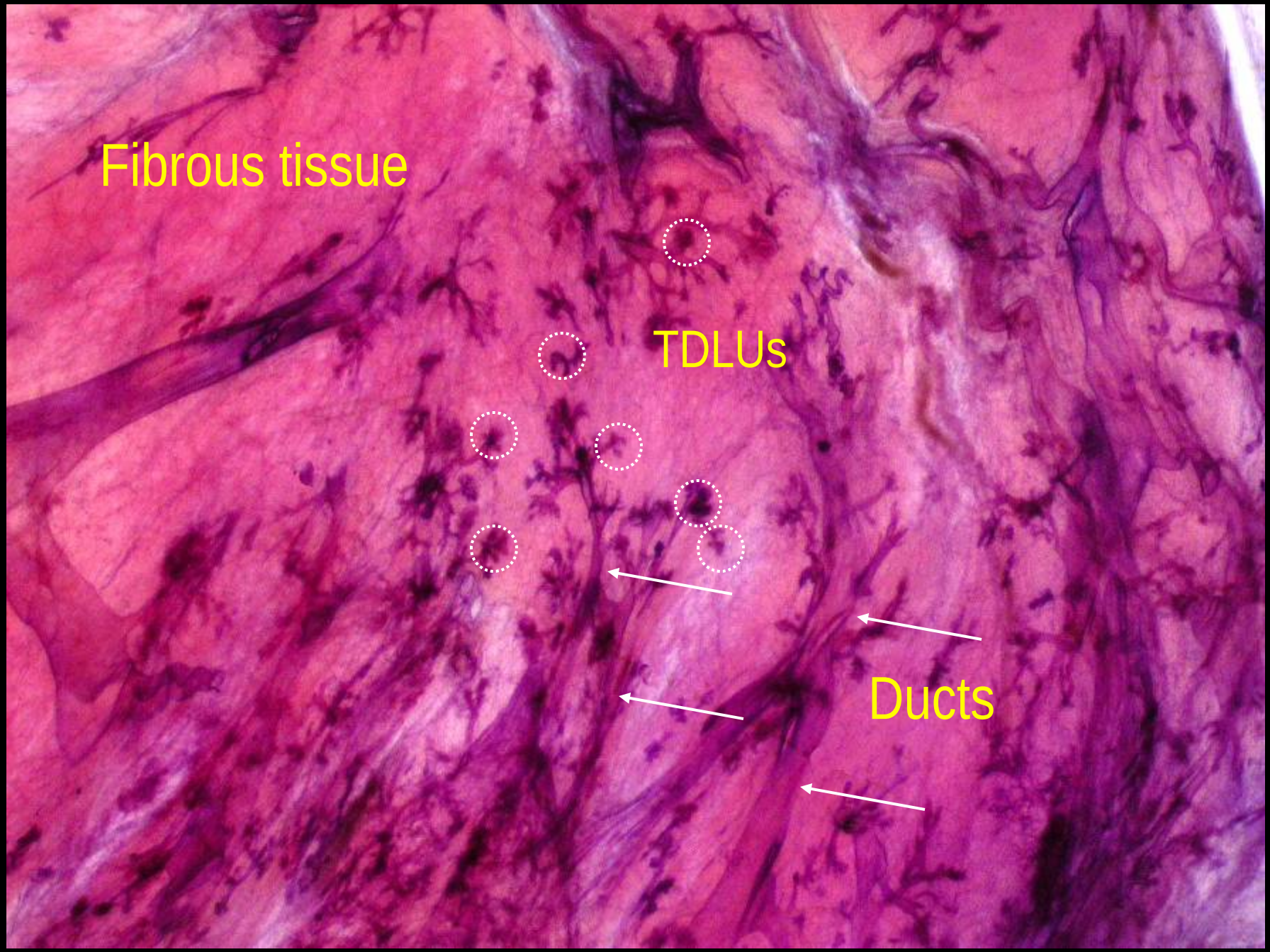
Collagen (connective tissue)





Ms. Beverly Doolittle


Fibrous tissue

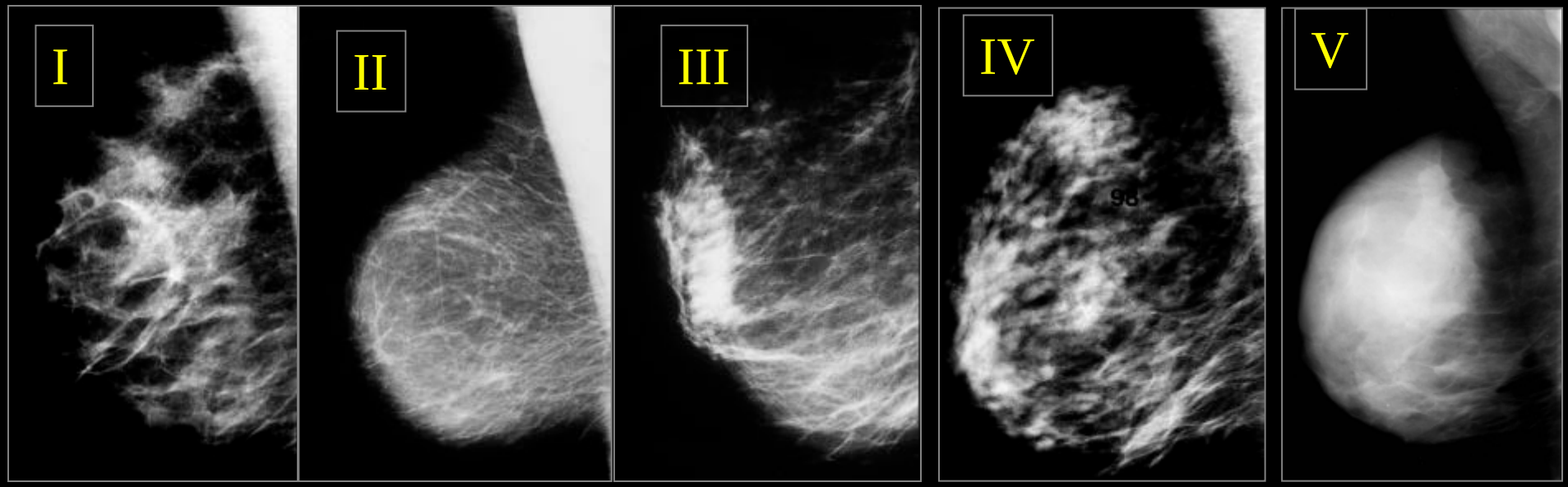

Fibrous tissue
TDLUs
Ducts



Classification of normal breast anatomy into structural groups using large section / subgross / mammographic correlation

will simplify the decision process required to differentiate normal from abnormal.

The breast, unlike any other organ, has five structurally different parenchymal patterns

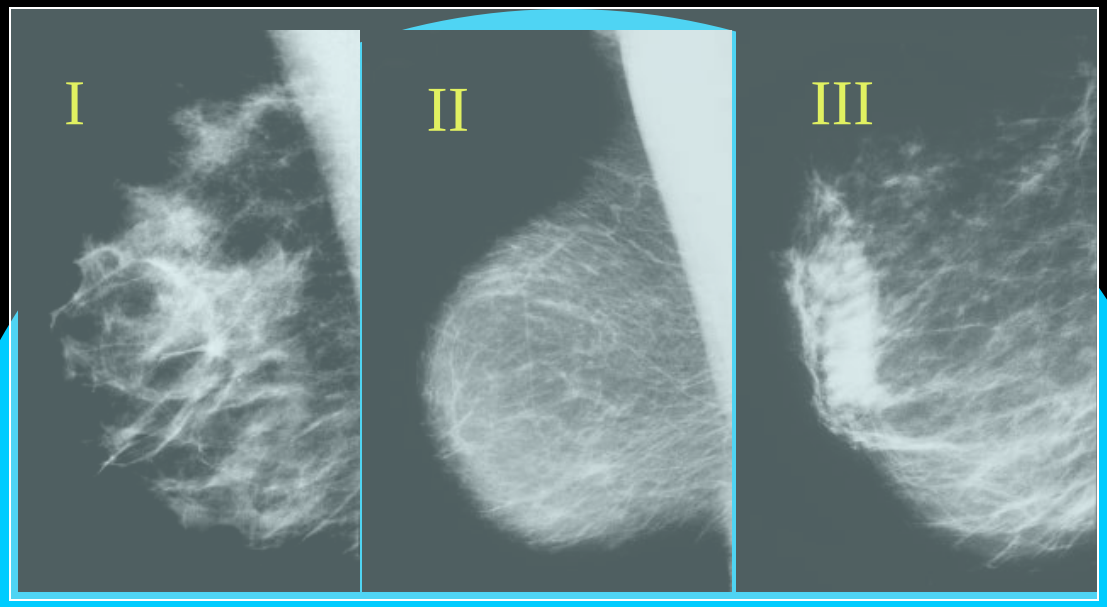


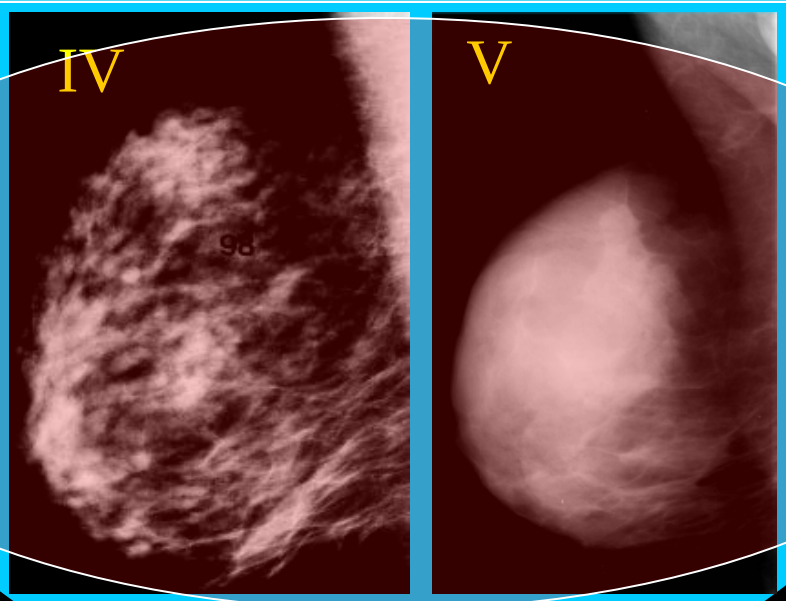
Low risk group

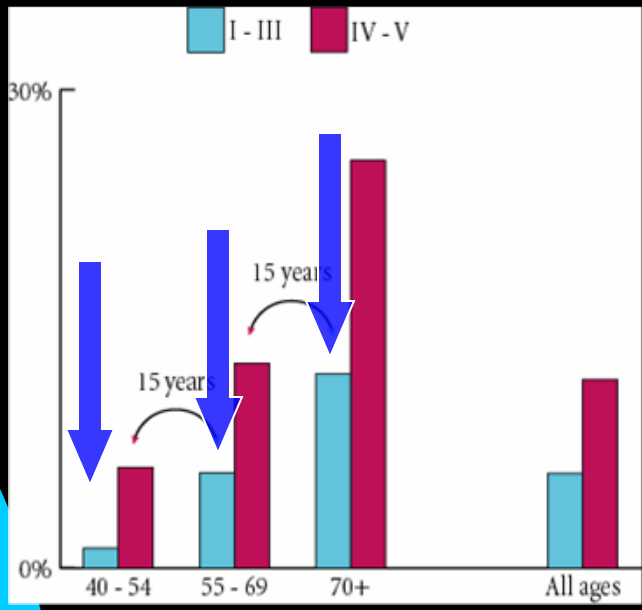
High risk group

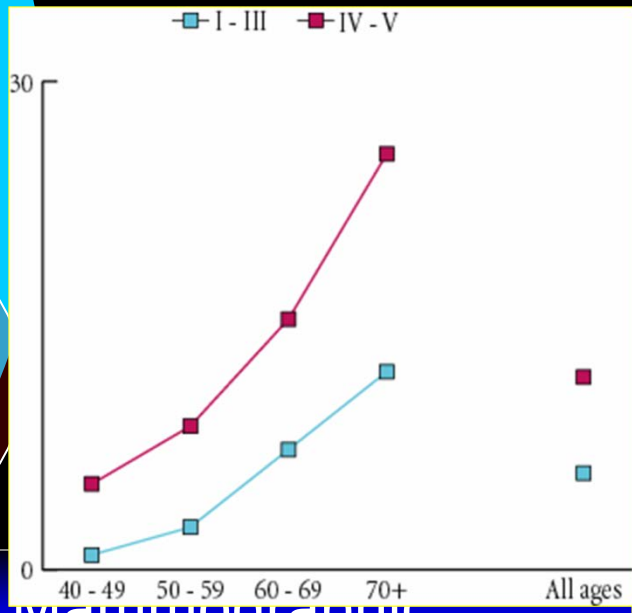
These patterns can affect the detectibility of small breast cancers

JAMA Jan 1982.





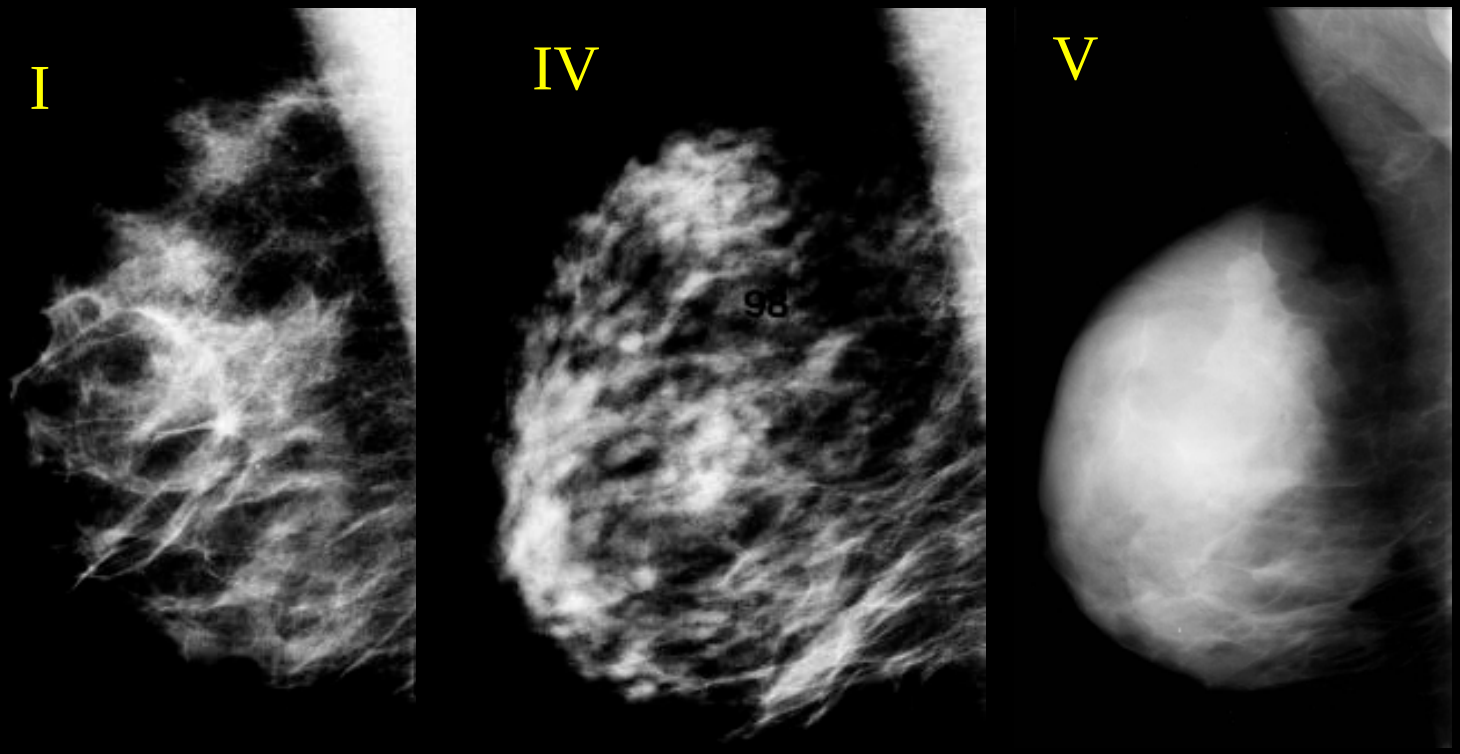




Mammographic parenchymal patters

The issue of ”imaging dense breasts”:

Mammographic parenchymal patterns: I, IV and V.



In women with Patterns I, IV, V the success of finding breast cancer early enough using *mammography only* may be considerably jeopardized.

Background

• Mammography can detect breast cancer at an earlier stage in its development, and it is highly sensitive (80-85%) in asymptomatic women.

• The sensitivity of mammography is limited in *women with dense breast*, as low as 50%.

Background

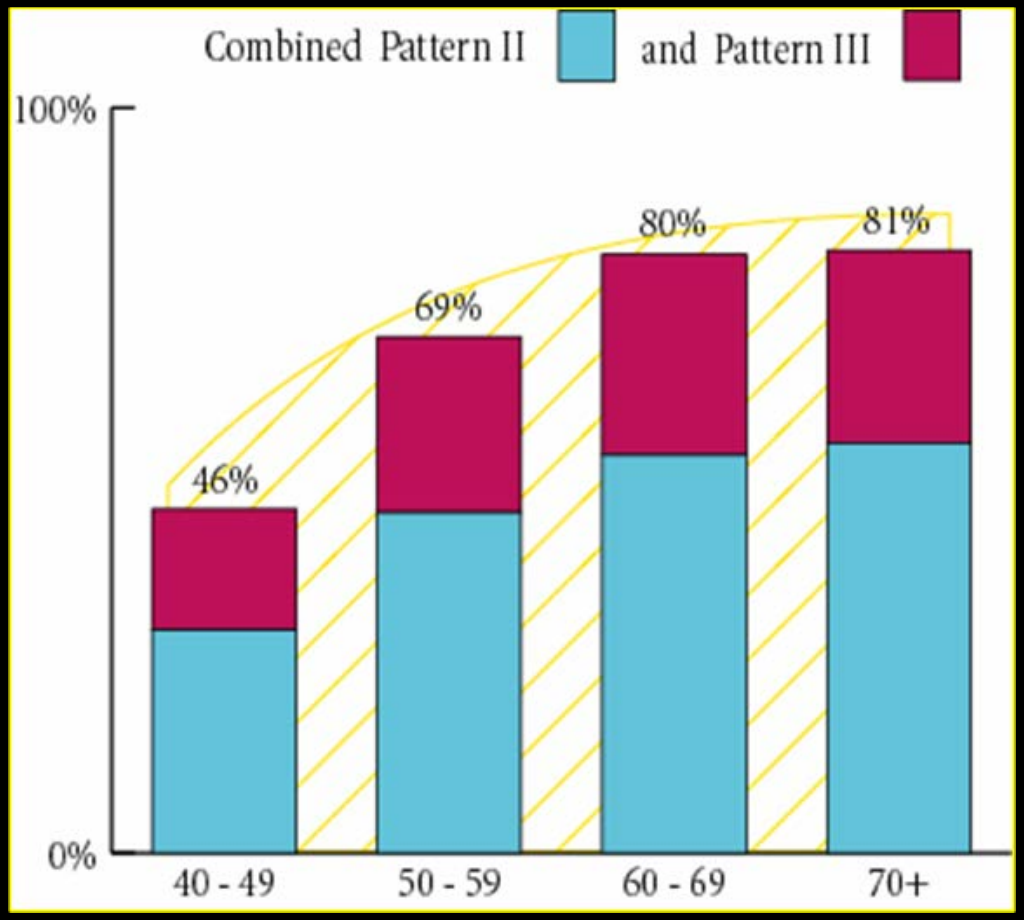
- Increased breast density is a major limitation to the effectiveness of mammography in cancer detection among those women attending screening.

Frequency of women with dense breasts

- Two-thirds of premenopausal women
- 25% of all perimenopausal women
- 50% of all postmenopausal women receiving hormone replacement therapy

Kolb, T et al

Frequency of women with adipose breasts by age



Tabar L, T Tot & PB Dean *The Art and Science of Early Detection with Mammography, Thieme Verlag*

Background

Hand-held ultrasound examination of the breast has broad acceptance among radiologists in diagnostic evaluation of

- Palpable lesions *and*
- Screen detected abnormalities

Hand-held ultrasound units are specifically designed and manufactured for

assisting in differential diagnosis

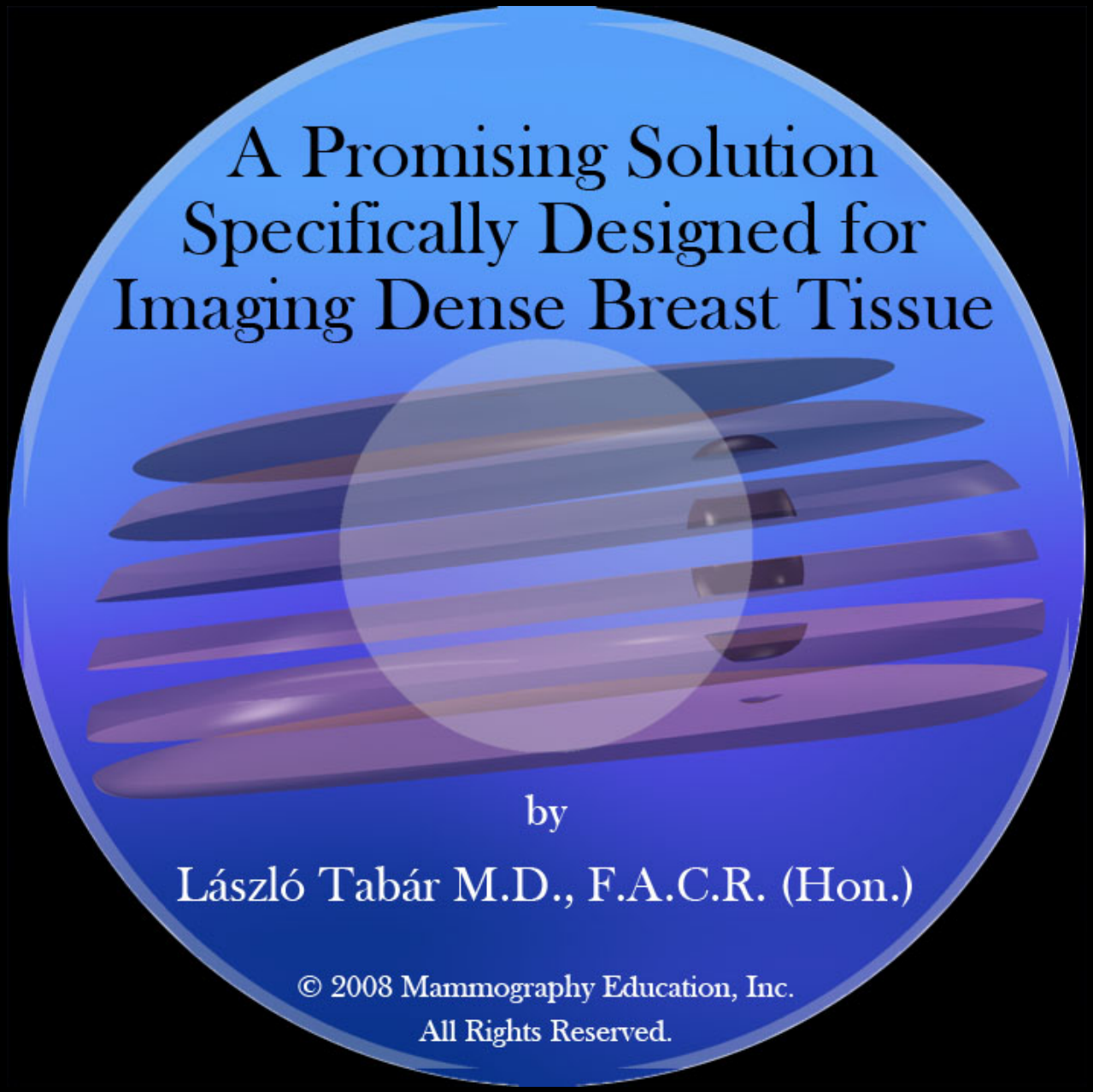
Background

The main limitations of hand-held ultrasound:

- Operator dependent / operator variation *and*
- Poor standardization of the technique

Background

There is an urgent need for an automated ultrasound unit that has been specifically designed and manufactured for screening purposes *and* helps reduce the limitations of the hand-held technique



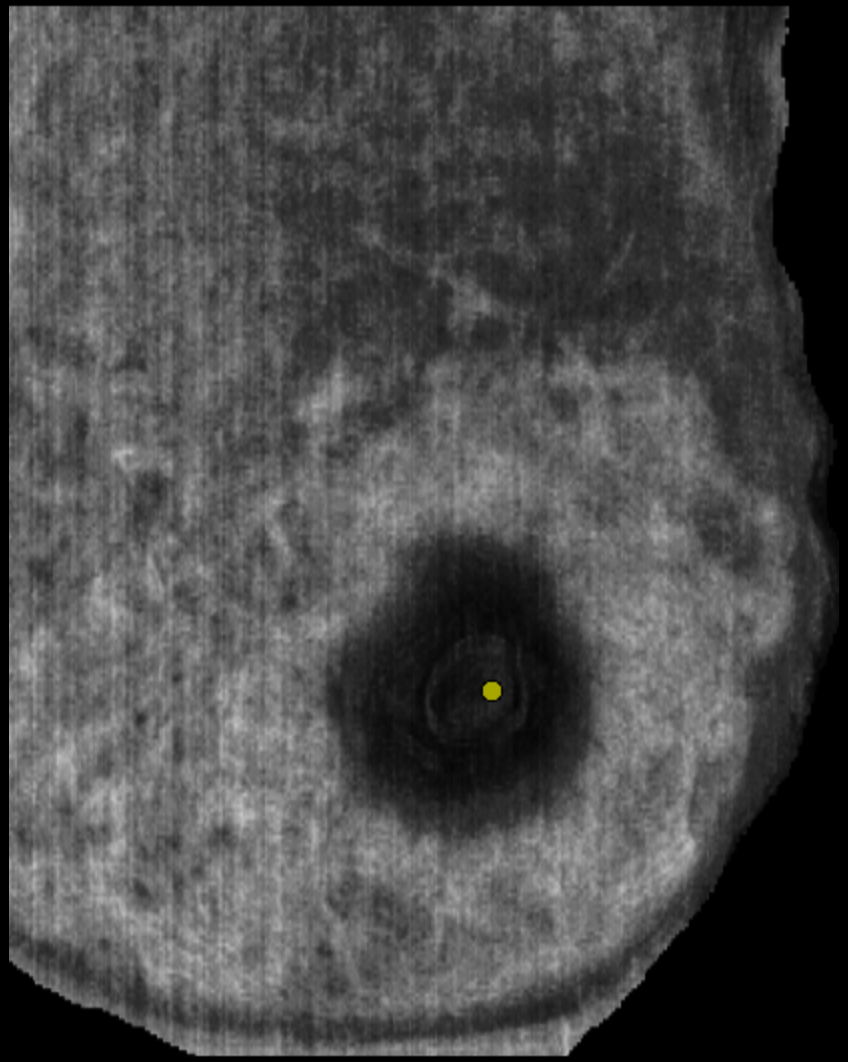
DVD

Automated 3-D ultrasound screening

INTRODUCTION

Correlation of subgross, thick section (3-D) histologic images of normal and pathologic breast tissue with reconstructed coronal 3D automated ultrasound image slices.

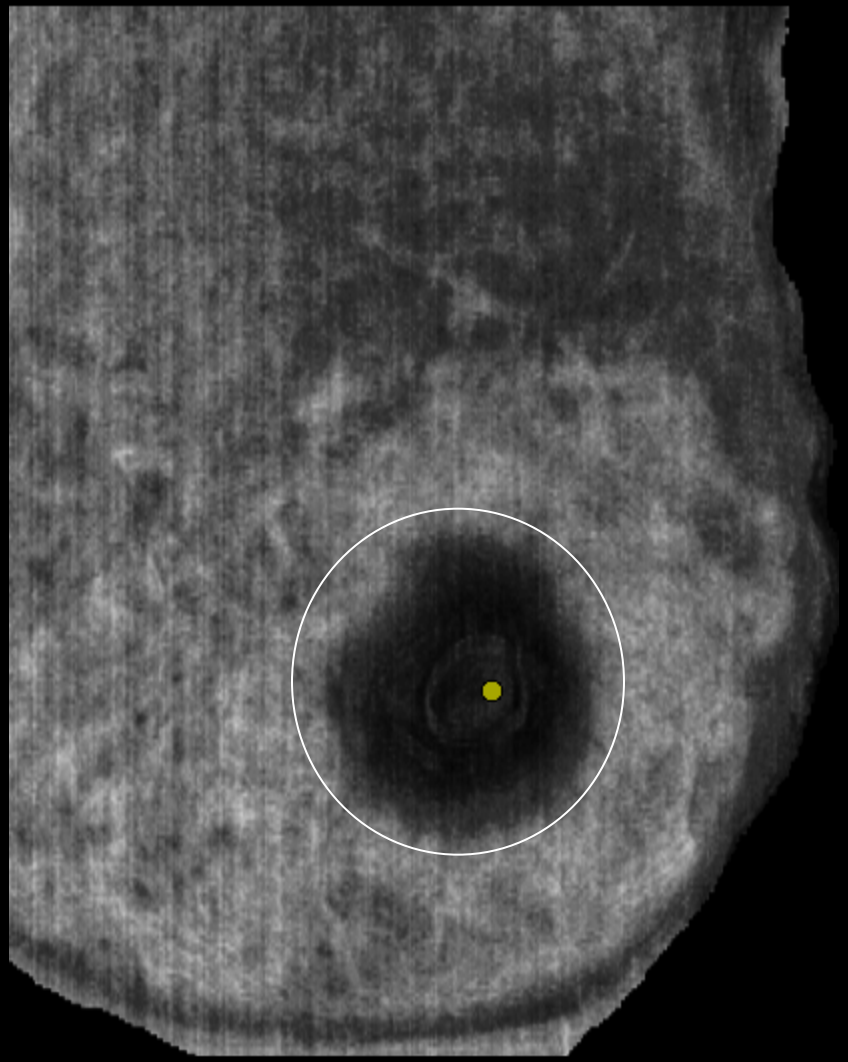
Skin level

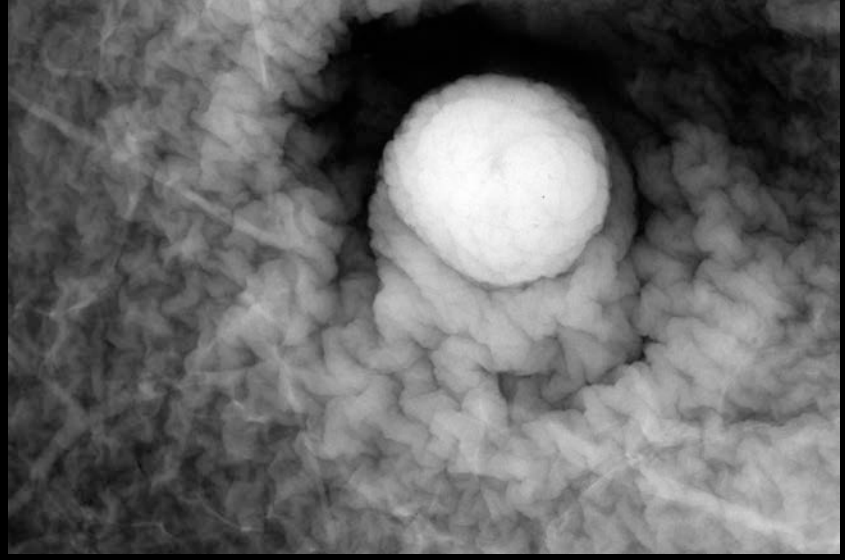


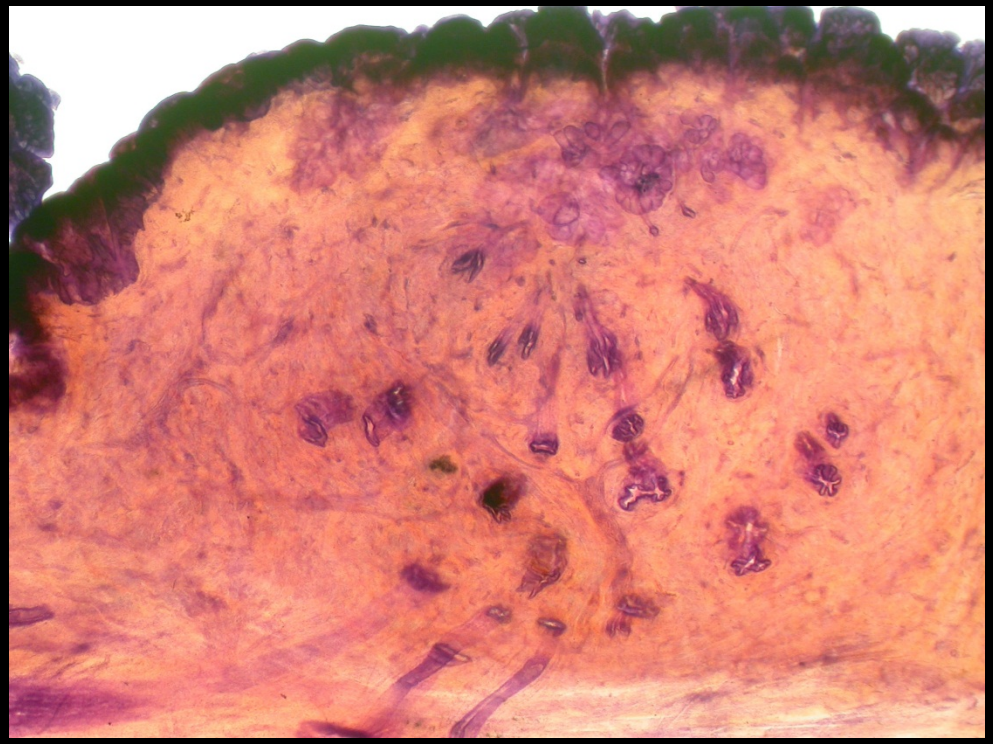
ABUS image of the skin and the nipple-areola complex

Anatomic specimen: Low kV mammographic image of the skin after removal of the glandular tissue.

Skin level

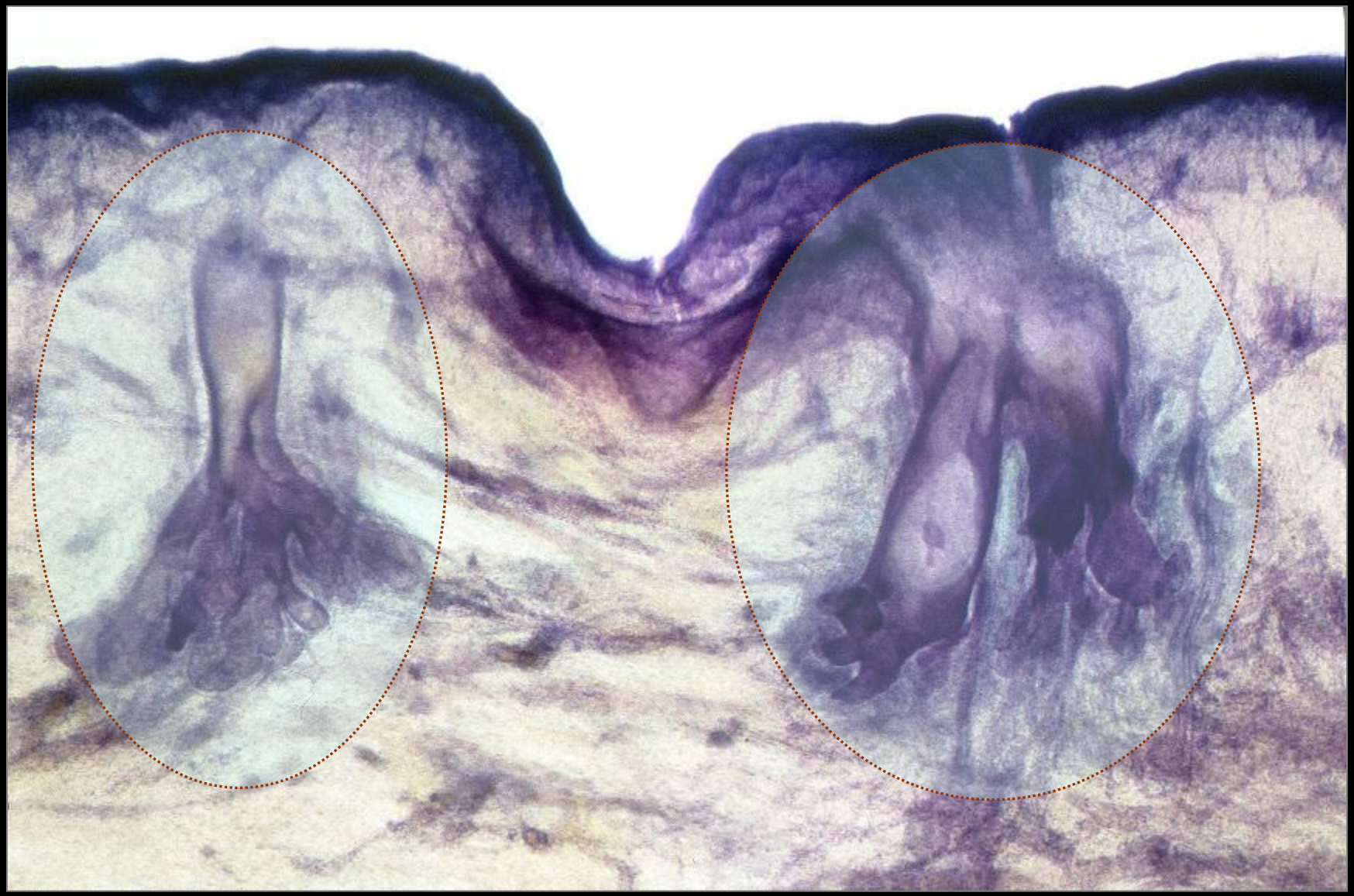






The nipple-areola complex gives a characteristic image on ABUS -

- due to the compact tissue within and behind the nipple/areola.



Sebaceous glands

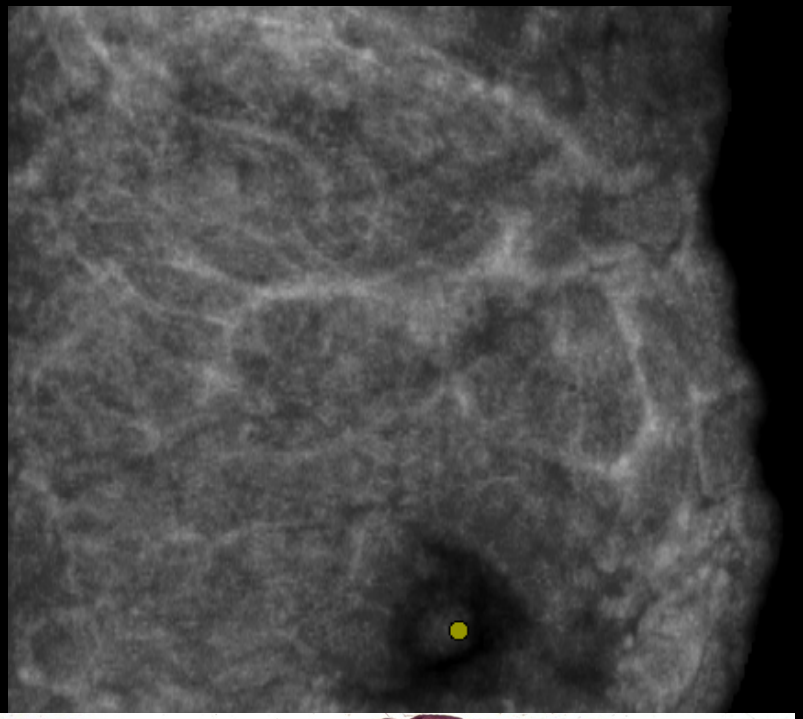
Skin level – ABUS

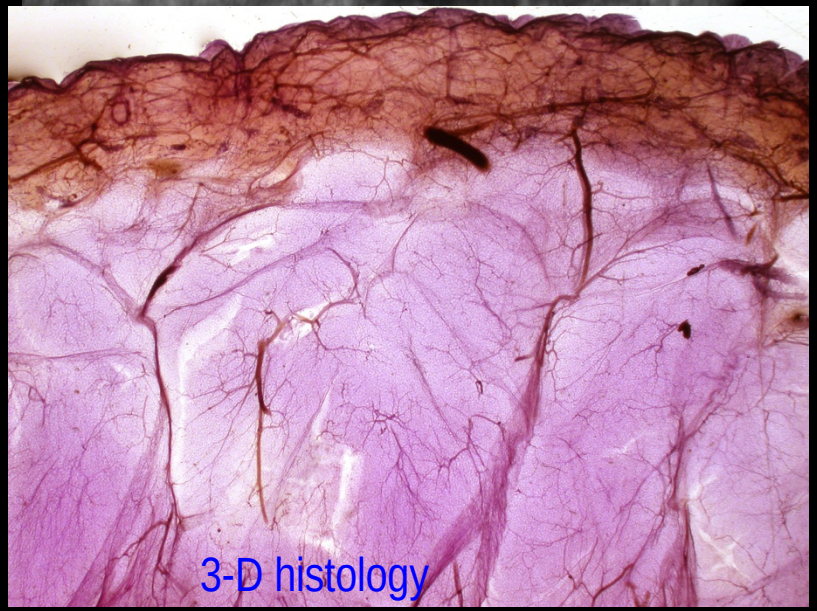
The sebaceous glands contain sebum

Mammogram of the skin

Perception *and* appreciation of the *four* basic building blocks of the breast on coronal ABUS images *through* comparison with the underlying subgross, thick section (3-D) histology.

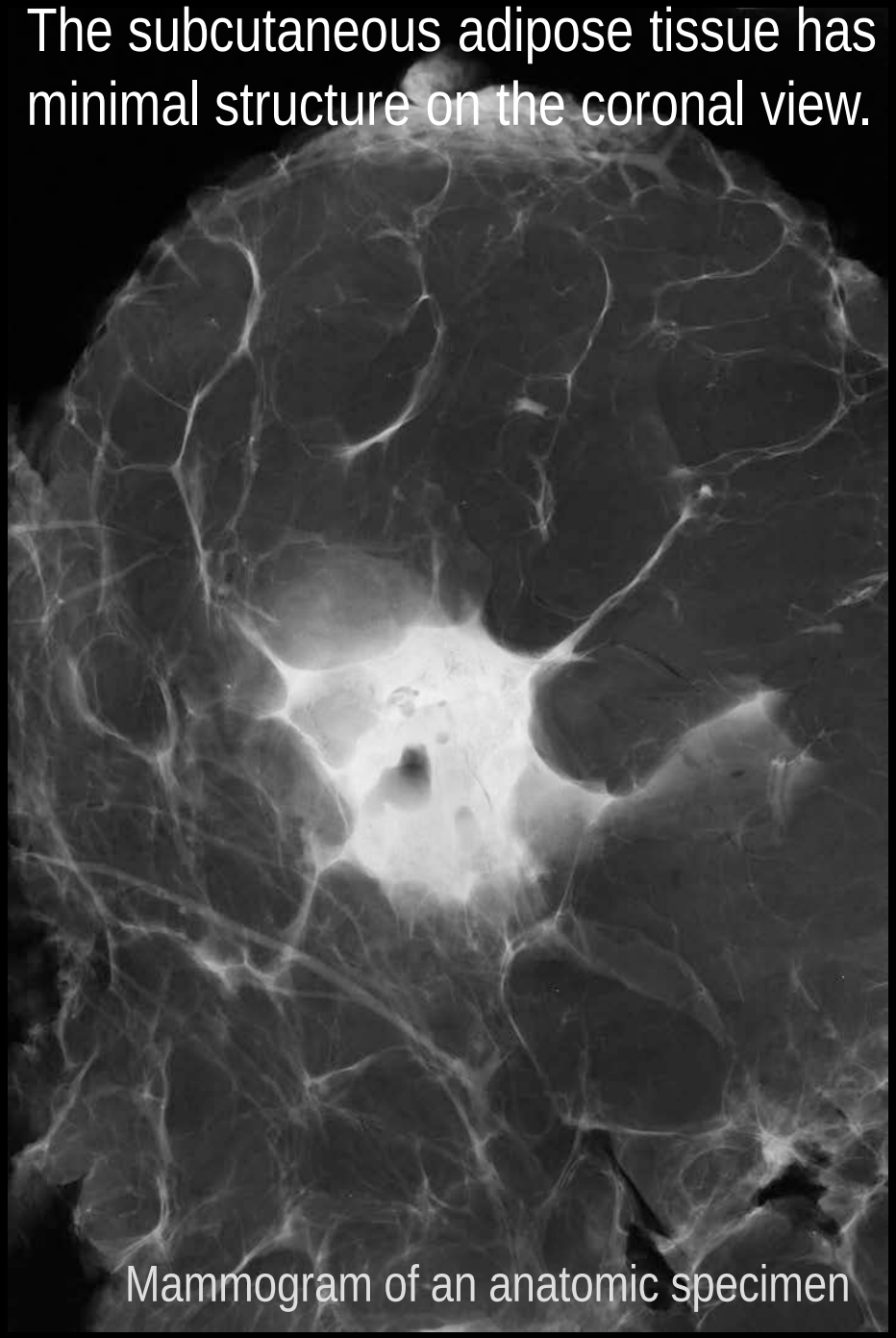
A slice *2 mm* deep to the skin.



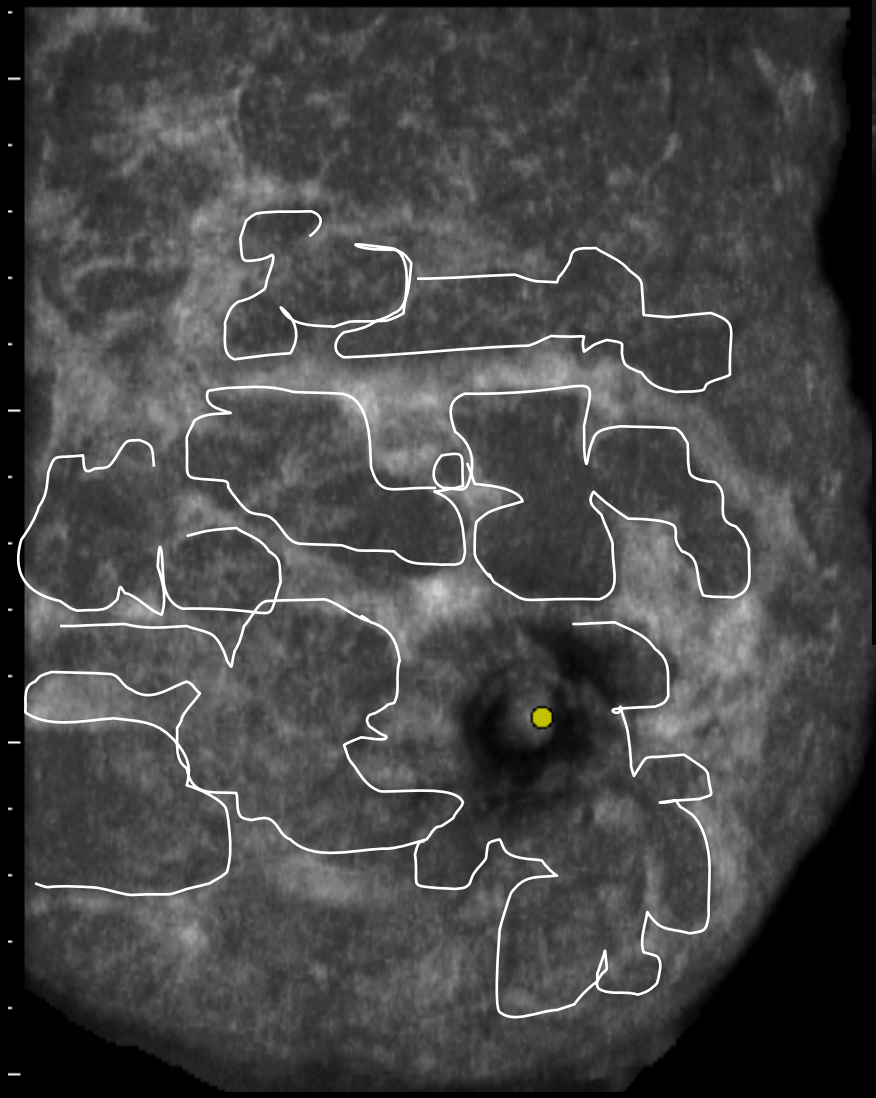


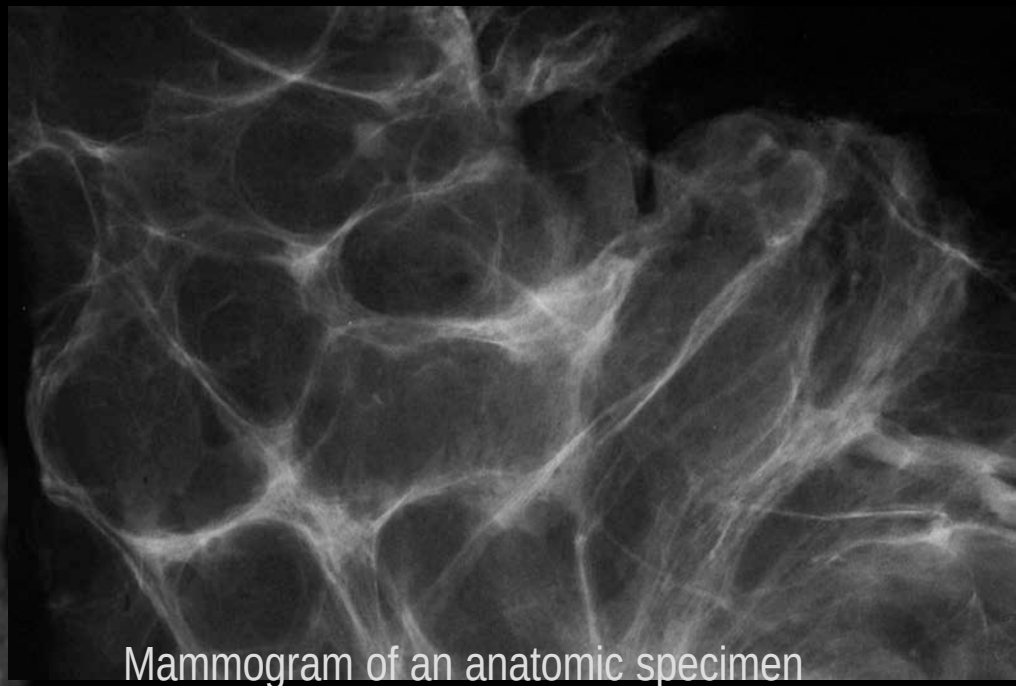
3-D histology

The subcutaneous adipose tissue has minimal structure on the coronal view.

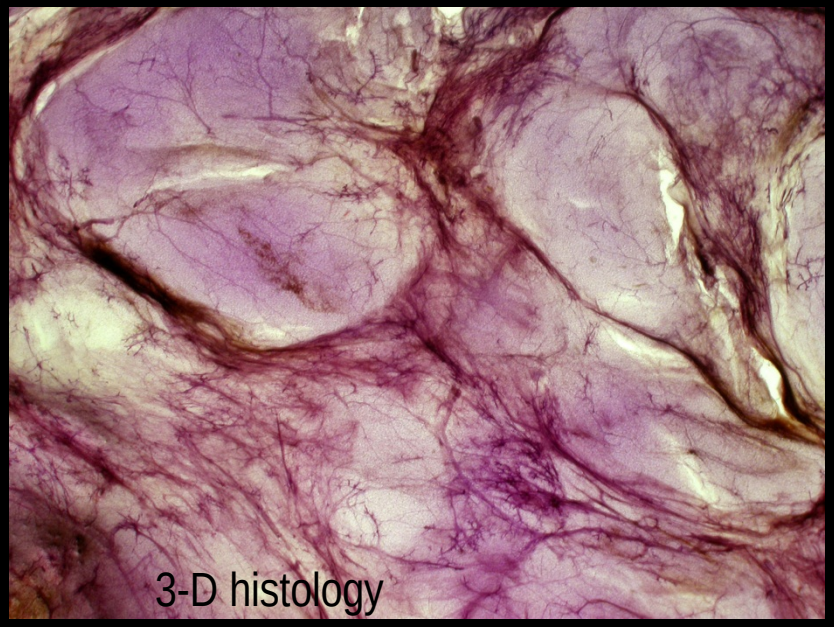


Mammogram of an anatomic specimen





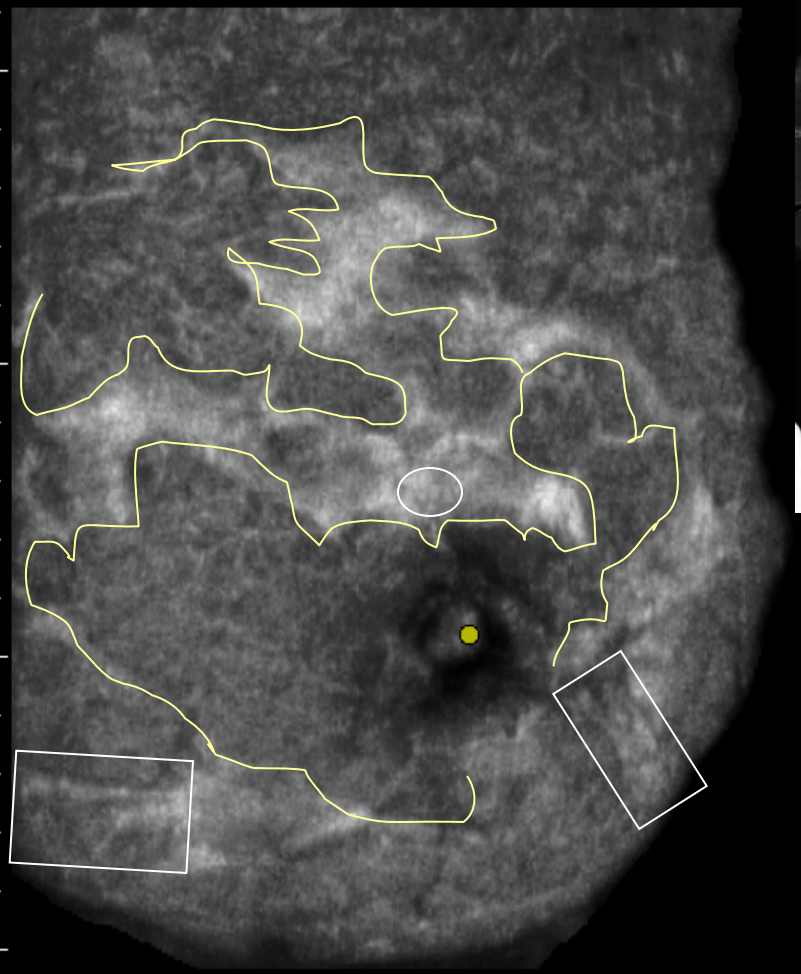
Mammogram of an anatomic specimen



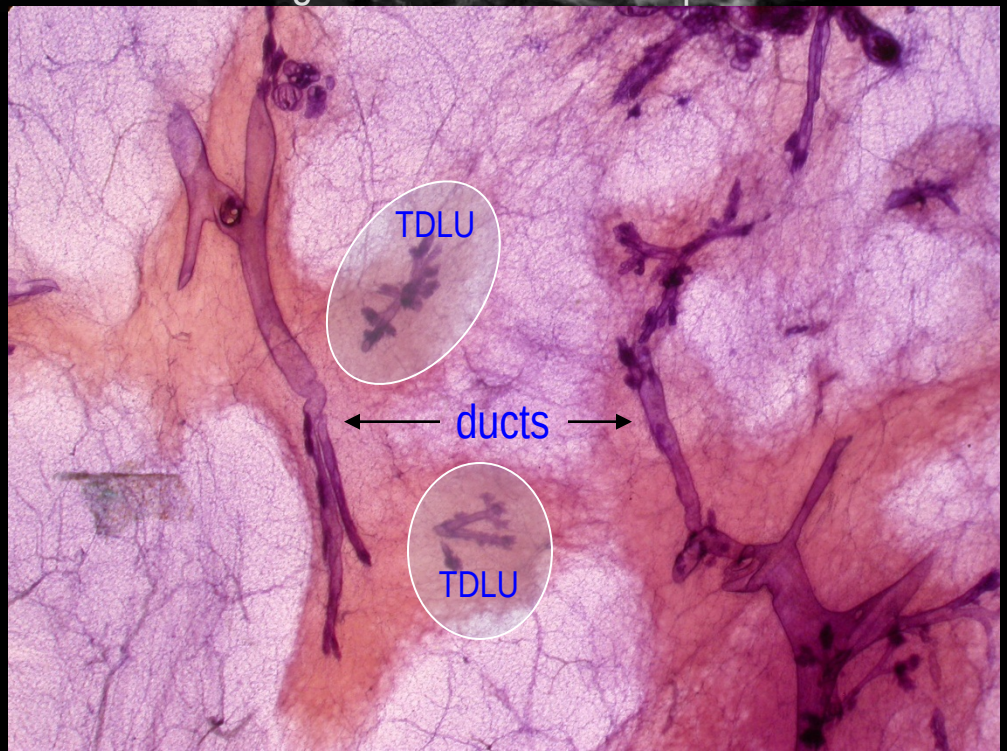
3-D histology

In deeper slices the atrophic glandular tissue starts to emerge, but still, it is the adipose tissue that dominates the picture.

6mm deep to the skin

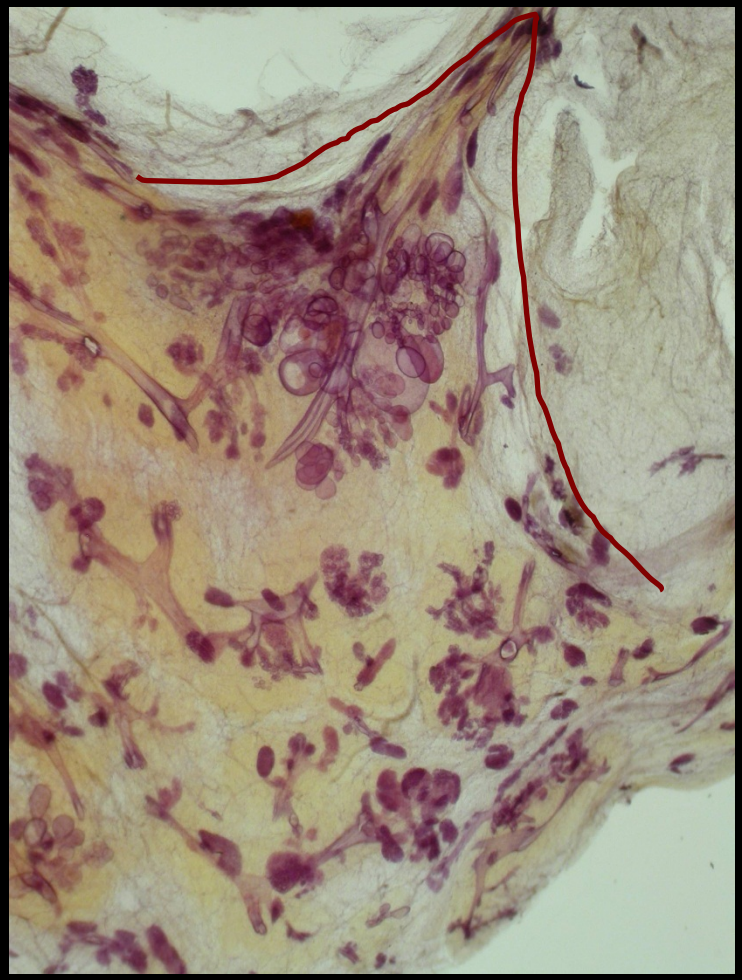


Mammogram of an anatomic specimen



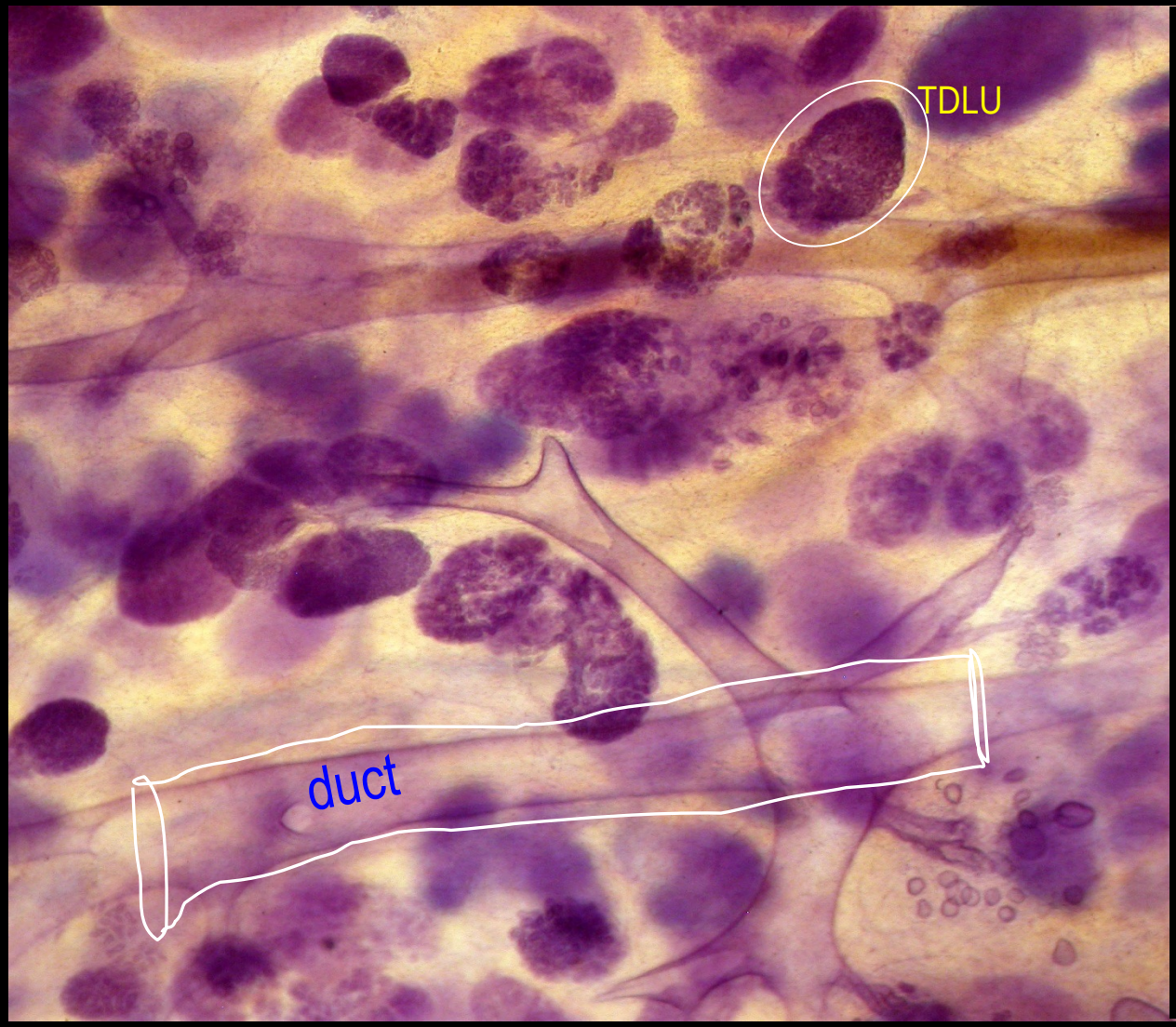
In this example the atrophic glandular elements (ducts and TDLUs) are hidden within the fibrous tissue.

10 mm deep to the skin

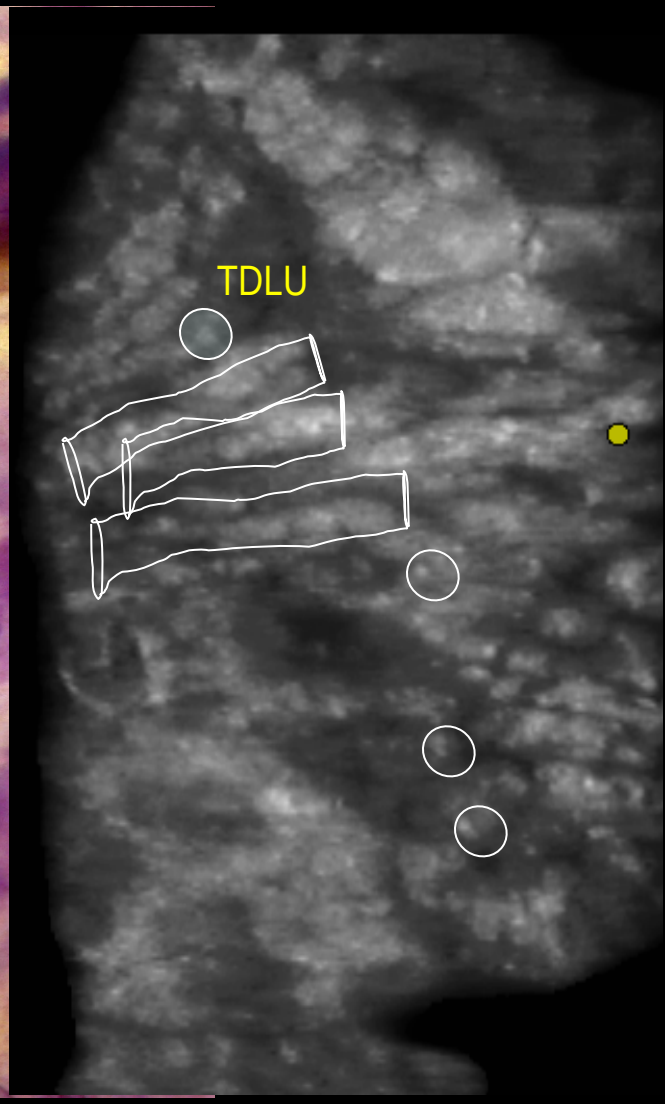


Cooper's ligament-like structures are composed of TDLUs and ducts (glandular tissue) surrounded by ground glass-like homogenous fibrosis with concave contours *(fibroglandular tissue).*

12 mm deep to the skin



3D histology



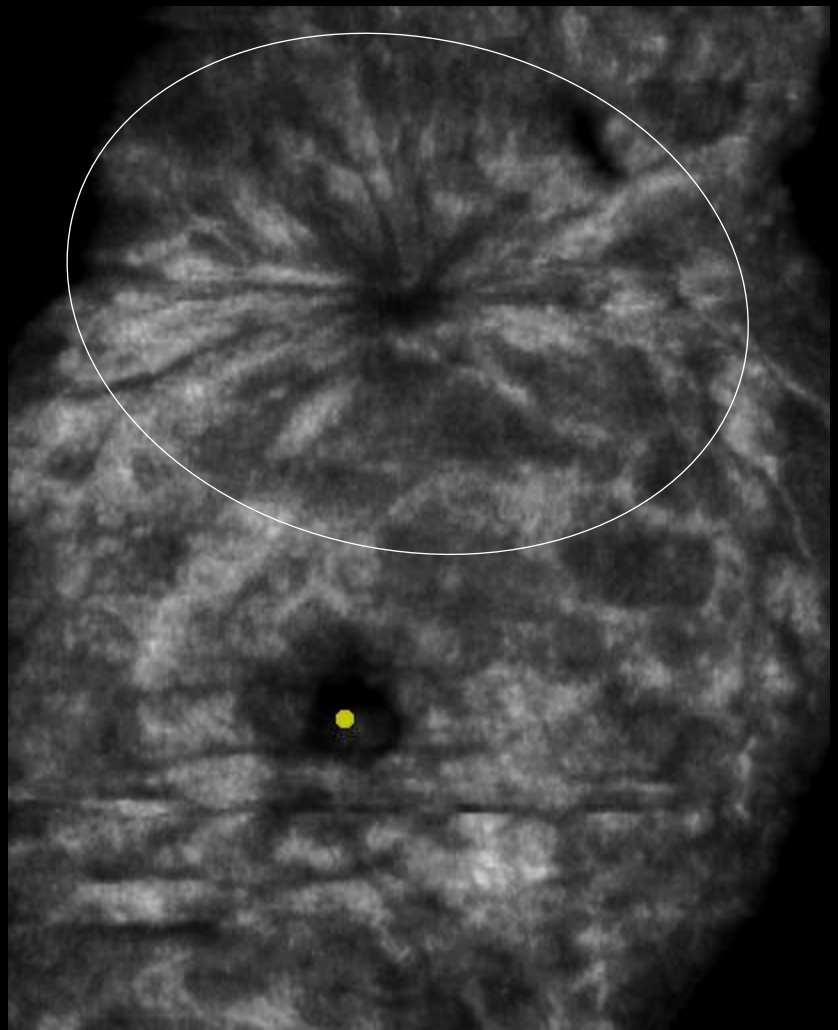
ABUS the coronal section

The *four "building blocks"* of normal breast can be well demonstrated, individually, on the reconstructed 2 mm coronal tissue slices:

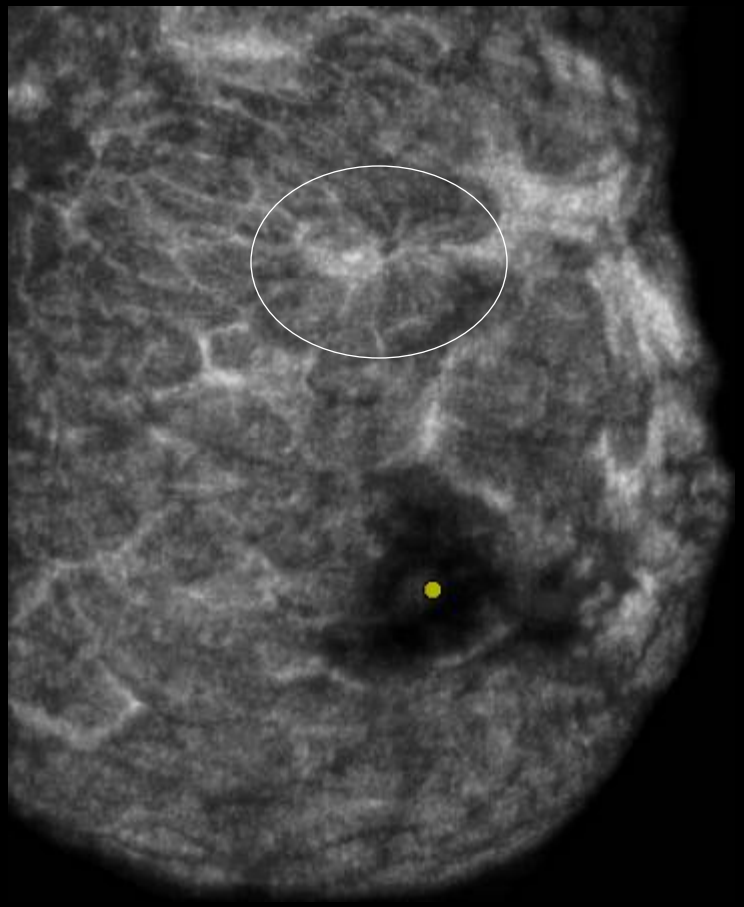
- Terminal ductal lobular units (TDLUs)
- Ducts and their branches
- Fibrous tissue (collagen)
- Adipose tissue

Together, they form a harmonious pattern that will be changed by any kind of pathologic lesion, benign or malignant.

- The larger the lesion, the easier it is to perceive on the ABUS slices.

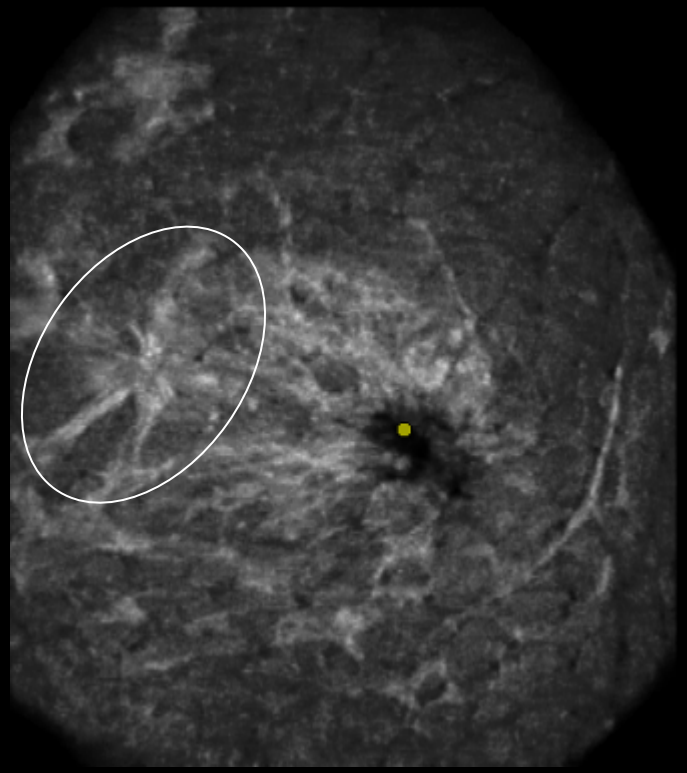


- The smaller the lesion, the greater the challenge in detecting a benign or malignant lesion.



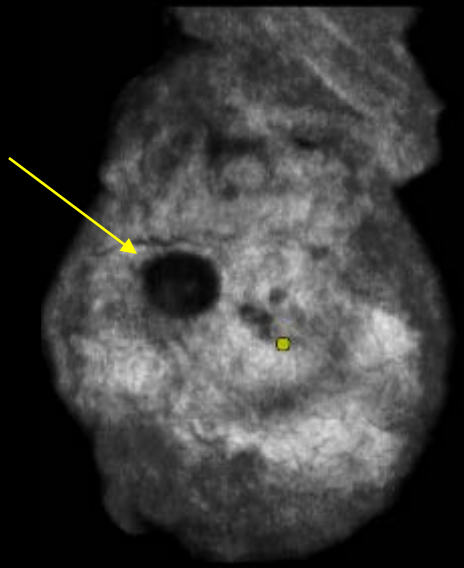
The most frequent signs leading to the detection of an abnormality on the 2 mm ABUS slices.

1) Architectural distortion:

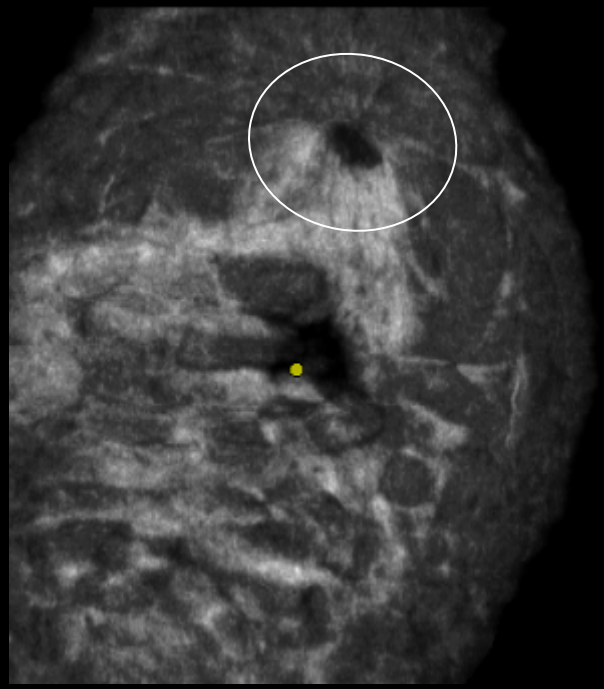


The most frequent signs leading to the detection of an abnormality on the 2 mm ABUS slices.

2) The presence of either fluid *or* solid tissue within the abnormal lesion (cyst, fibroadenoma, cancer, etc.) alters the normal structure. This is visible on ultrasound as a circular/oval defect.

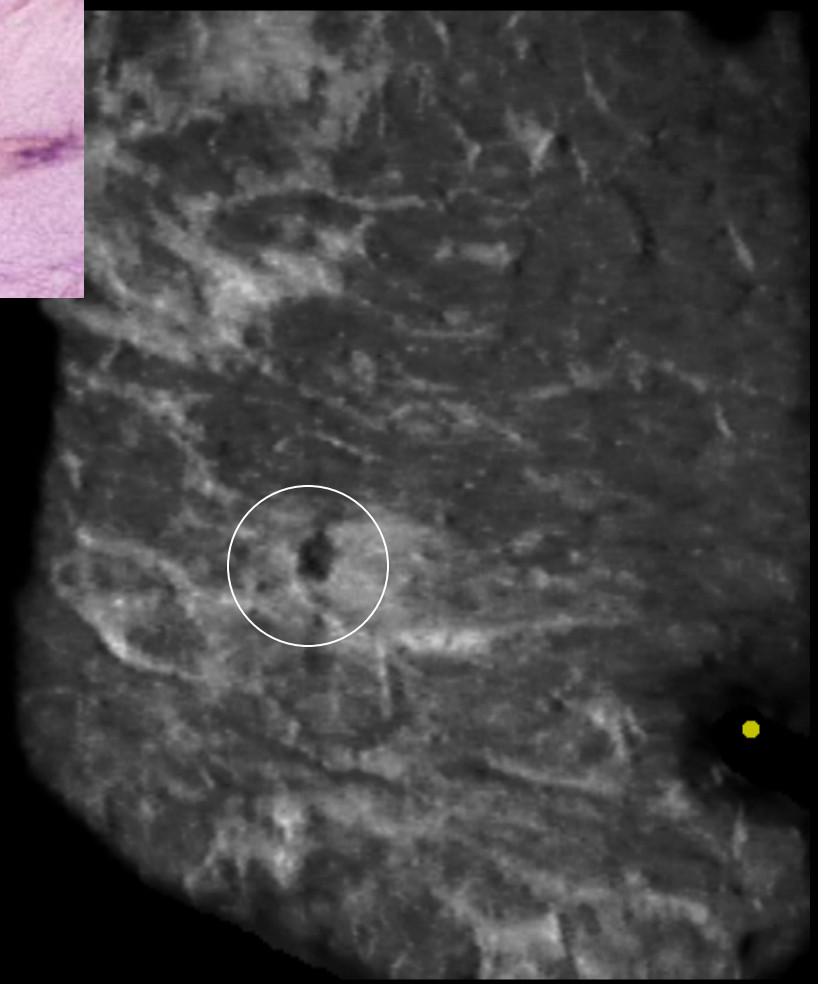


Simple cyst



Breast cancer

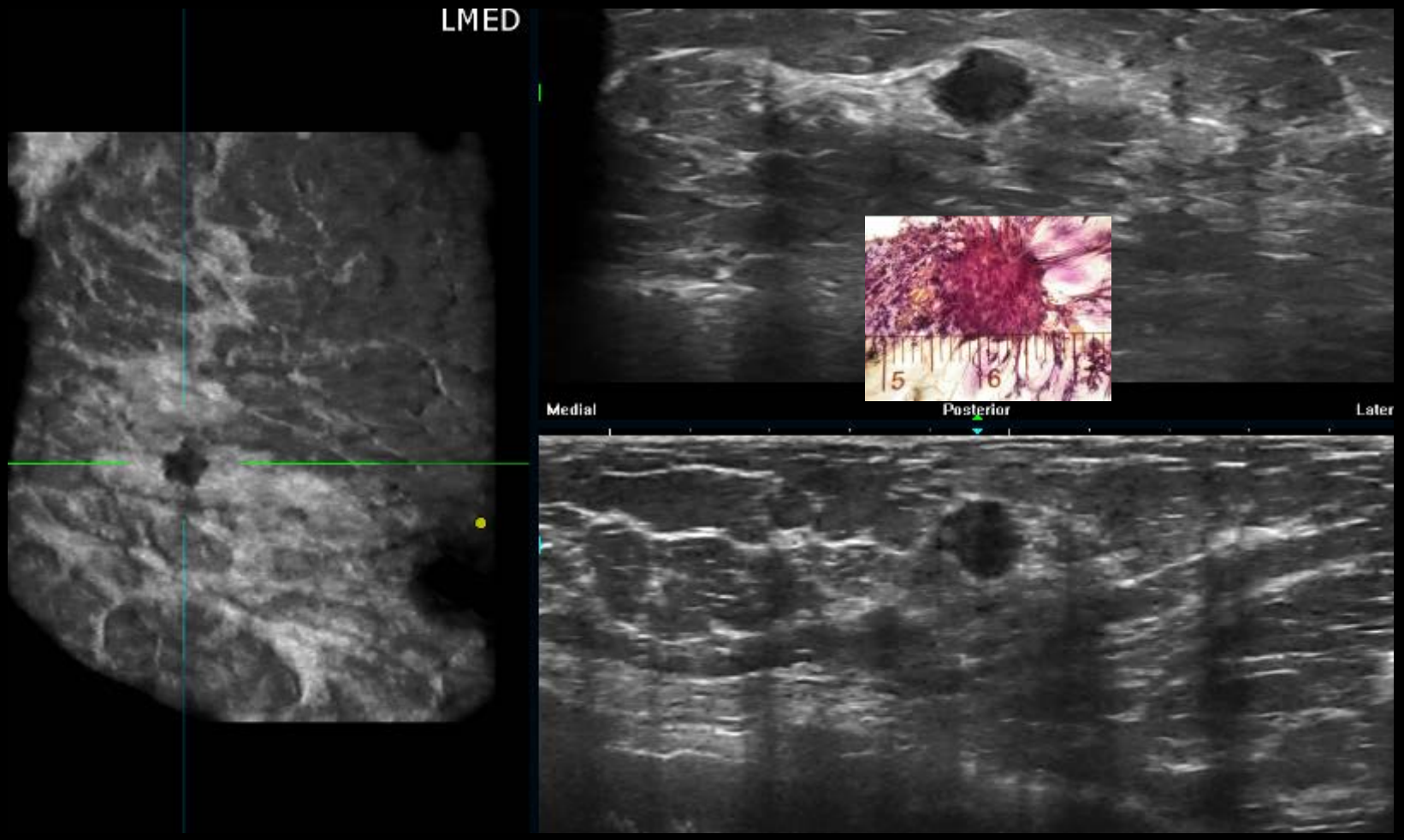
Example 1



The concave contoured ground glass-like fibrosis hides atrophic ducts and TDLUs. Normal.

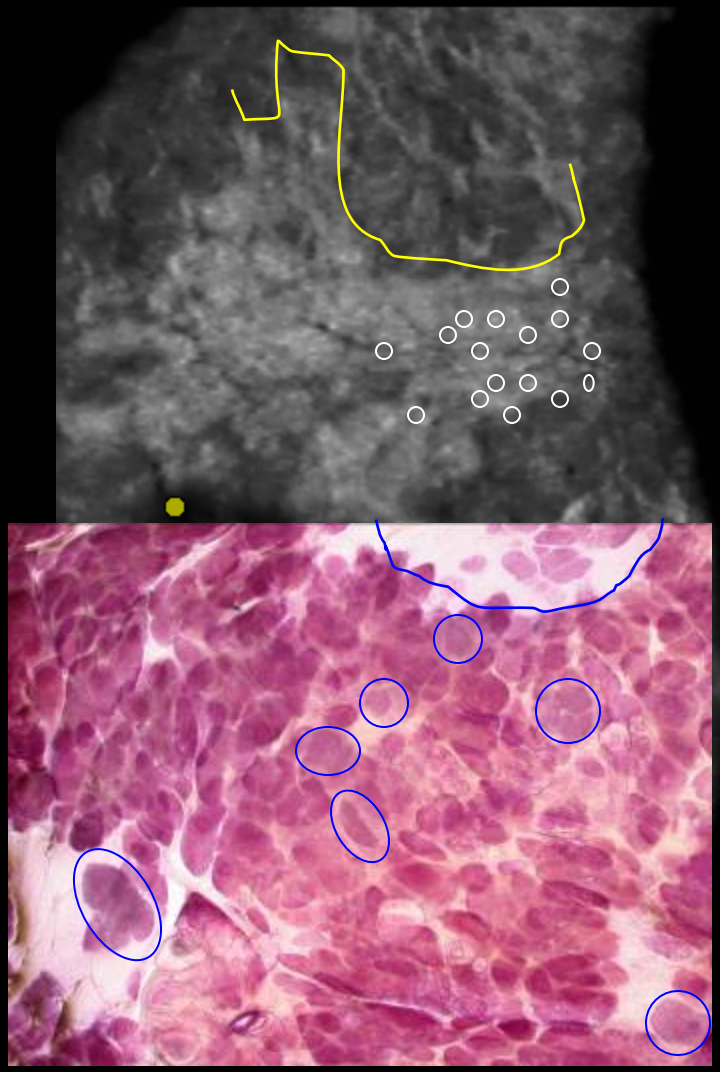
The neighboring slide shows a disruption of the normal pattern, indicating the presence of an abnormality (continuation on the next slide).

Example 1 continued



ABUS and conventional ultrasound presentation of this 10 mm invasive ductal carcinoma.

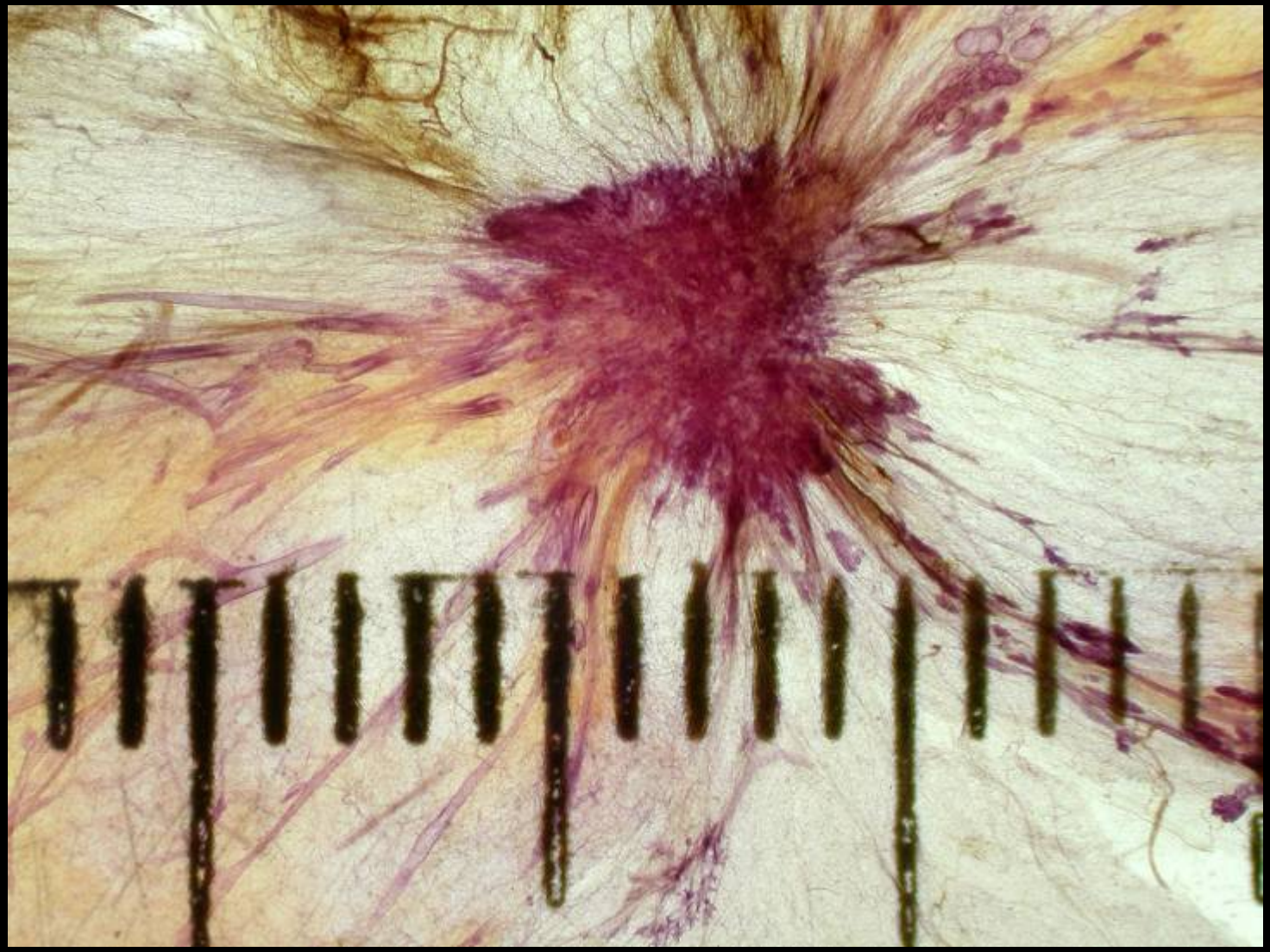
Example 2



The coronal view demonstrates a large number of 1mm sized circular-oval densities (TDLUs).

This harmonious image is considerably changed by a cancer.

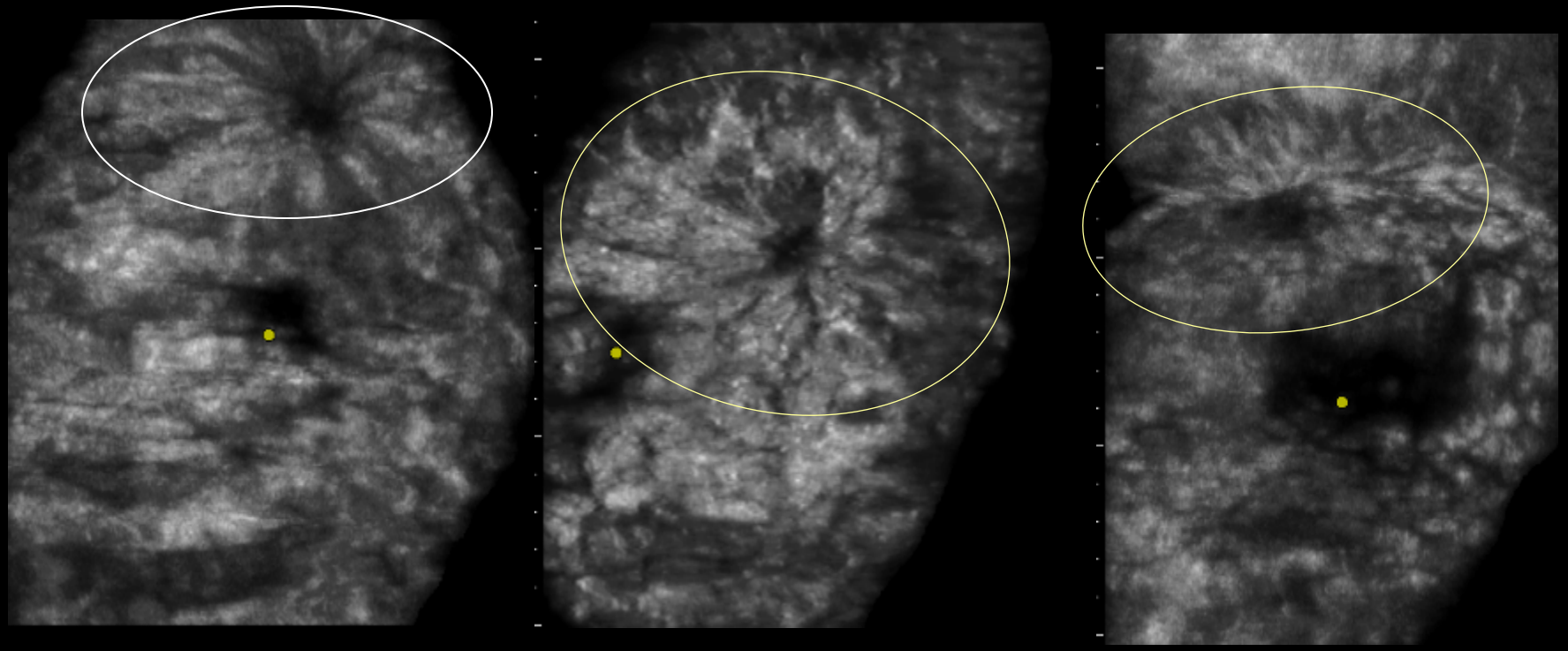
Example 2 continued



Solitary stellate breast cancer

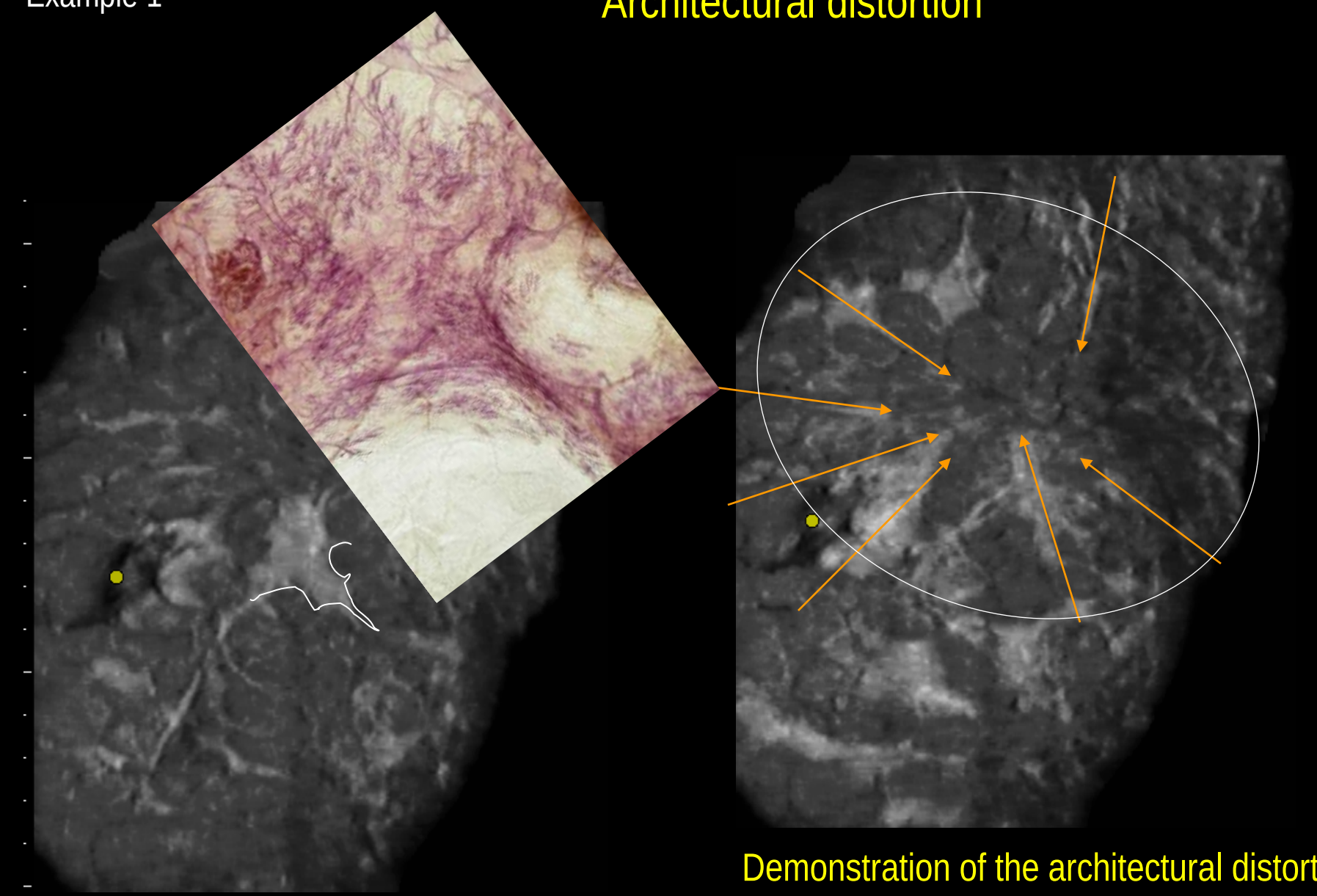
The most frequent signs leading to the detection of an abnormality on the 2 mm ABUS slices.

3) Combination of architectural distortion *and* a circular/oval defect (“black hole”) centrally.



Example 1

Architectural distortion

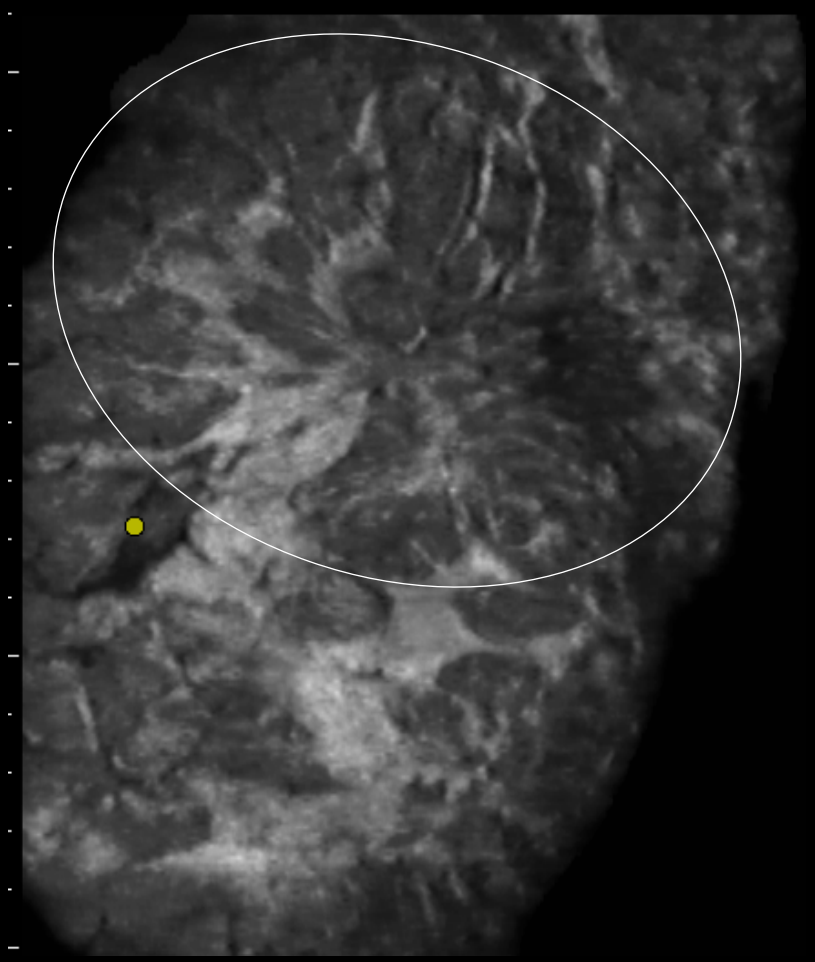


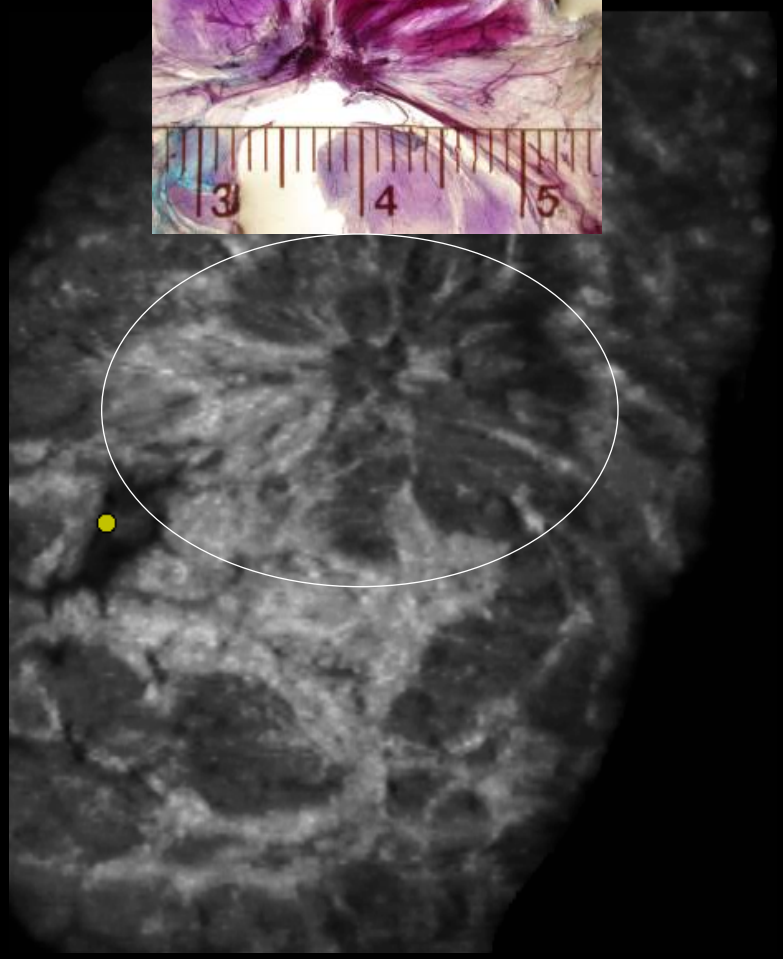
Normal, mostly adipose tissue.

Demonstration of the architectural distortion caused by cancer as it gradually appears in the 2 mm ABUS slices. (cont. on next slides)

Example 1 continued

Architectural distortion



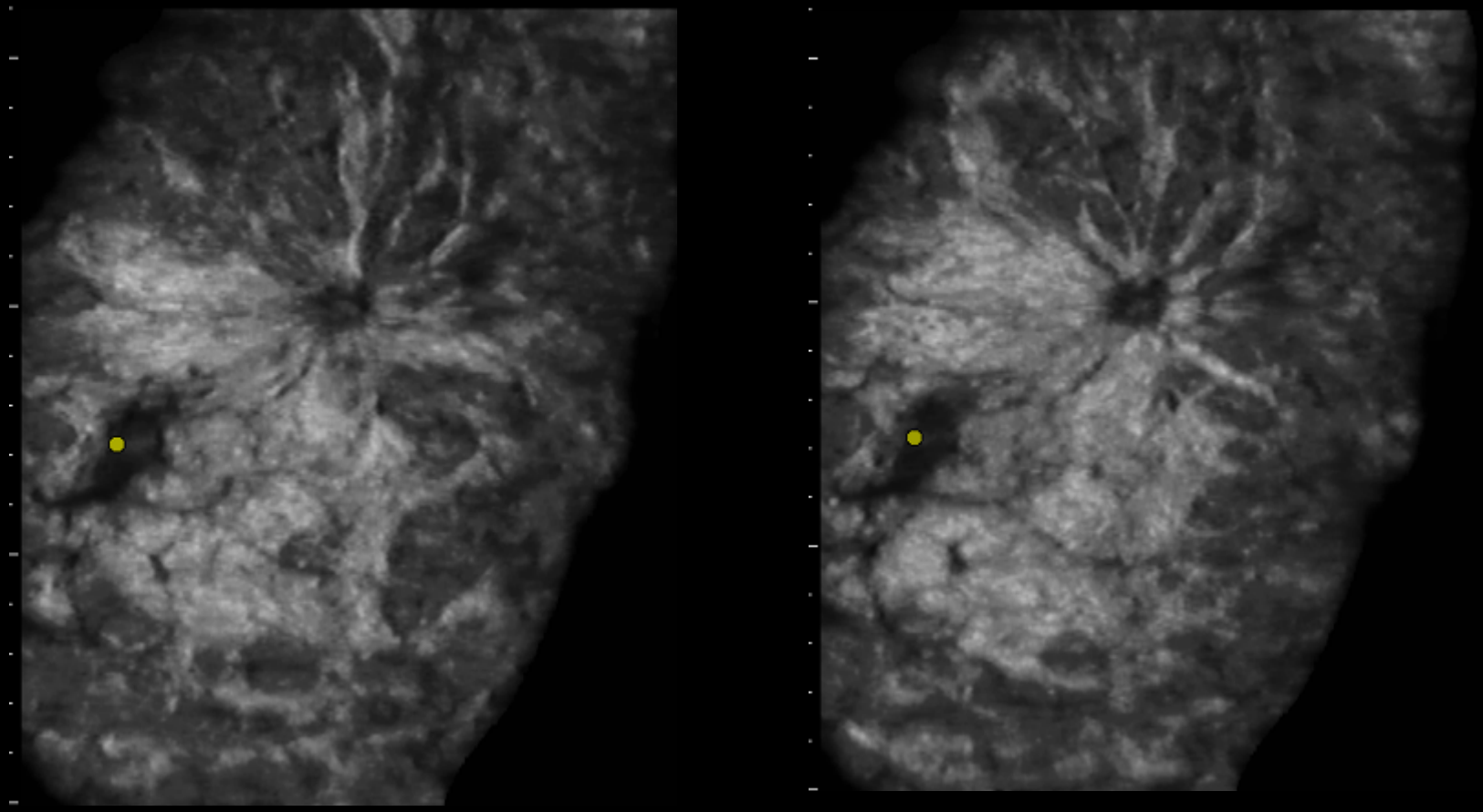


There is a considerable architectural distortion in the tissue-slice superficial to the cancer, without seeing the tumor mass itself at this level.

Both the tumor mass and the surrounding architectural distortion are obvious on this slice.

Example 1 continued

Architectural distortion and circular/oval defect



Several consecutive slices demonstrate the malignant process and its impact on the surrounding tissue.

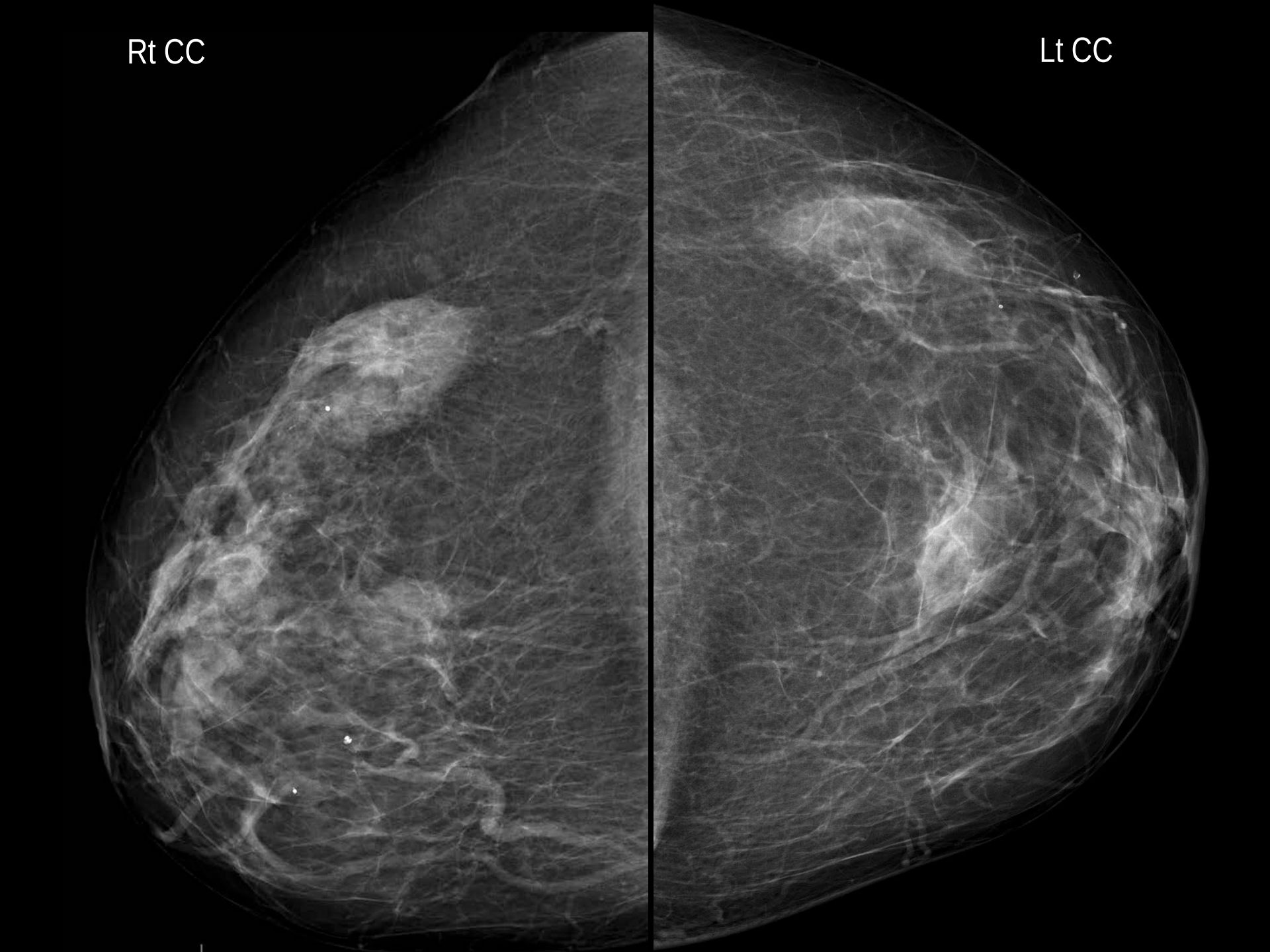
Reflections

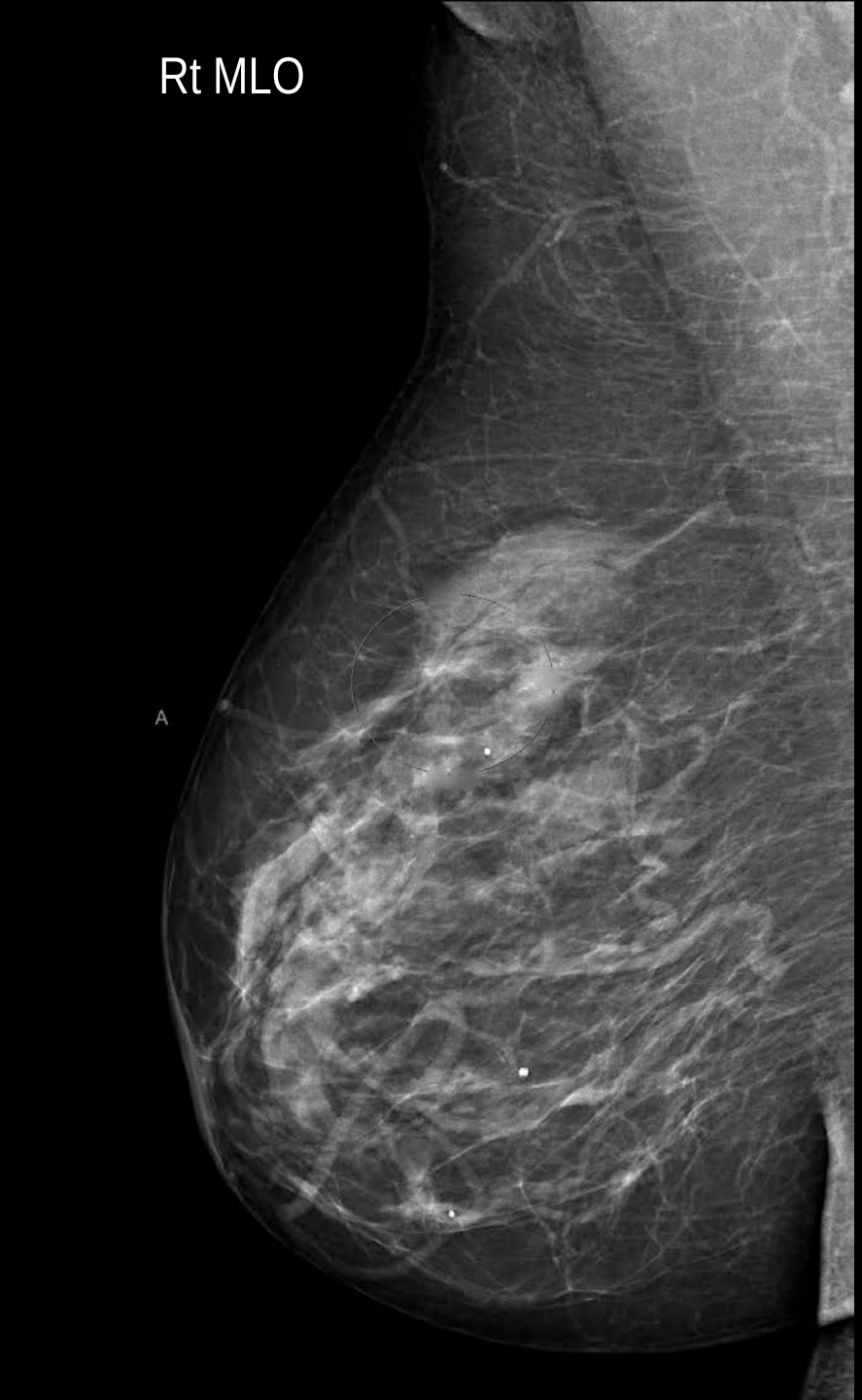
Description of the problem *and* presenting a potential solution to the difficulty in perception in Pattern I, using 3D automated ultrasound technique (2 mm coronal sections)

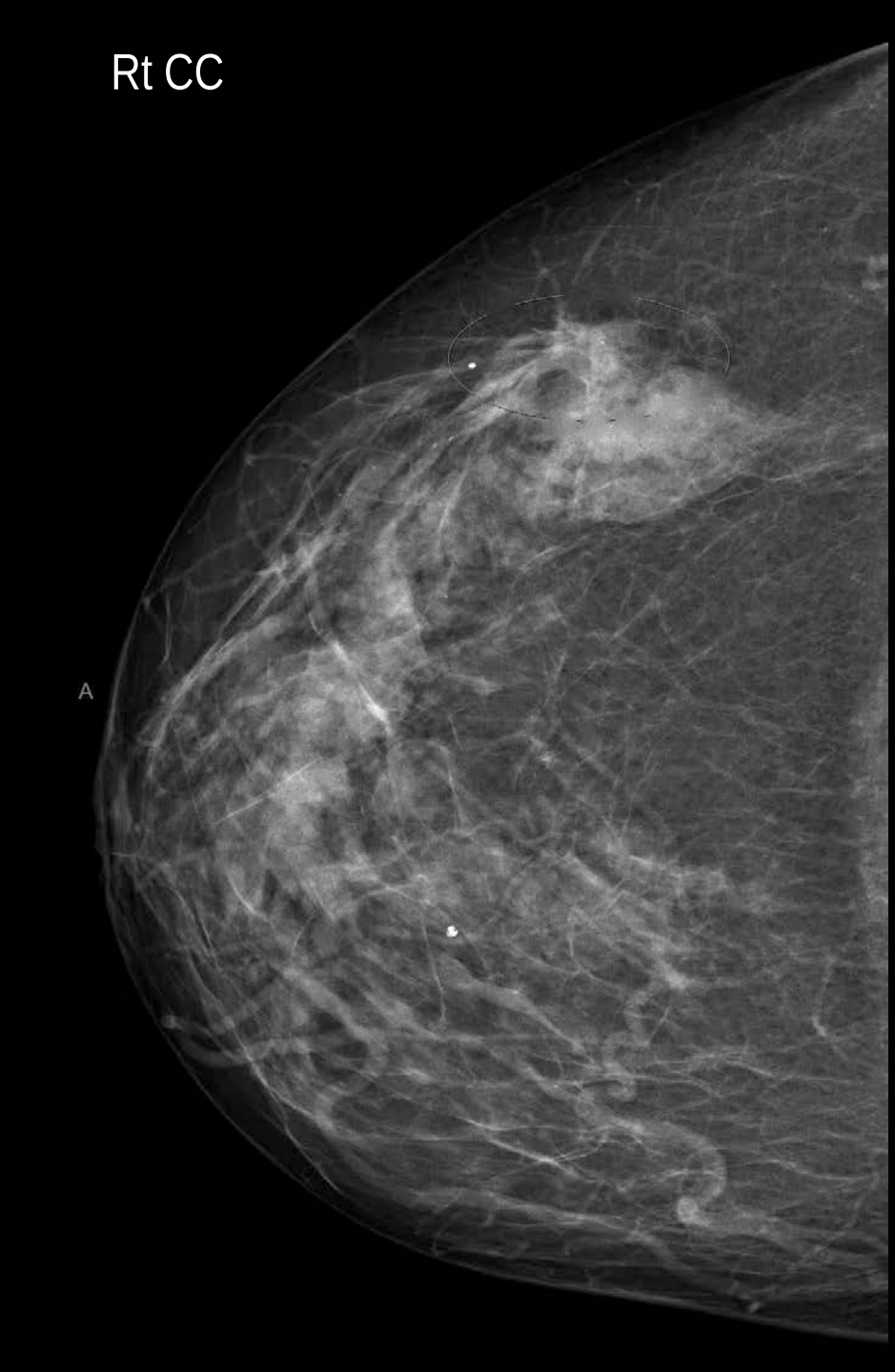
61 year old asymptomatic woman, called back from mammography screening for assessment of the asymmetric density in the upper-outer quadrant of her right breast.

From the Departments of Mammography *and* Clinical Pathology
Falun Central Hospital, Sweden

Example 1


Rt CC
Lt CC


Rt MLO
A


Rt CC
A

3D automated ultrasound

Skin level

2 mm deep to the skin

2mm thick consecutive coronal slices

3D automated ultrasound

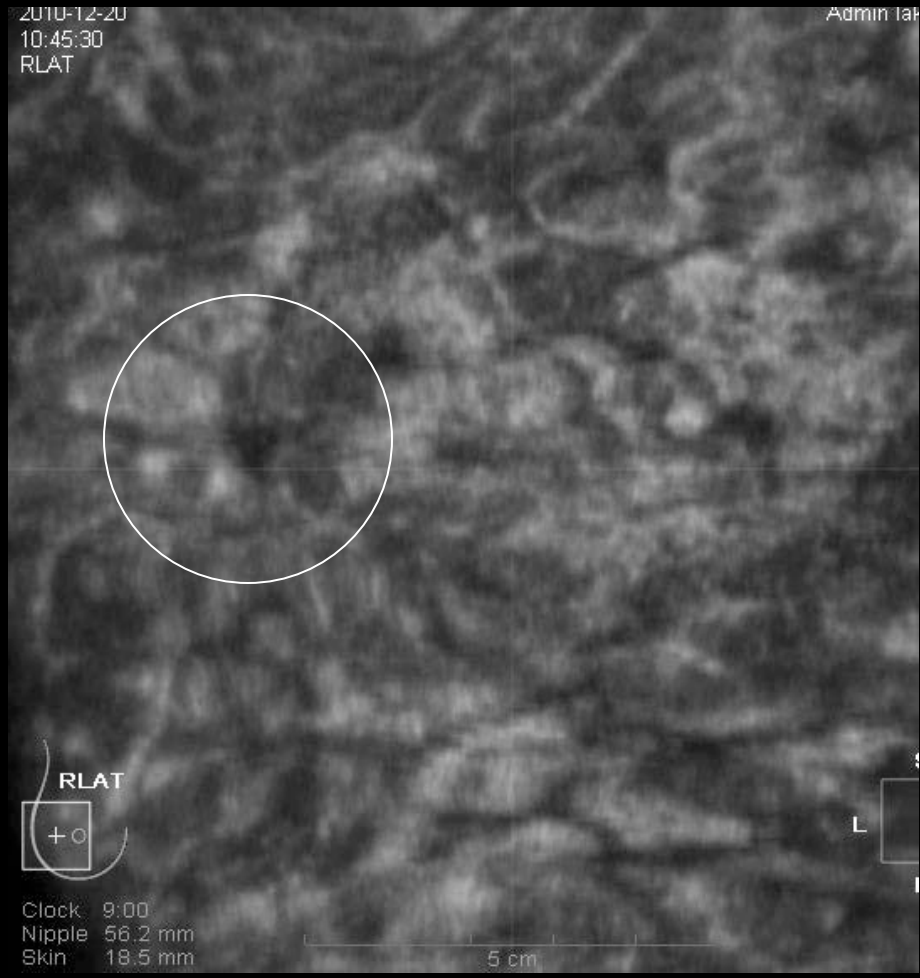
12 mm deep to the skin

14 mm deep to the skin

2mm thick consecutive coronal slices

3D automated ultrasound

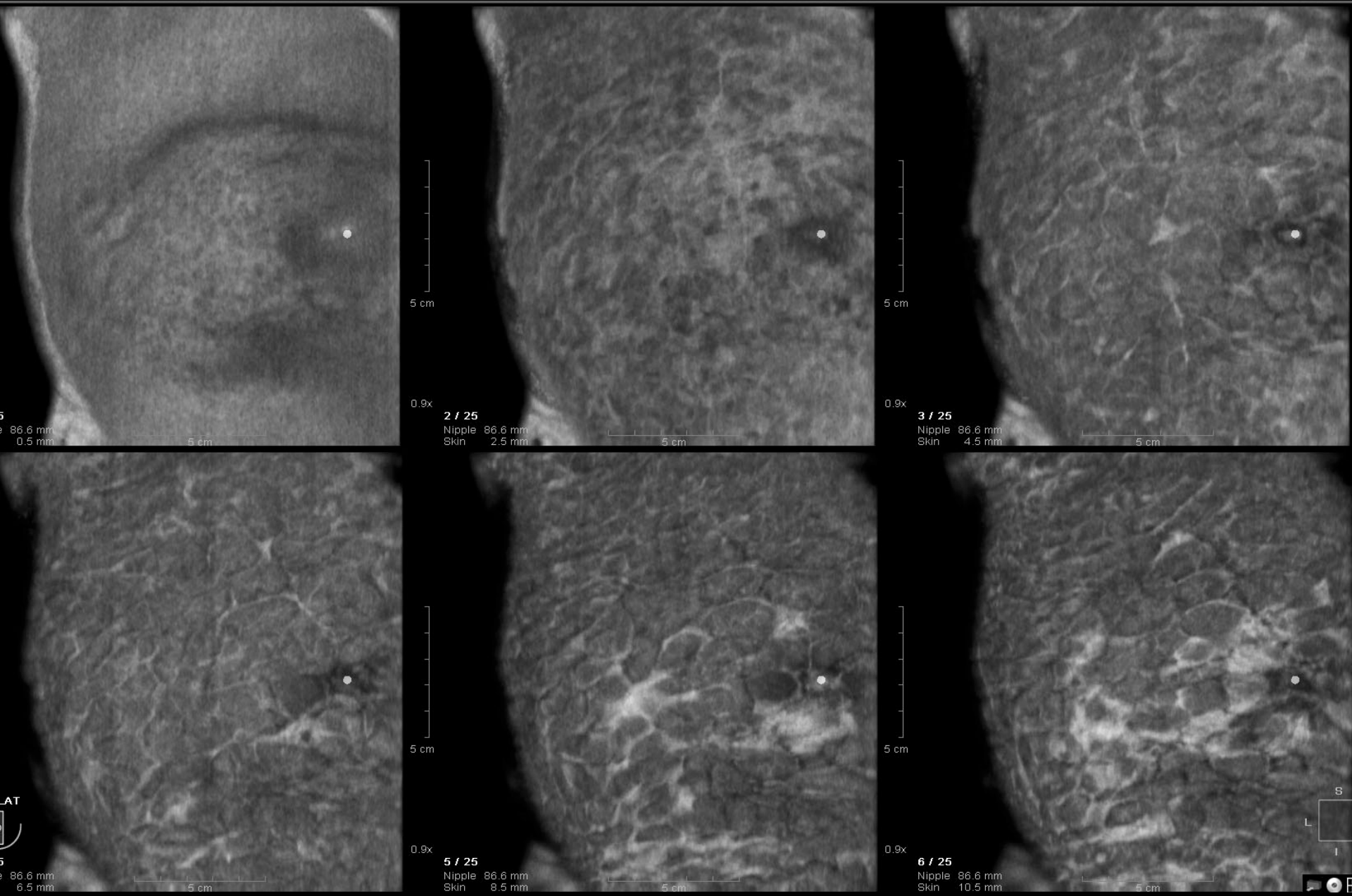
12 mm deep to the skin



14 mm deep to the skin

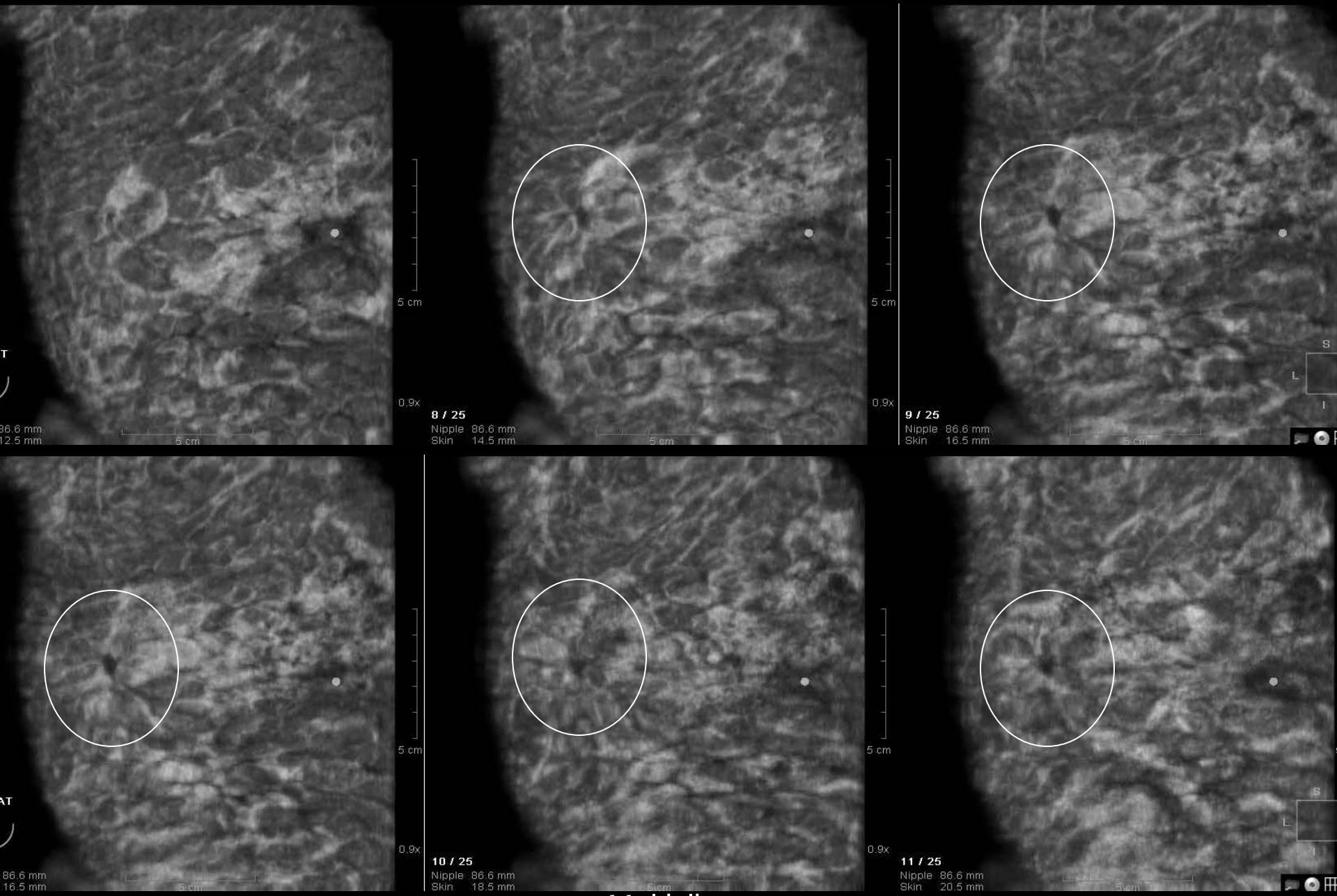
2mm thick consecutive coronal slices

3D automated ultrasound



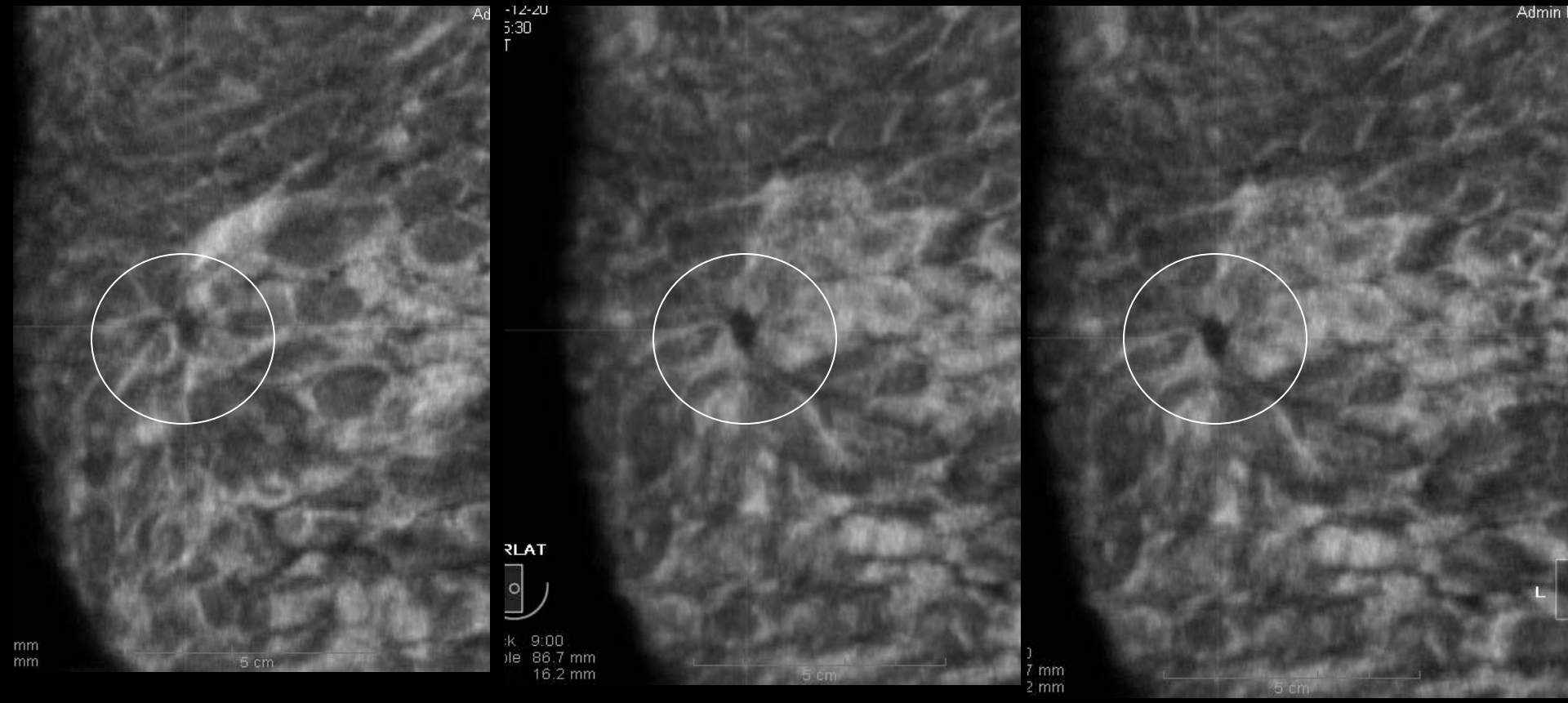
Multislice

3D automated ultrasound



Multislice

3D automated ultrasound

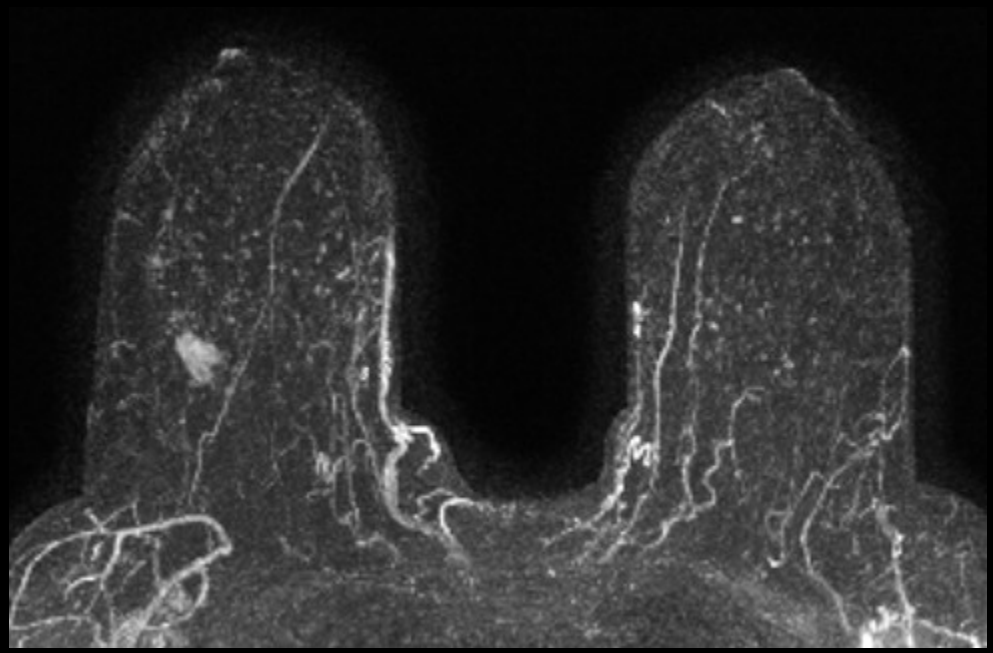


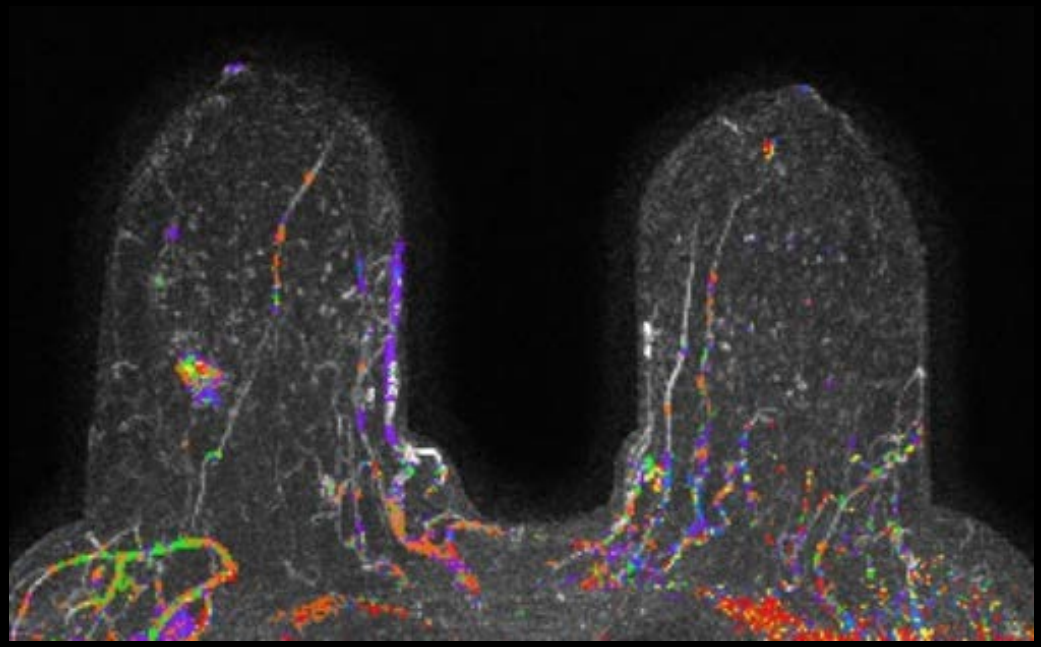
Three consecutive 2 mm thick coronal slices

3D automated ultrasound

Confirmation of the finding

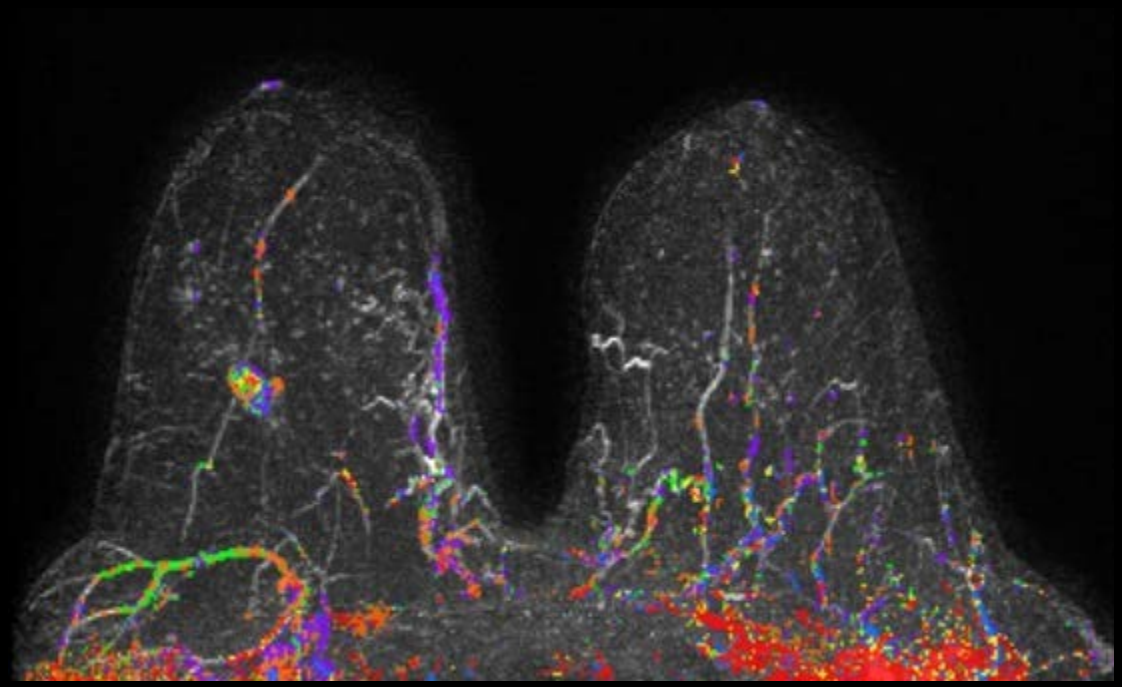
Breast MRI

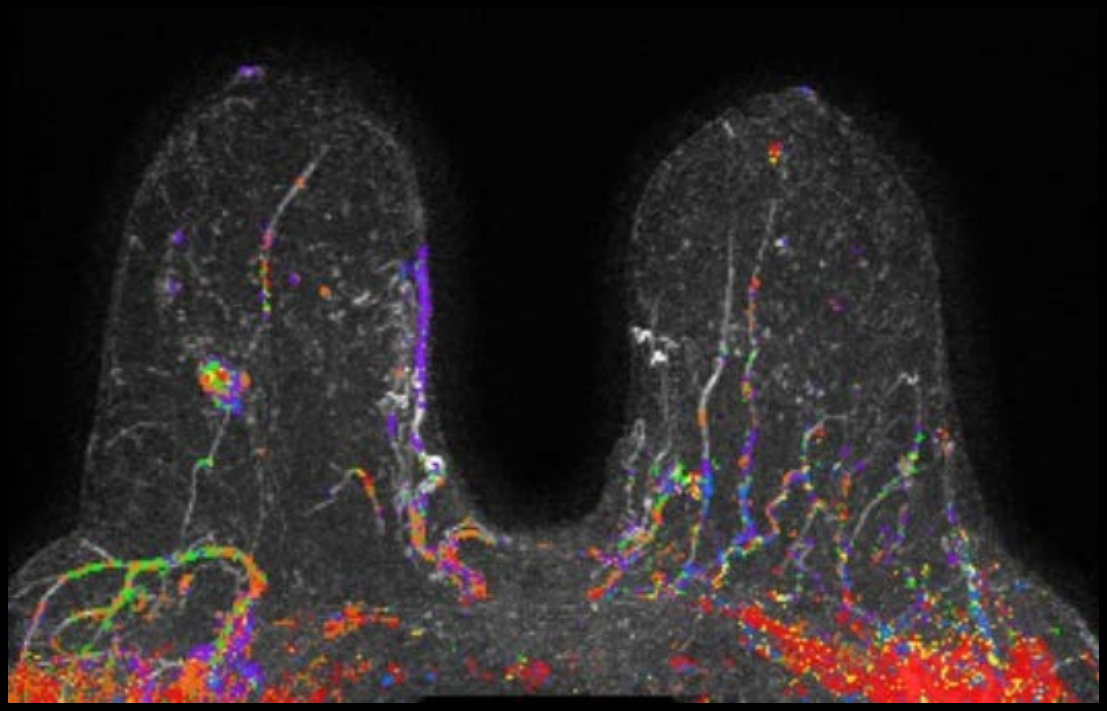




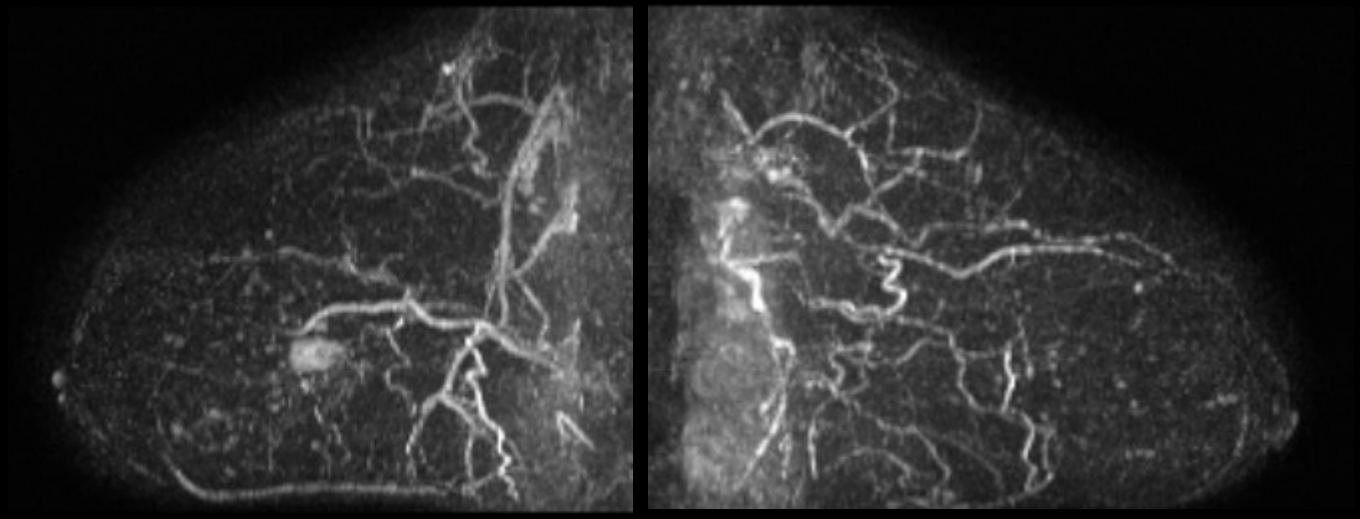
MRI exam courtesy: Mats Ingvarsson, M.D.

Breast MRI

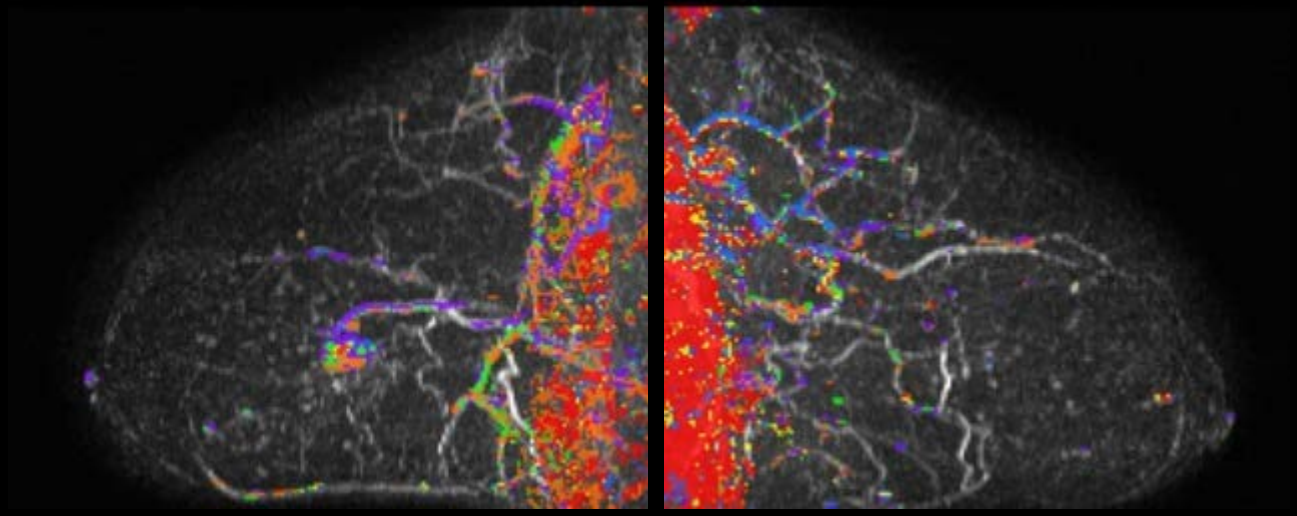




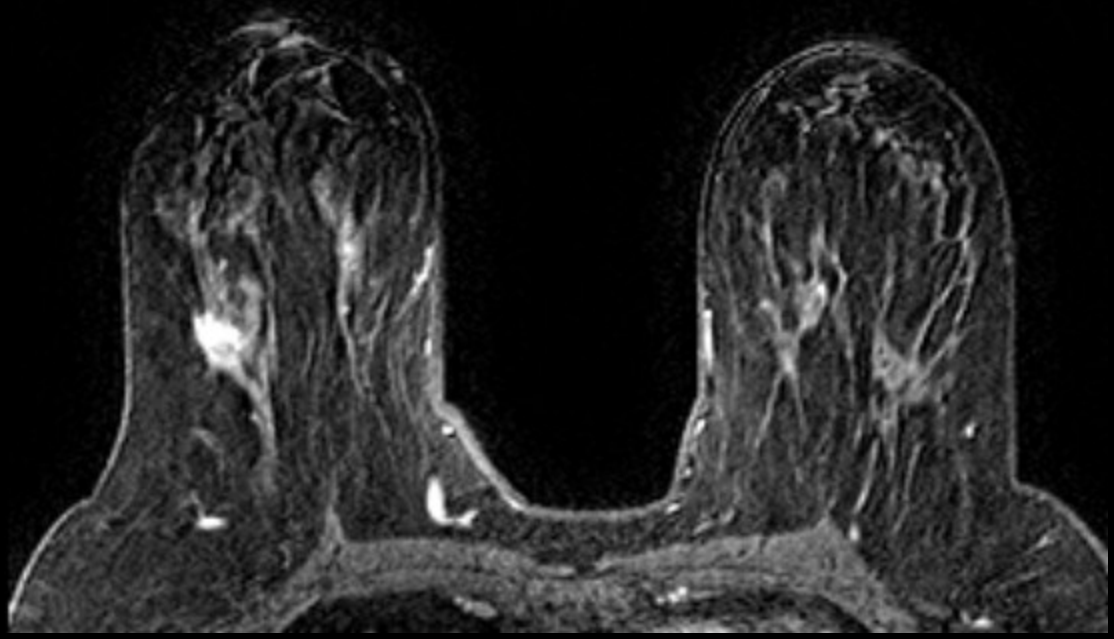
Breast MRI

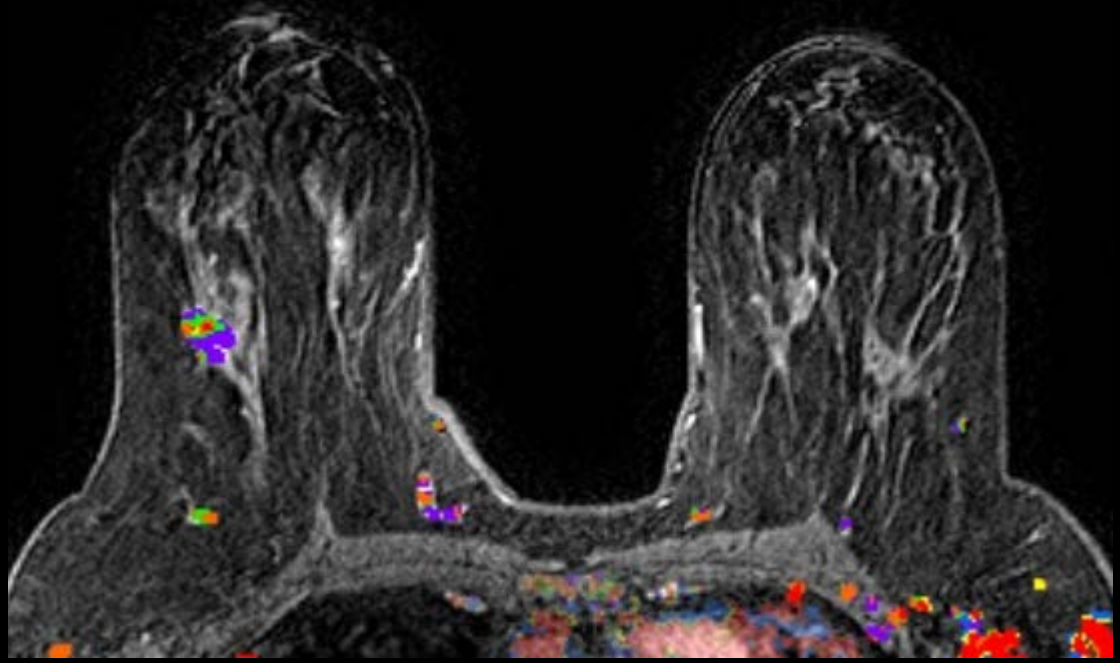


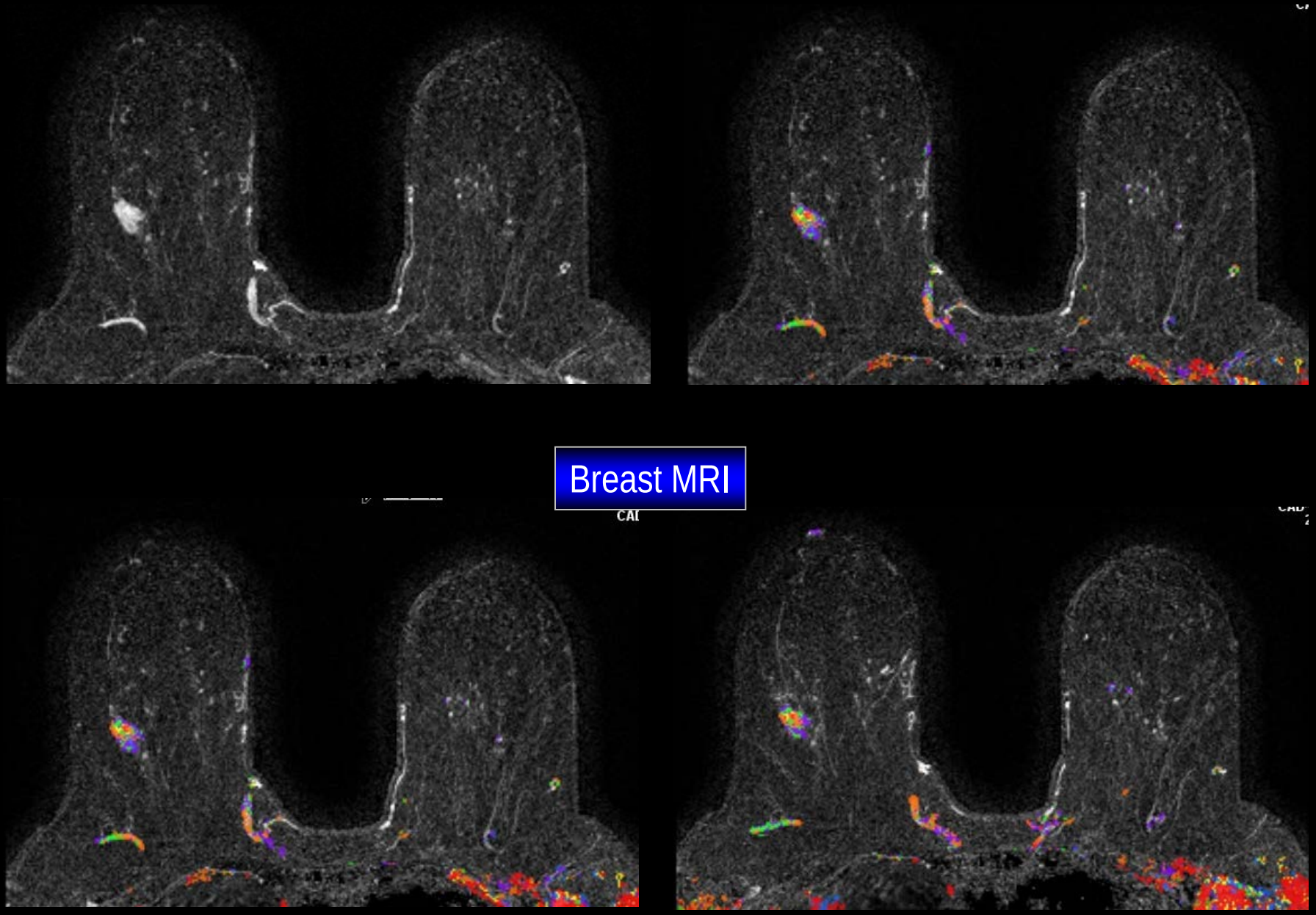
Sagittal view



Breast MRI



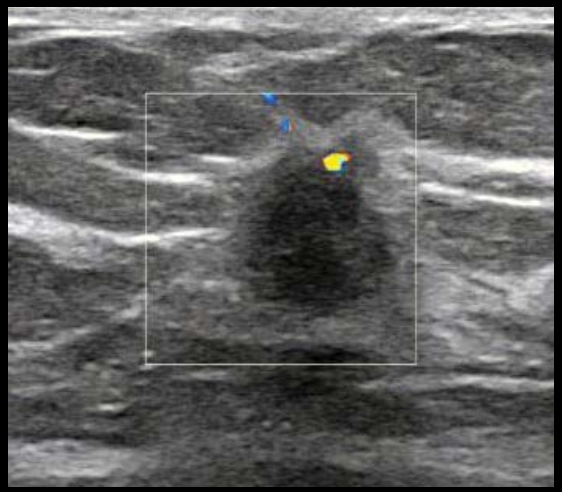



Breast MRI

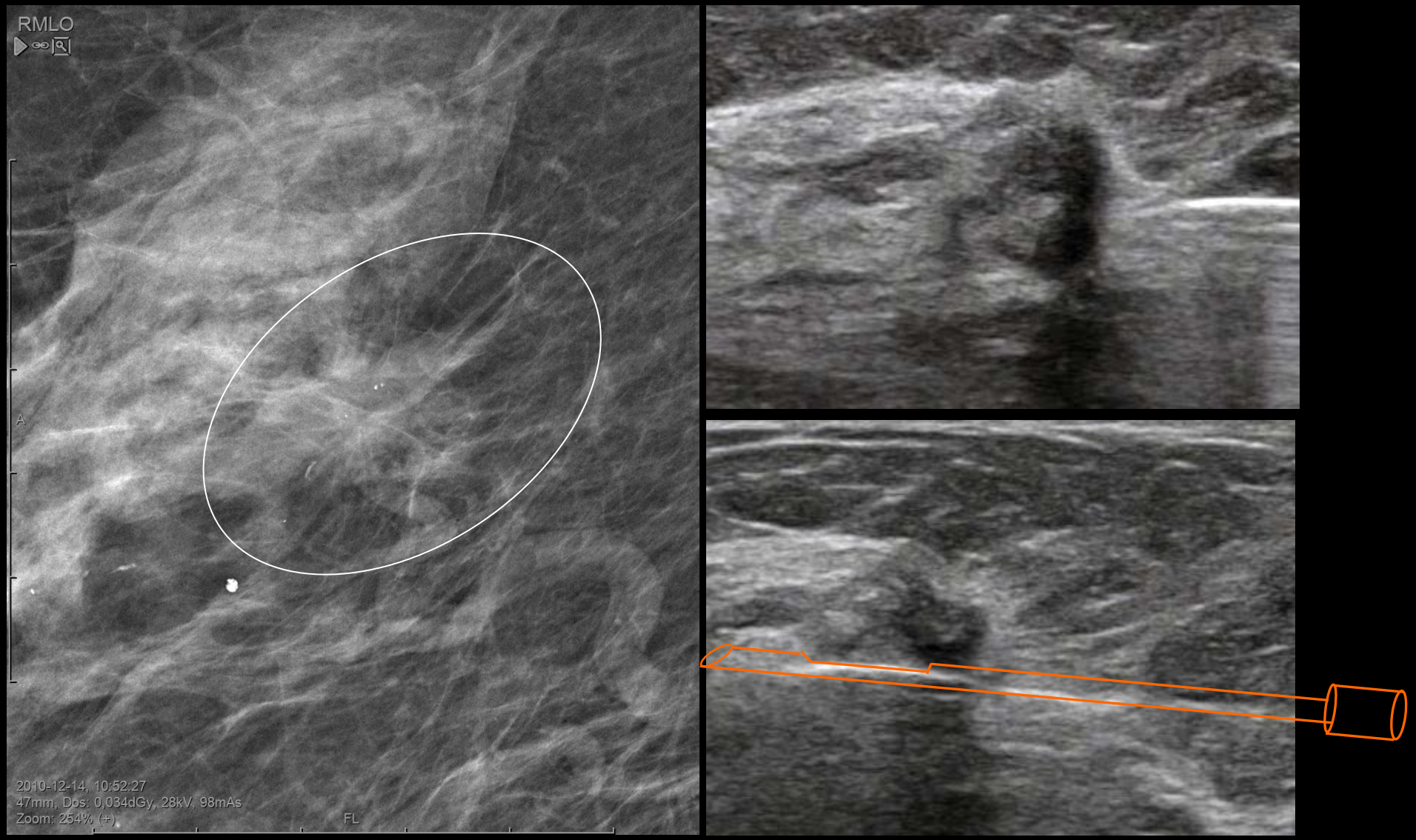
RMLO

Rt MLO

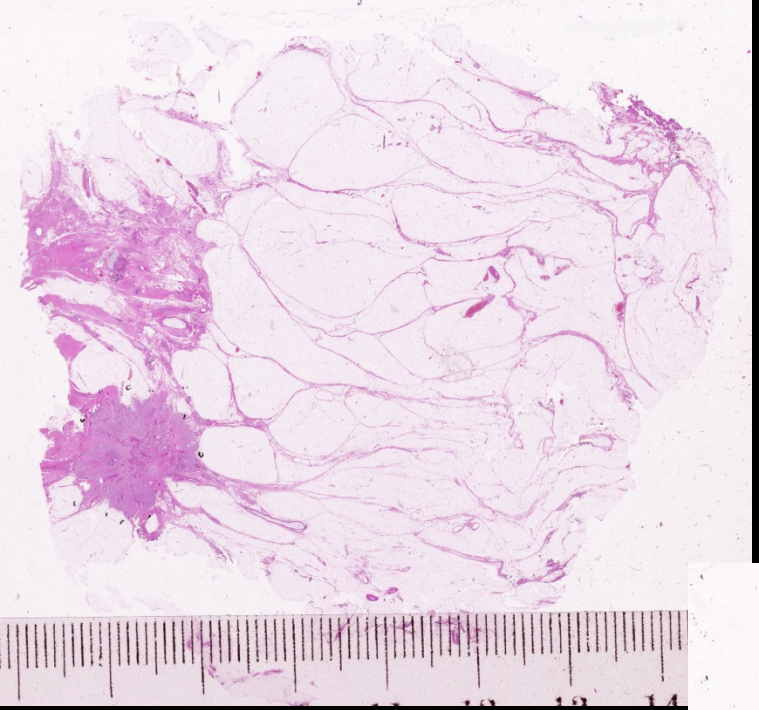
Microfocus magnification



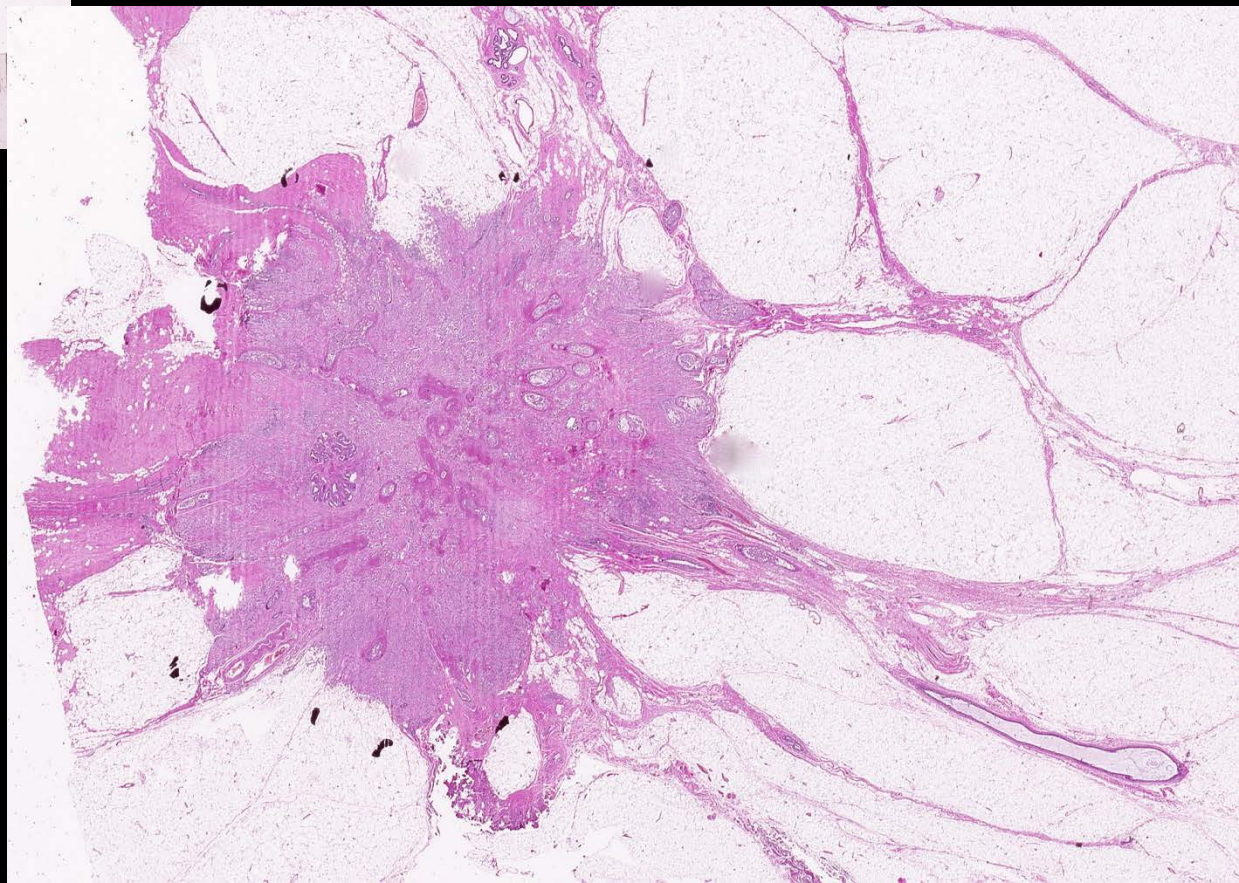
Hand-held ultrasound



Preoperative 14-g core biopsy

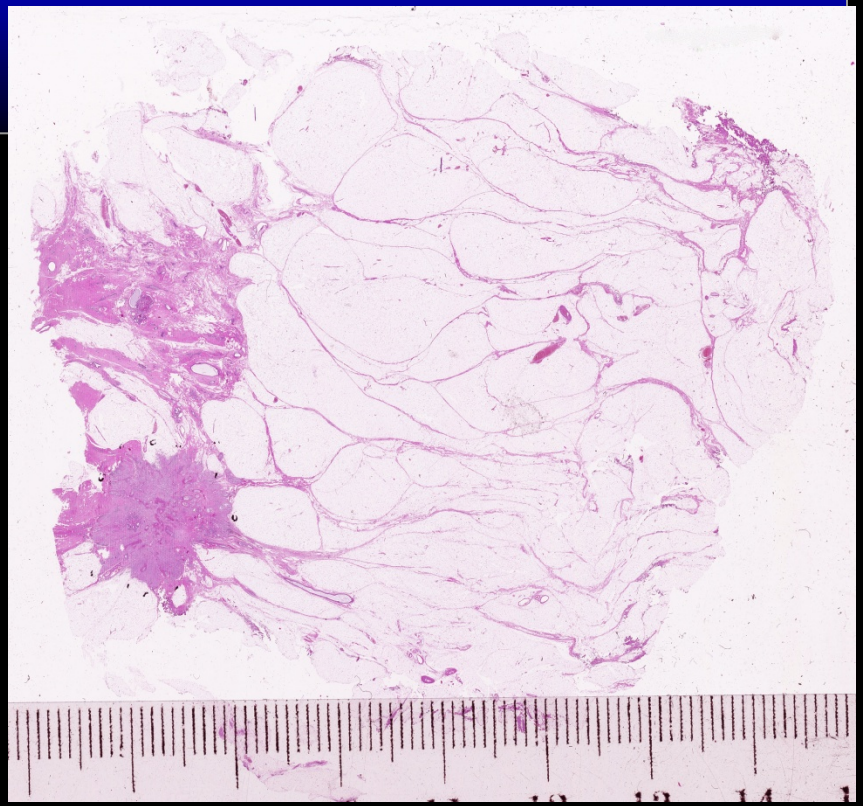


Histology exam courtesy: Tibor Tot, M.D.



Histology

10x10 mm solitary invasive ductal carcinoma.
Gr 1 & 2 *in situ* carcinoma in the spicules
Total extent: 18x15 mm
pN 0/2

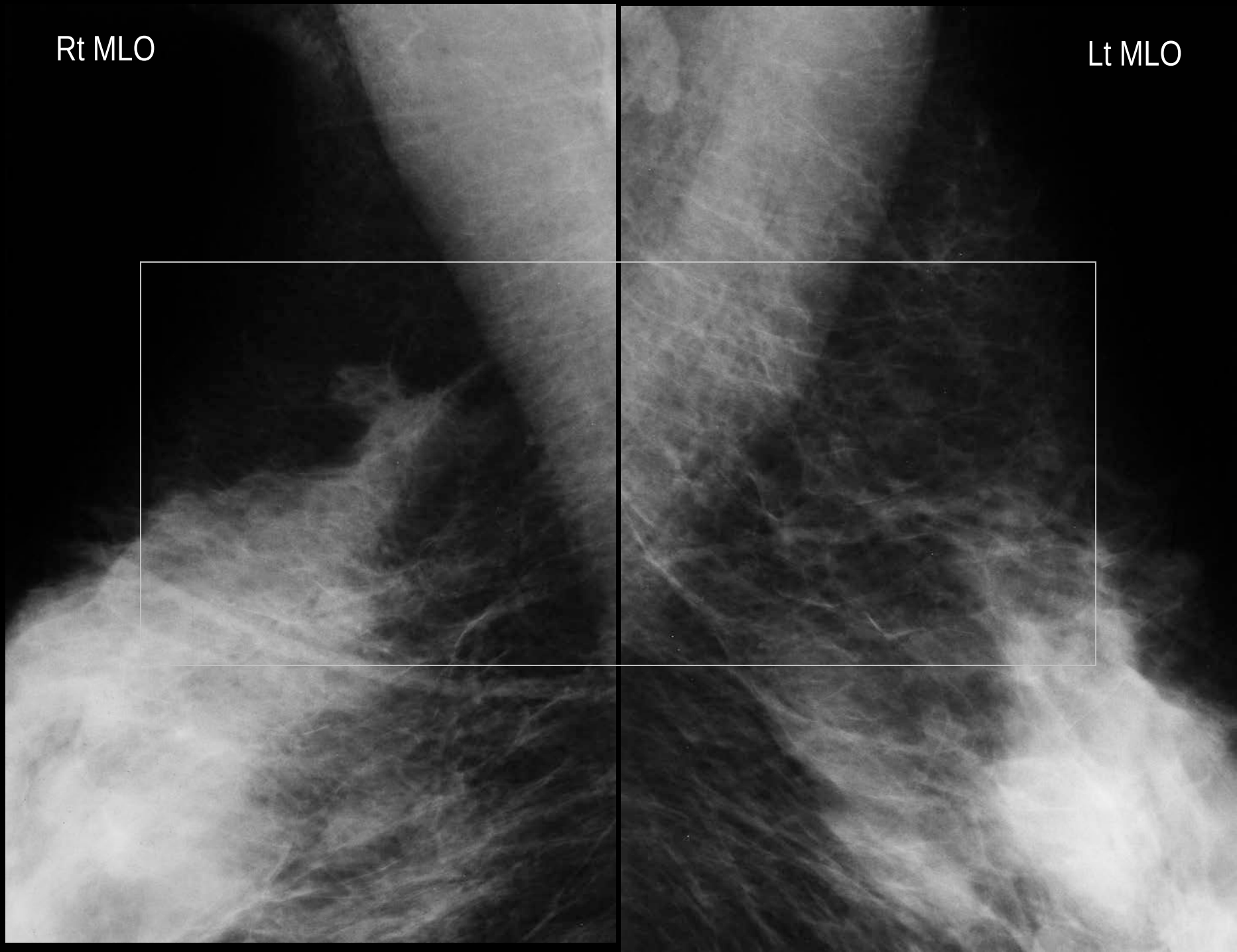


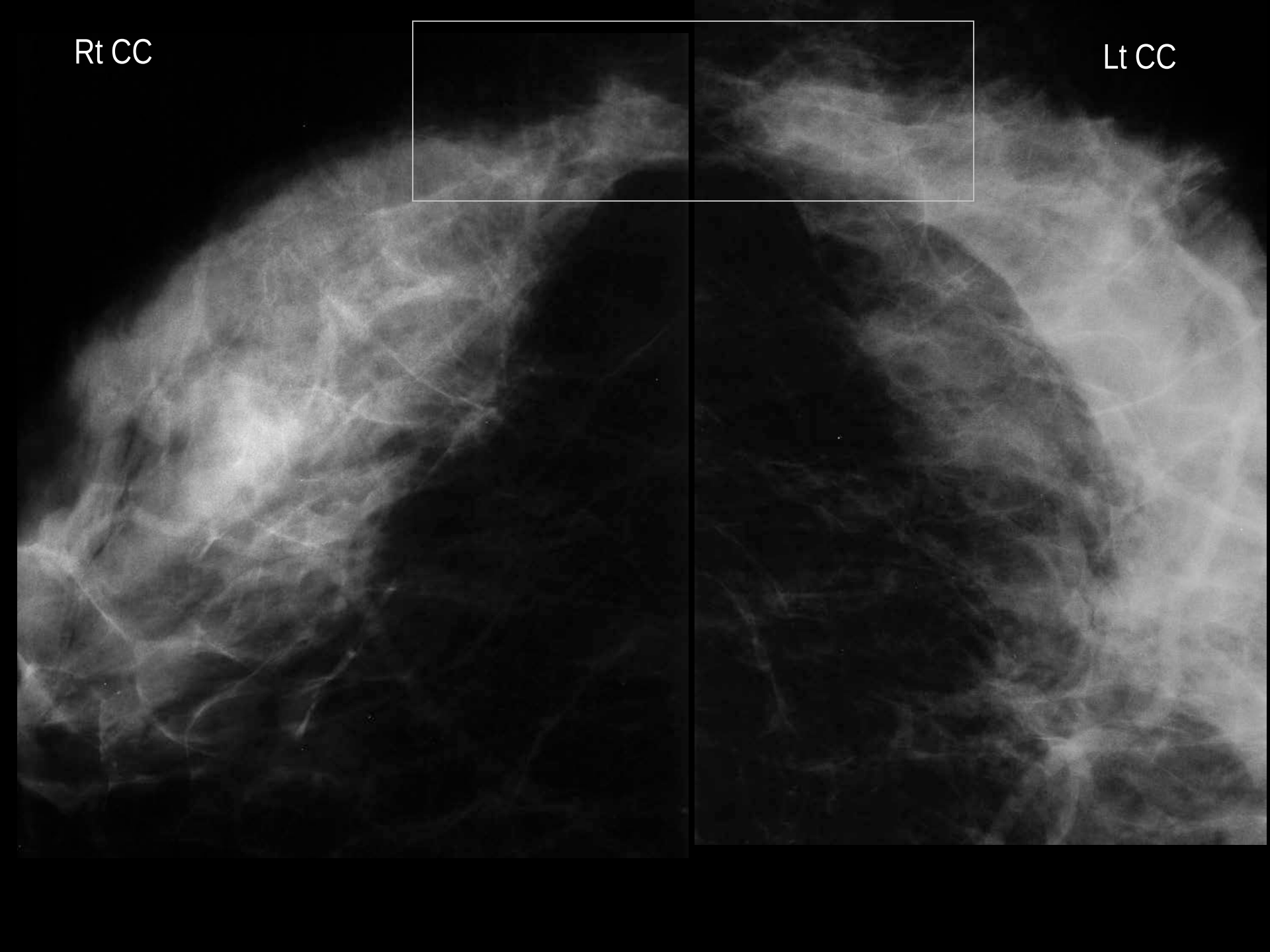
47 year old woman, called back from mammography screening for assessment of a stellate lesion in the medial portion of the left breast

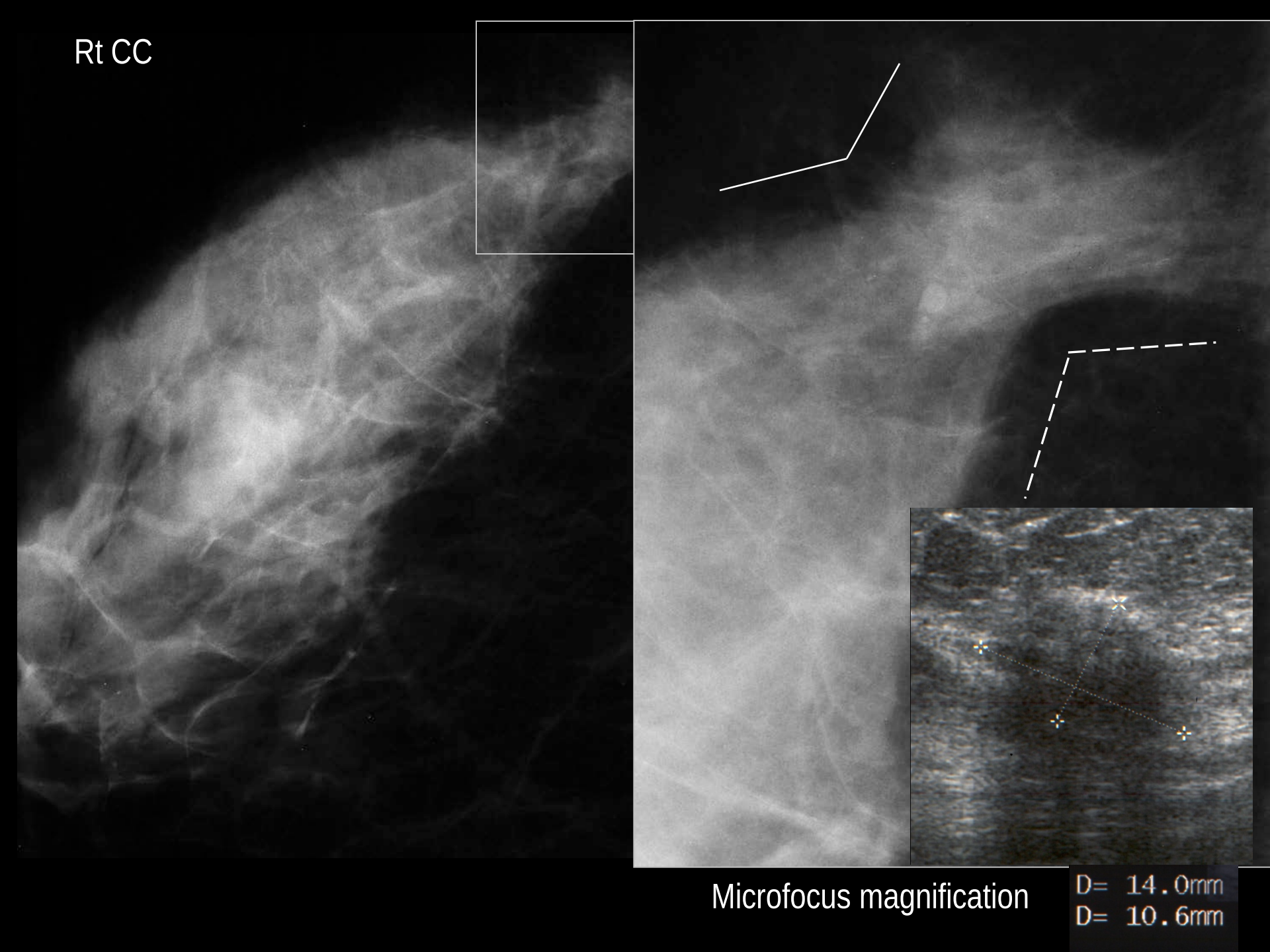
Example 2

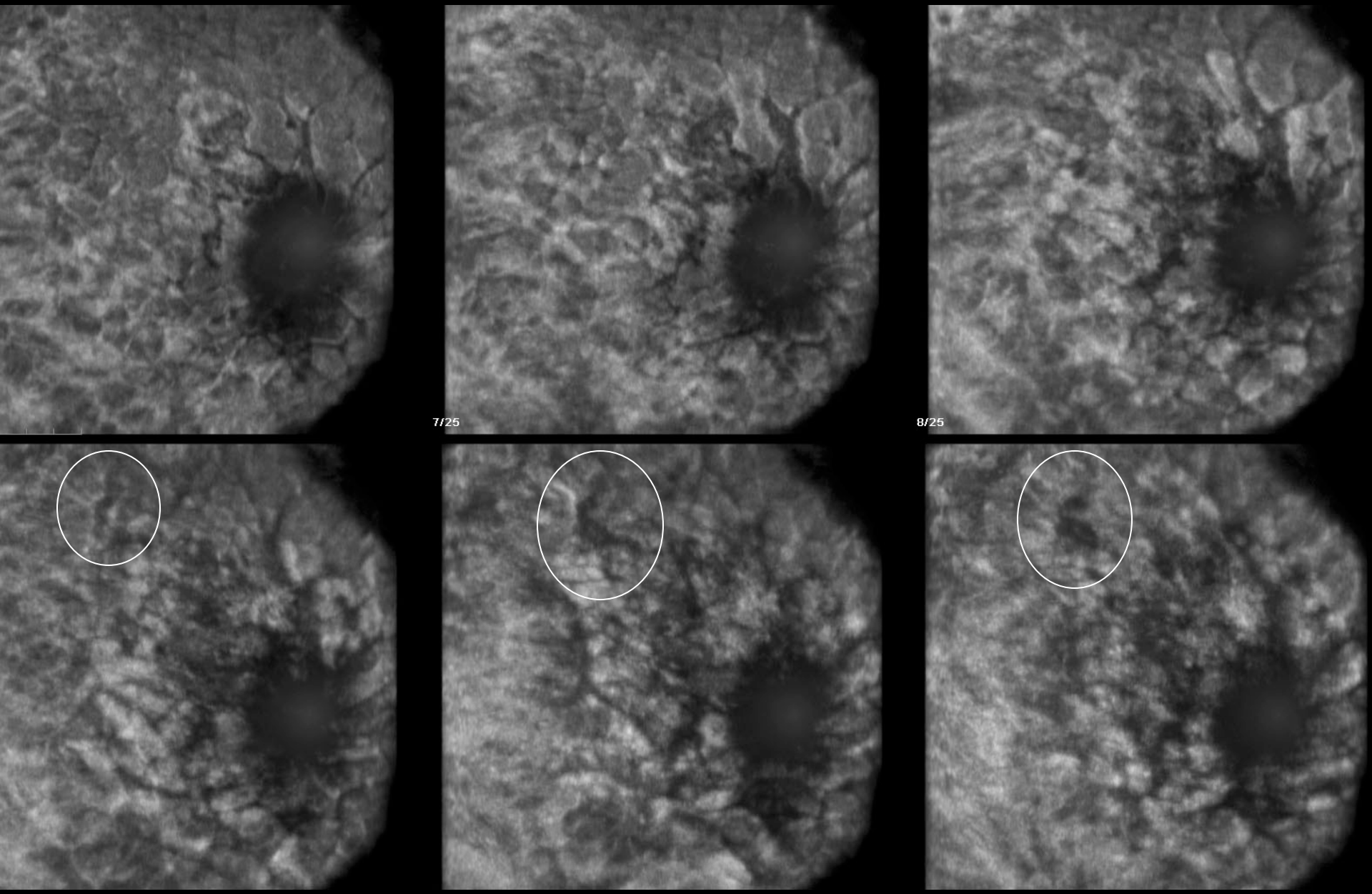
From the Departments of Mammography *and* Clinical Pathology

Falun Central Hospital, Sweden

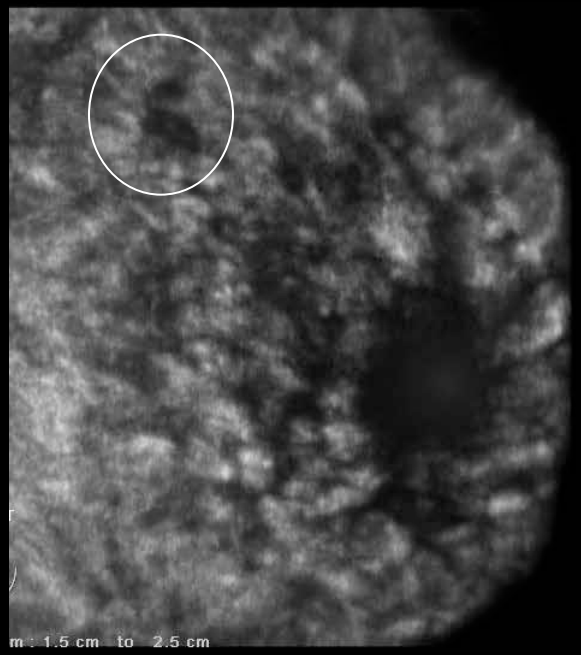

Rt MLO
Lt MLO

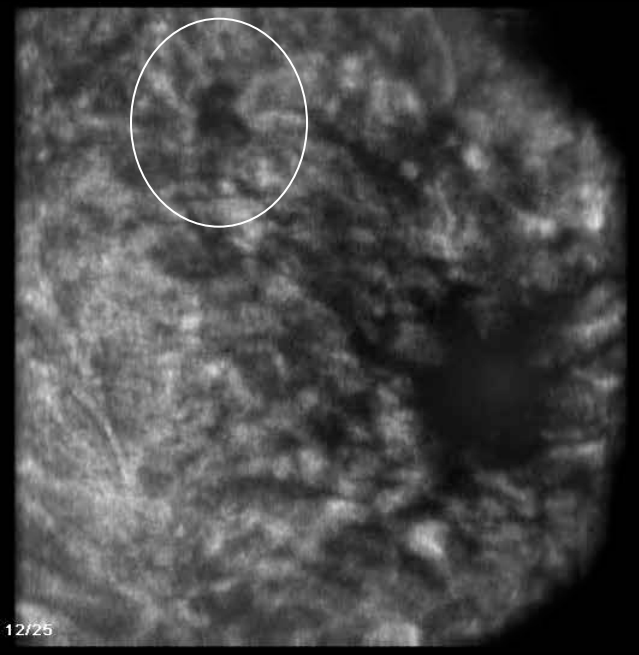

Rt CC
Lt CC

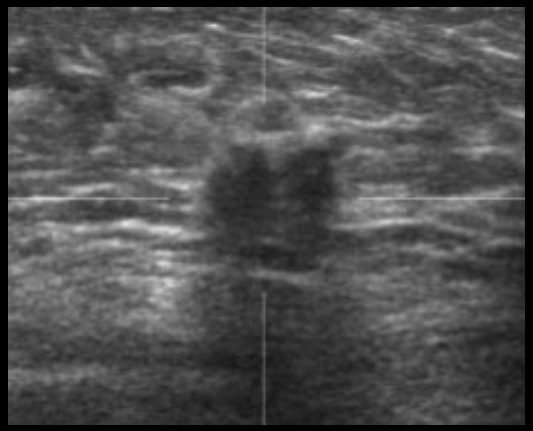

Rt CC
Microfocus magnification
D= 14.0mm
D= 10.6mm

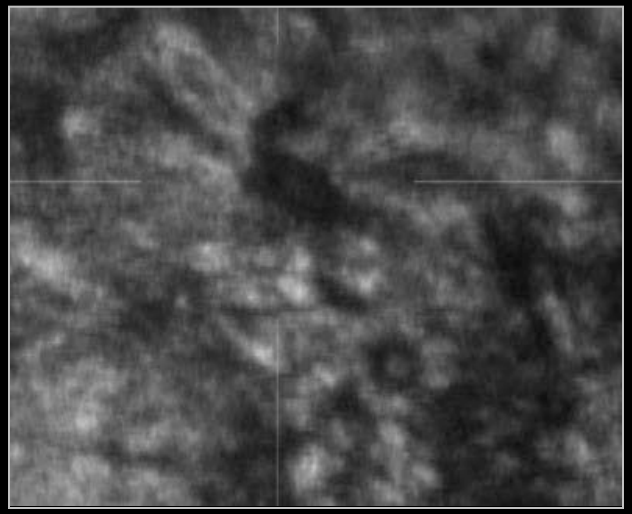


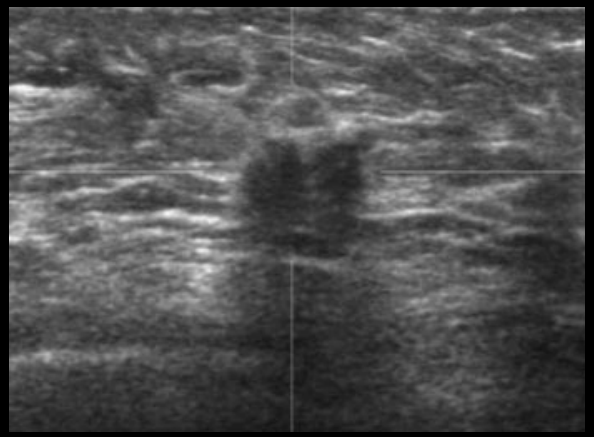
Consecutive 2 mm slices of the coronal sections, right breast



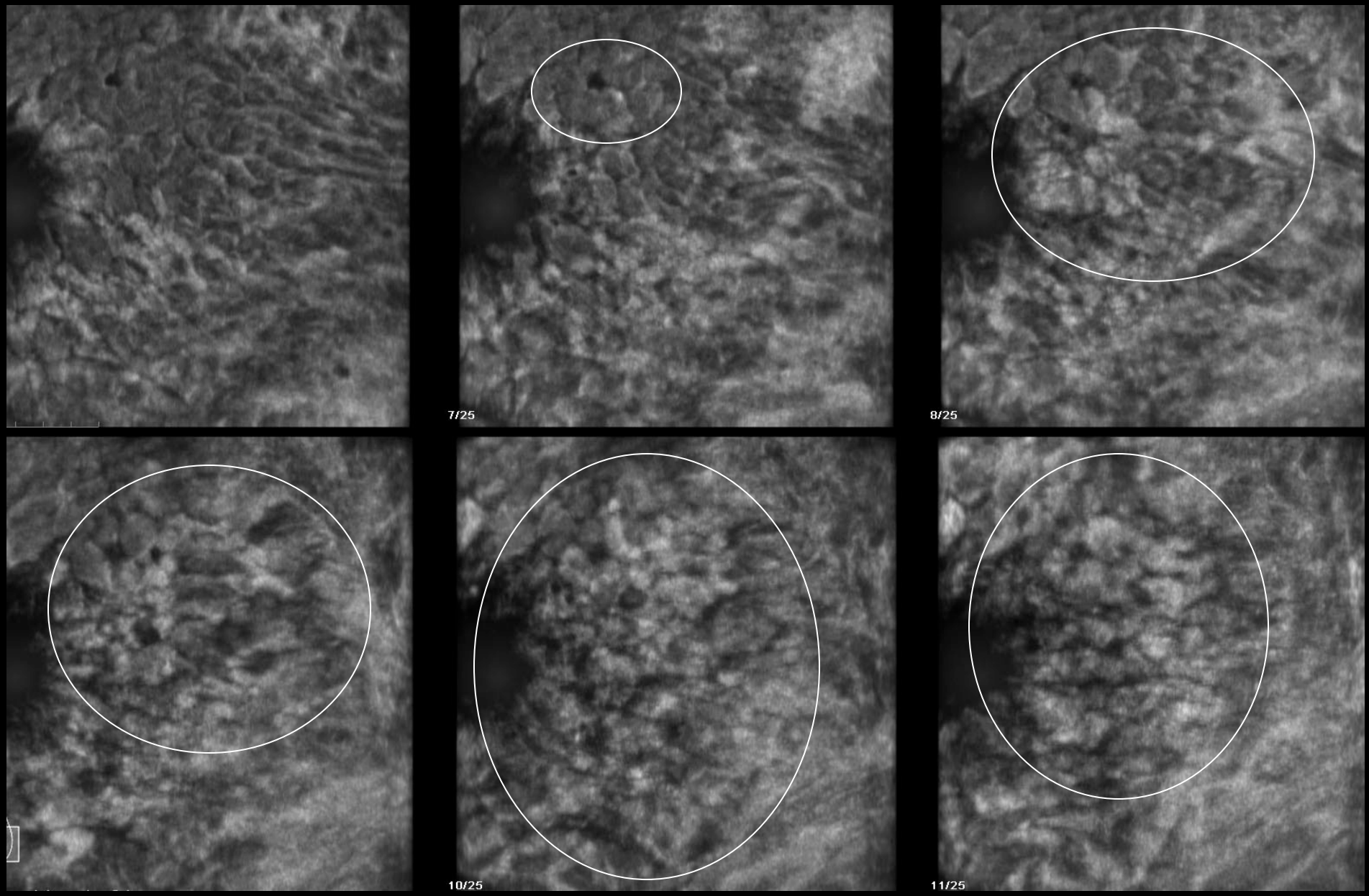




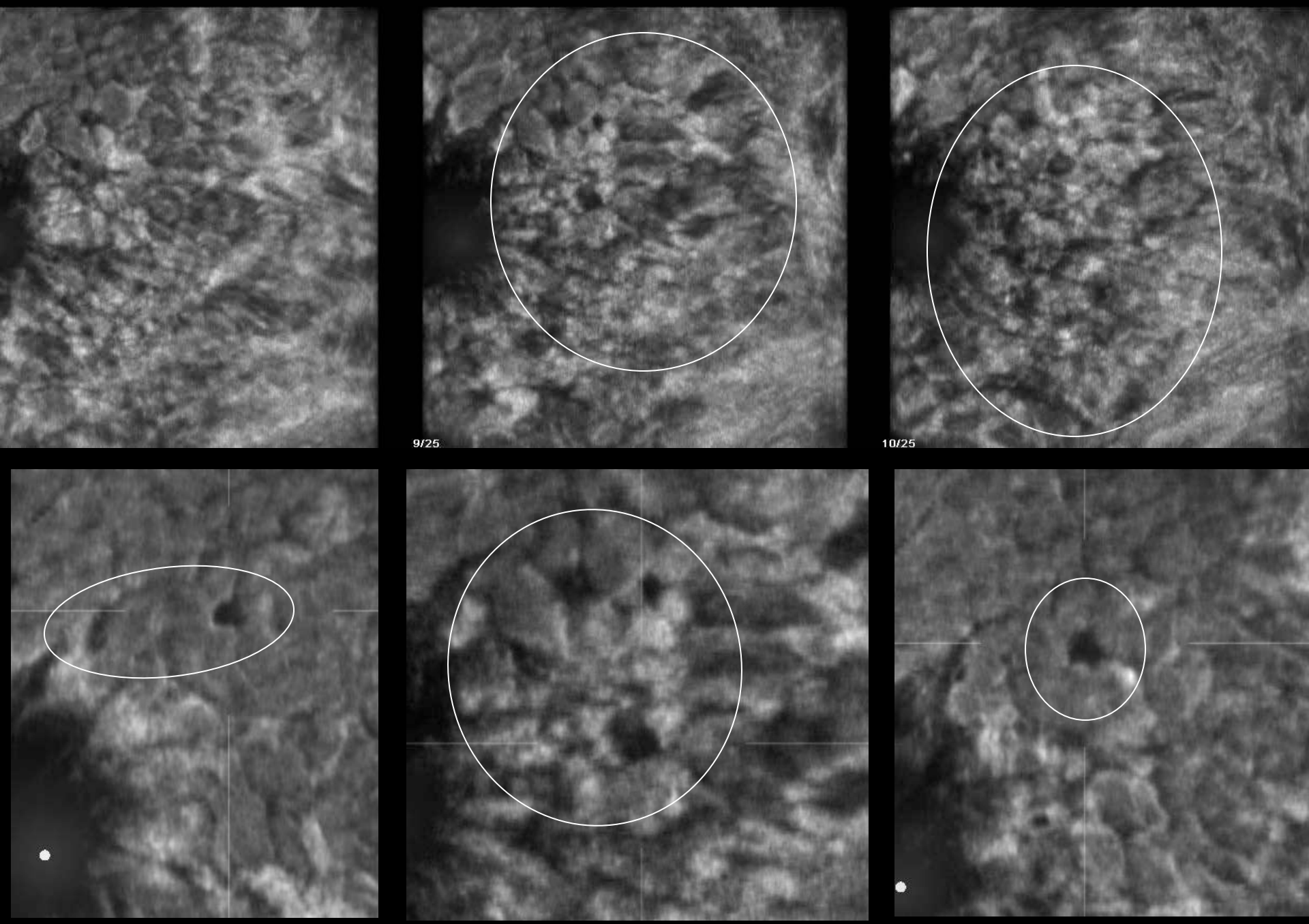




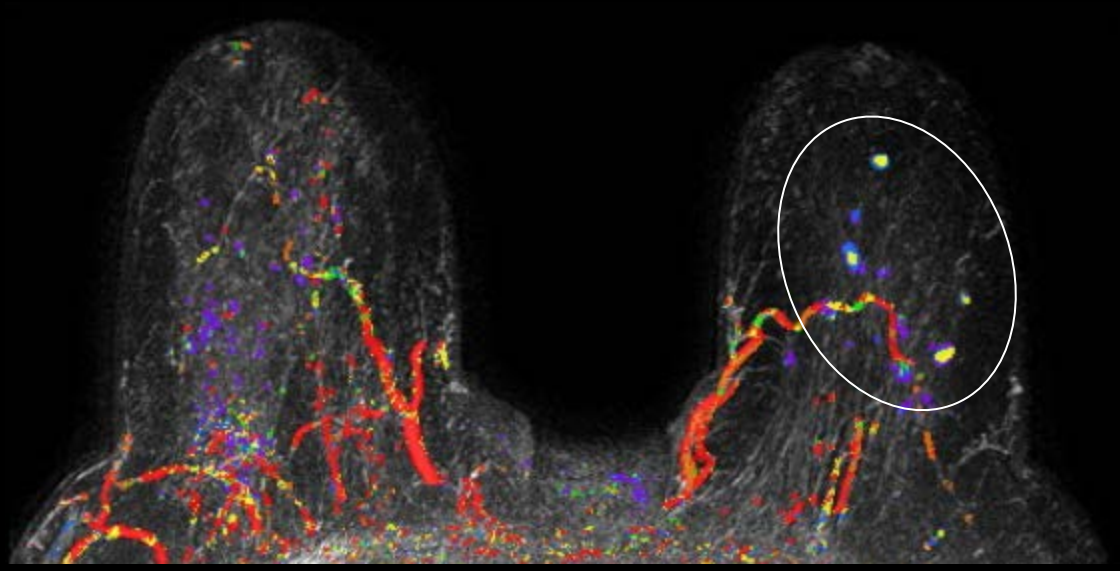
Histologic diagnosis (Rt breast): 16x10 mm solitary invasive ductal carcinoma



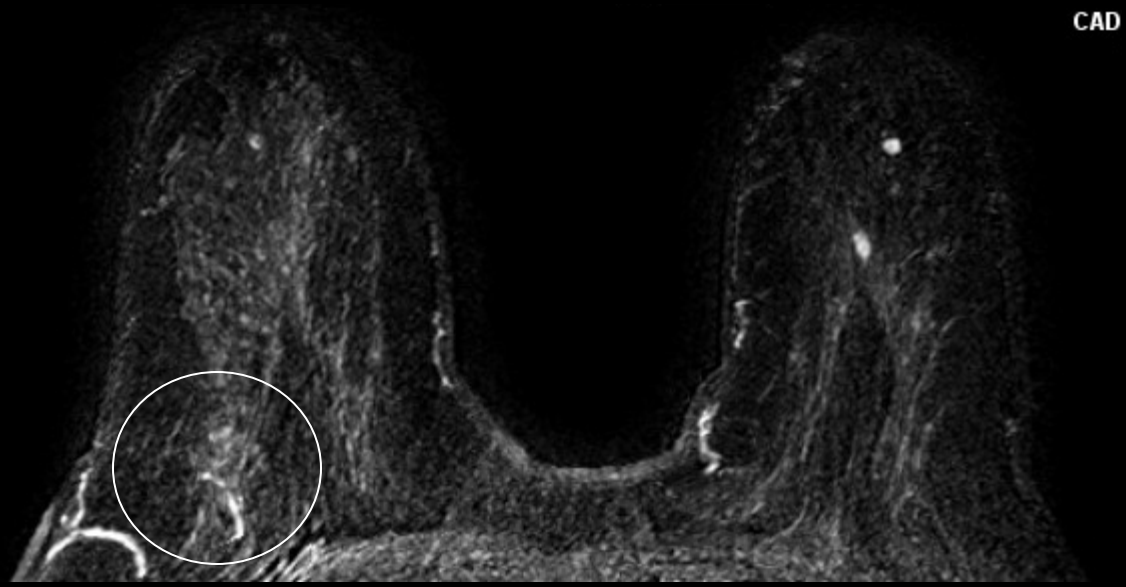
Consecutive 2 mm slices of the coronal sections, left breast

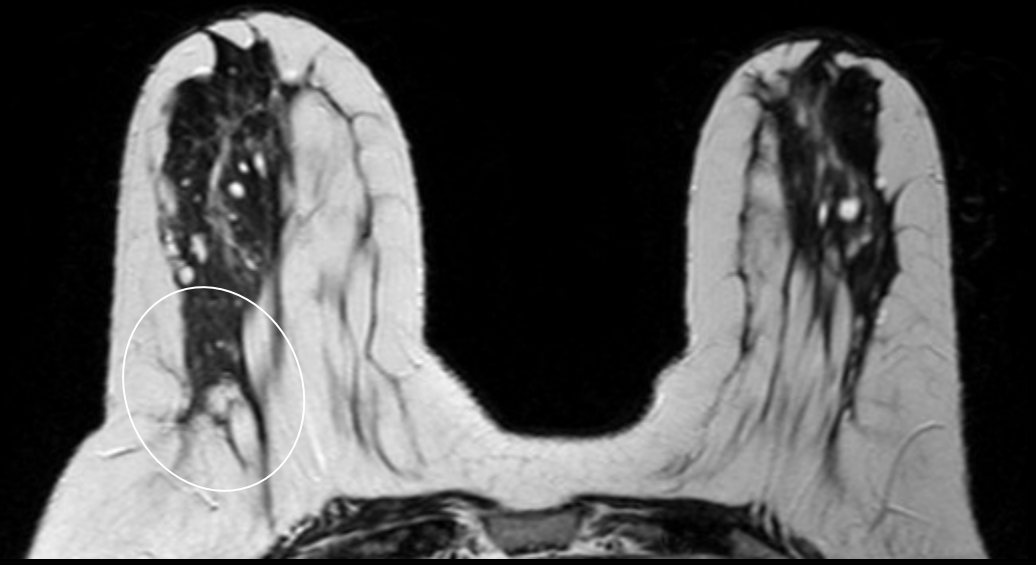


Histologic diagnosis (Lt breast): Multiple fibroadenomas

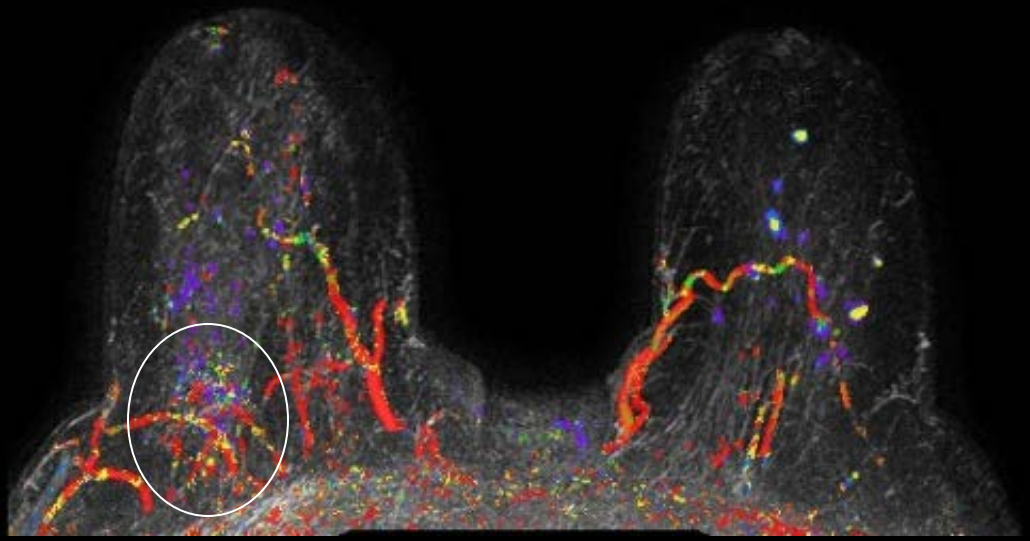


Breast MRI



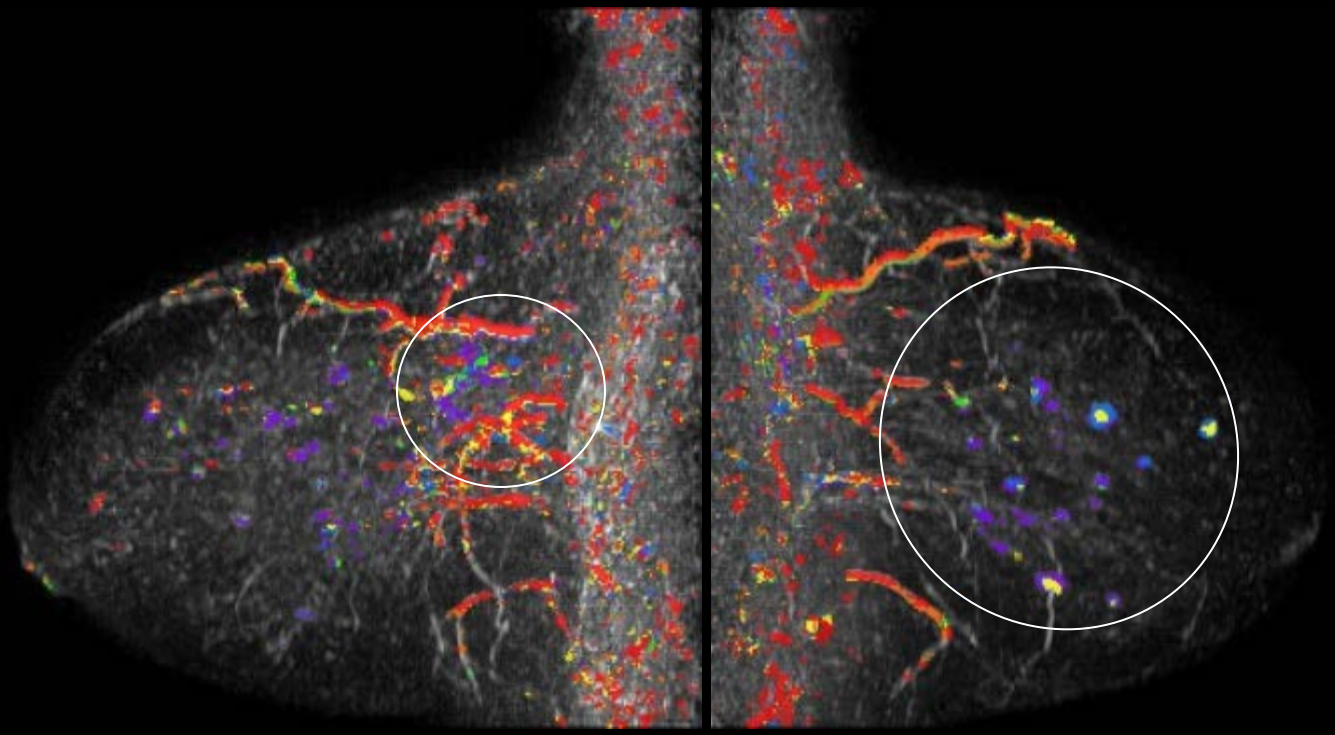


Breast MRI

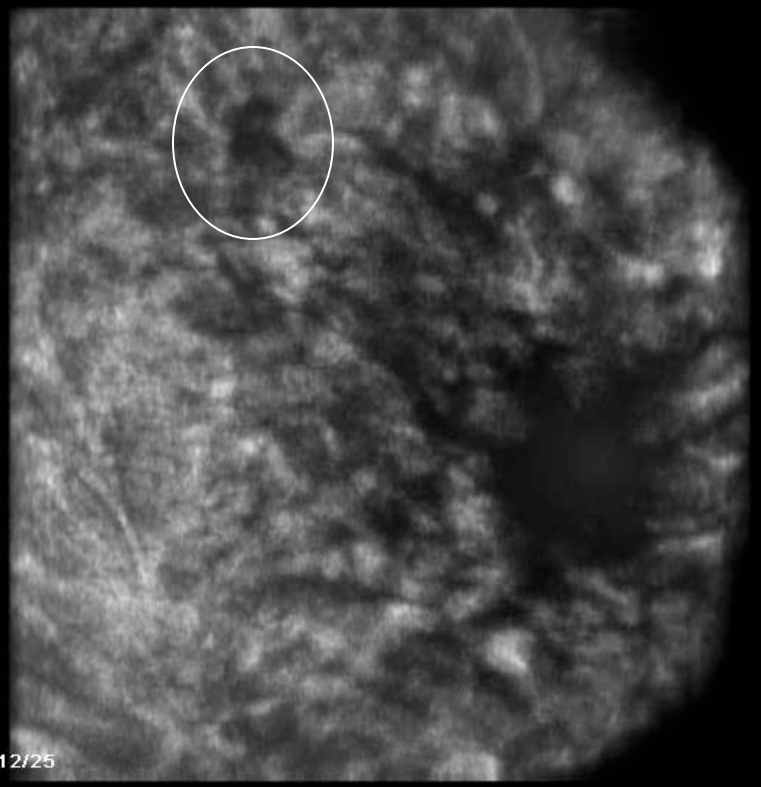


Slight contrast uptake and a non-specific architectural distortion in the right upper-outer quadrant. Several circular, benign lesions centrally in the left breast

Breast MRI

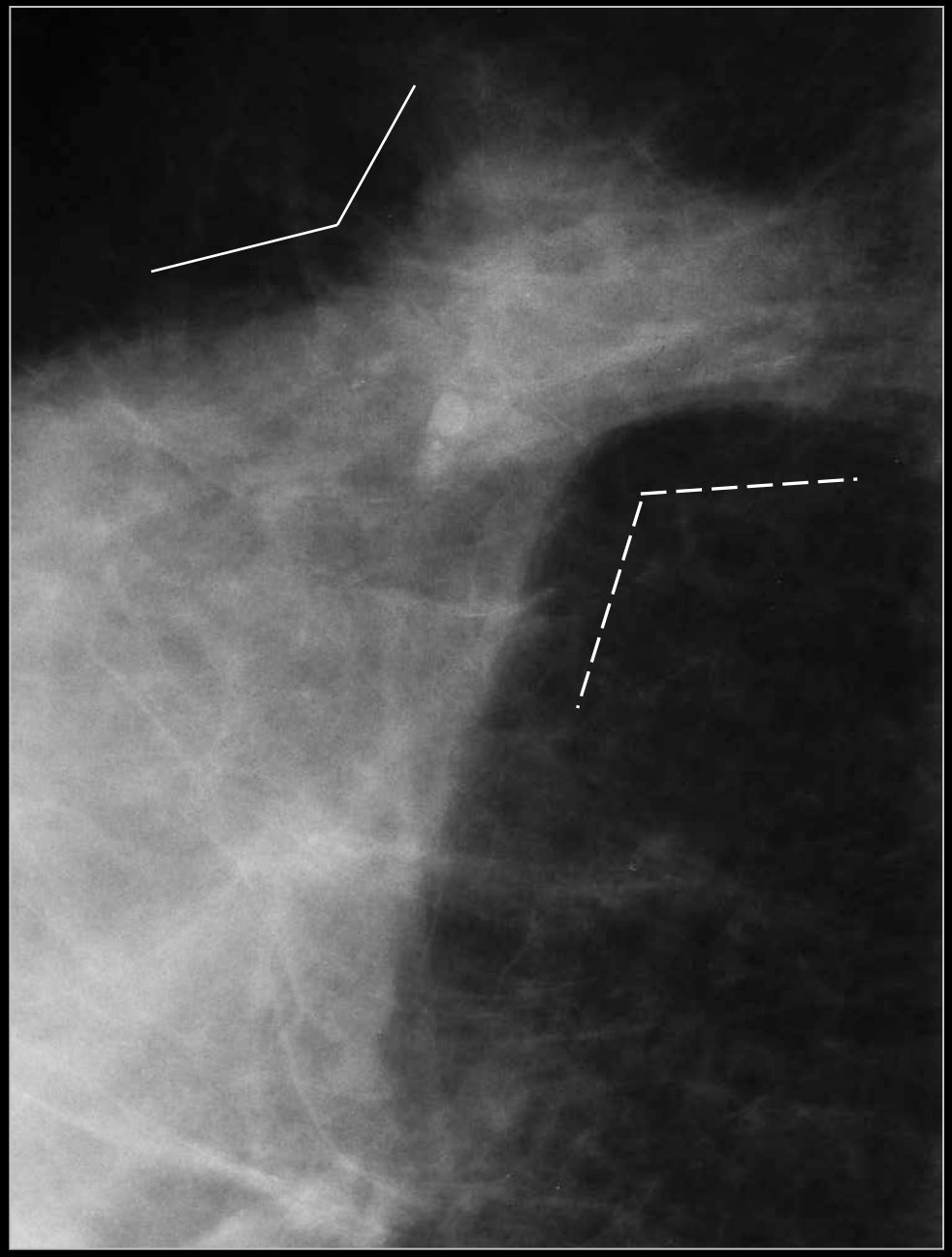


Slight contrast uptake and a non-specific architectural distortion in the right upper-outer quadrant. Several circular, benign lesions centrally in the left breast

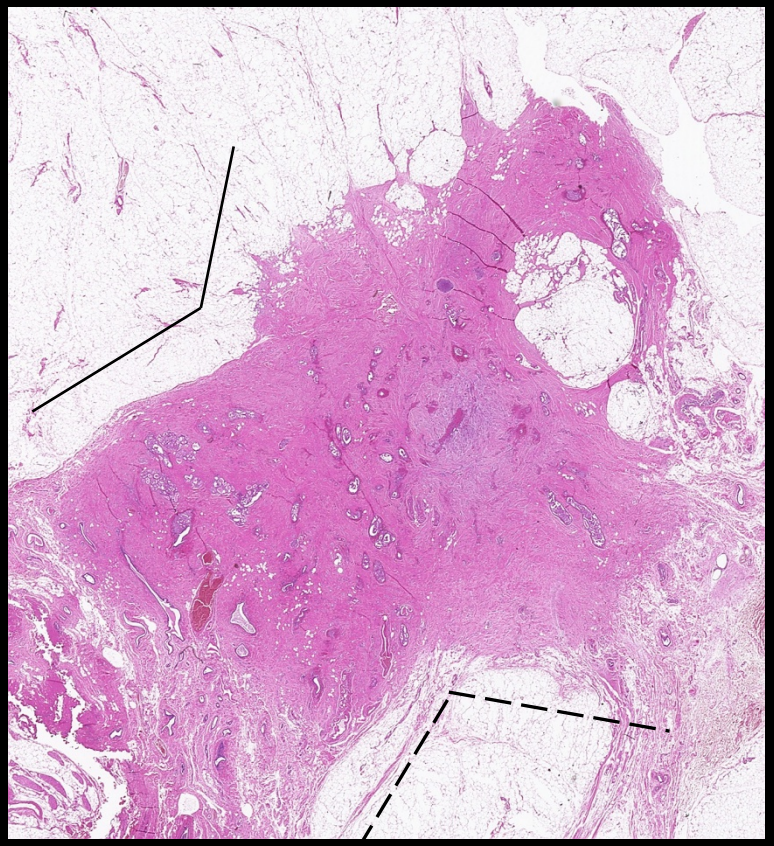


Histology: 16x10 mm solitary invasive ductal carcinoma

3D automated ultrasound



Microfocus magnification



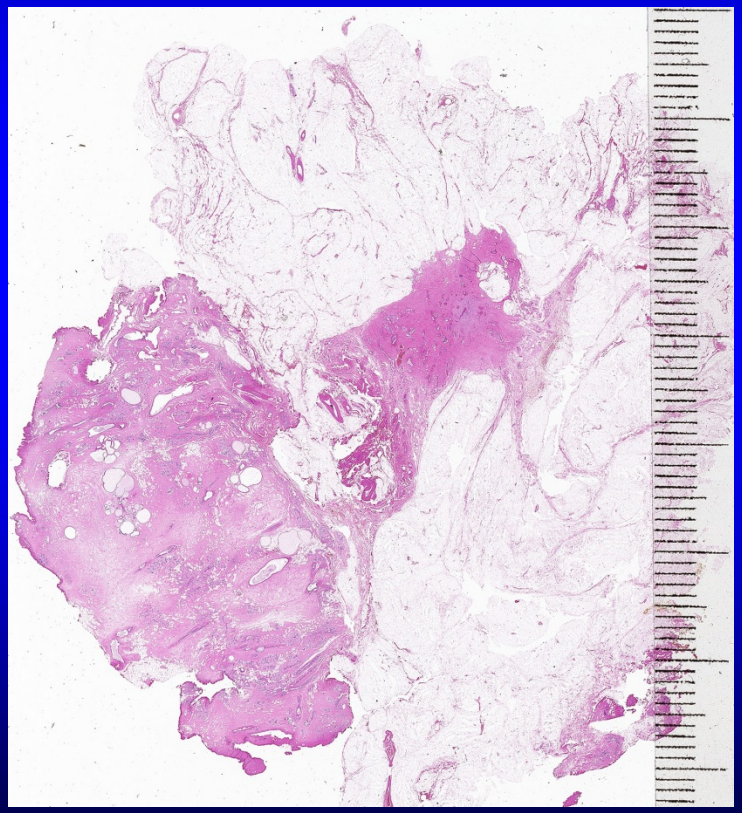
Histology: 16x10 mm solitary invasive ductal carcinoma

Histology

Right breast:

16x10 mm solitary invasive ductal carcinoma.

pN 0/2



Left breast: Several fibroadenomas

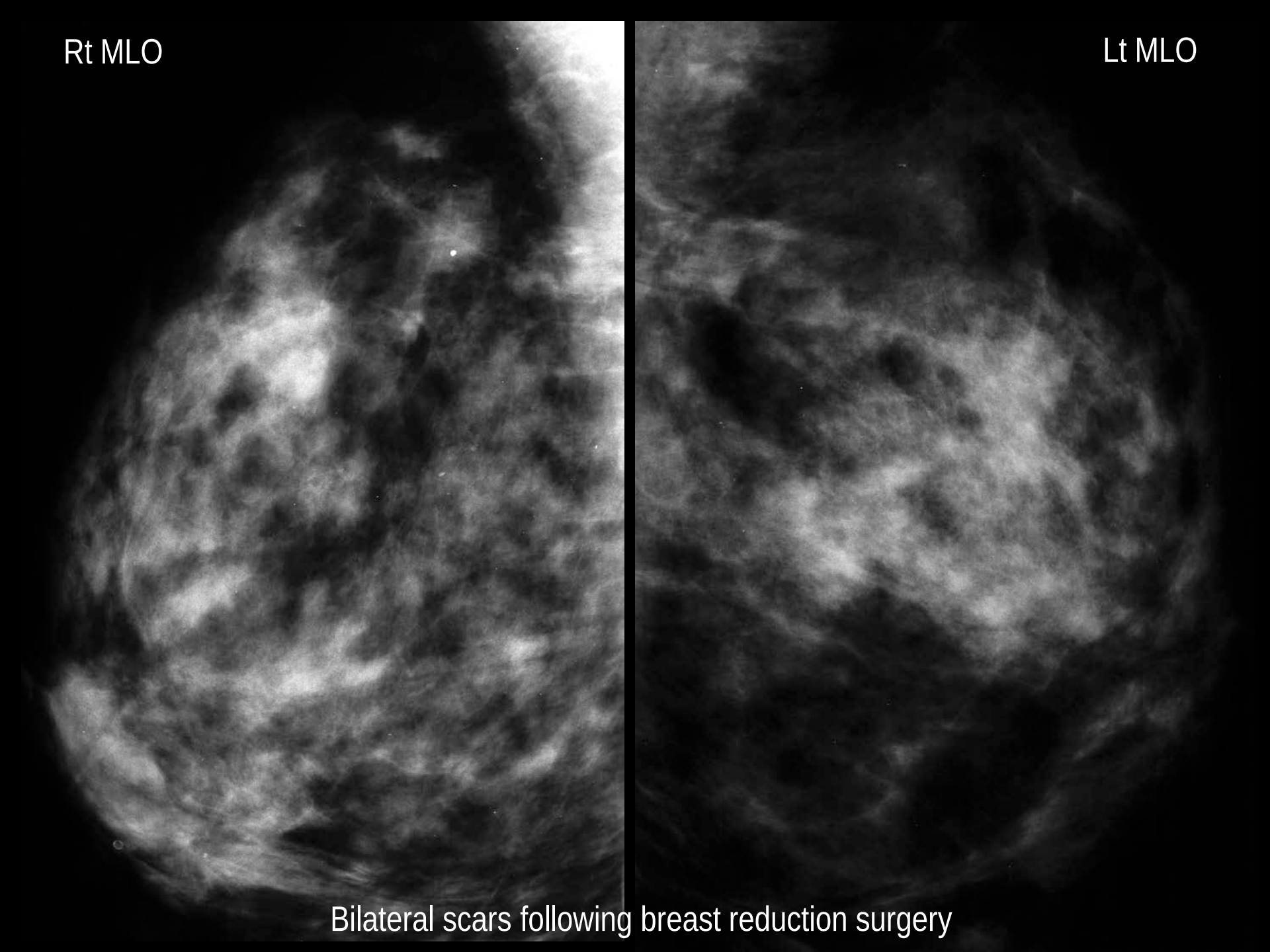
Kirstenbosch botanical Garden, Cape Town, South Africa

42 year old asymptomatic woman, screening examination

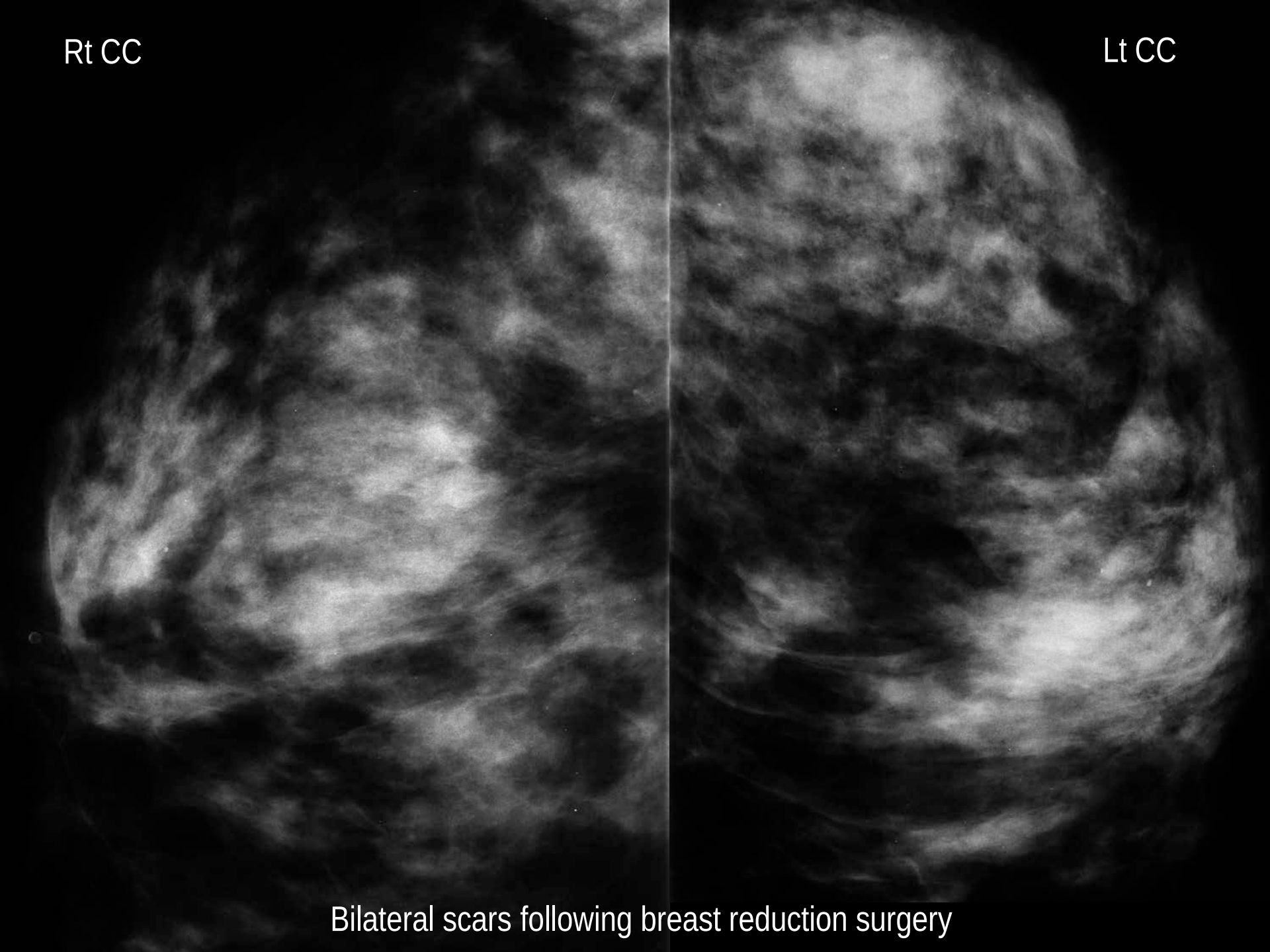
From the Departments of Mammography *and* Clinical Pathology

Falun Central Hospital, Sweden

Example 3

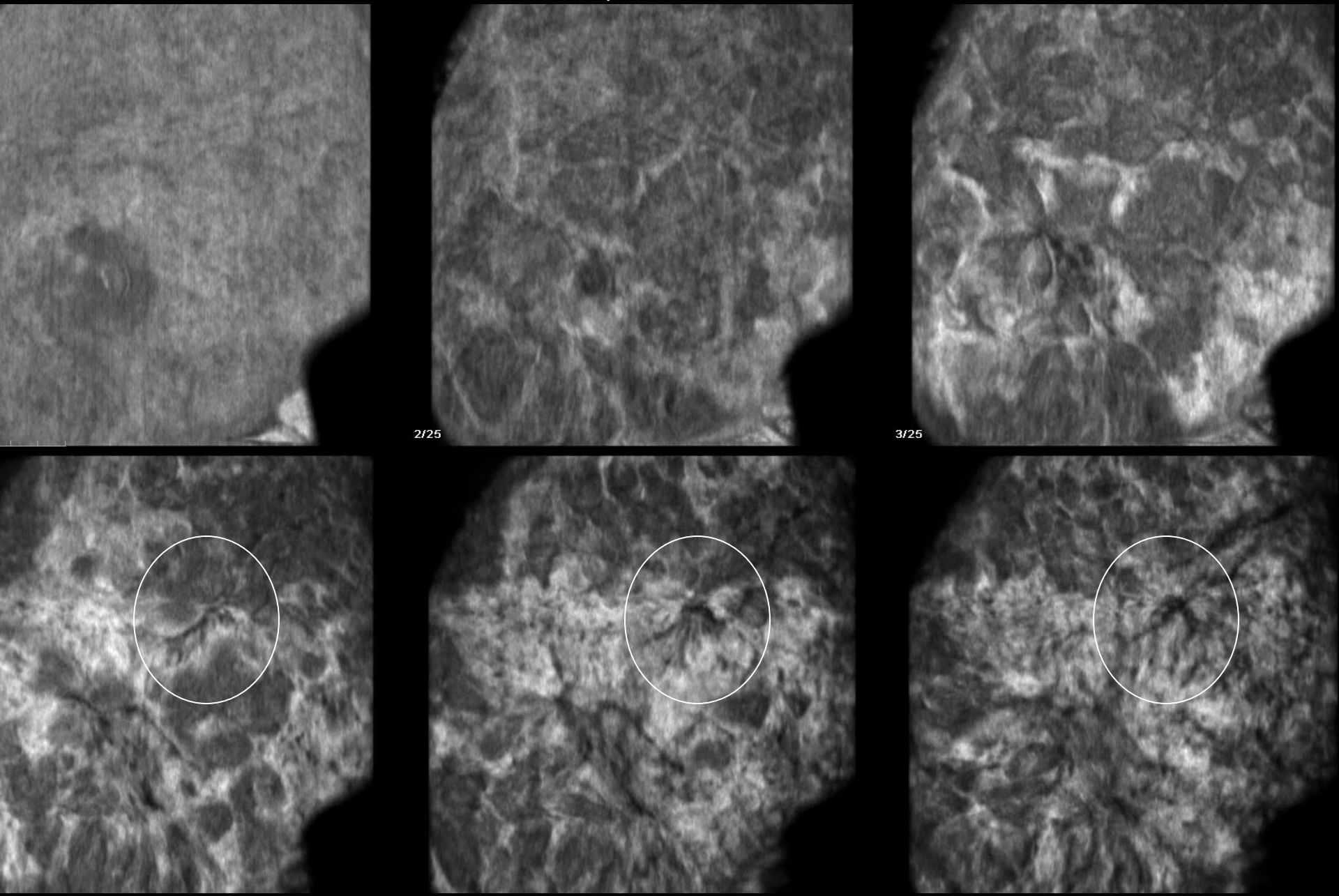


Bilateral scars following breast reduction surgery



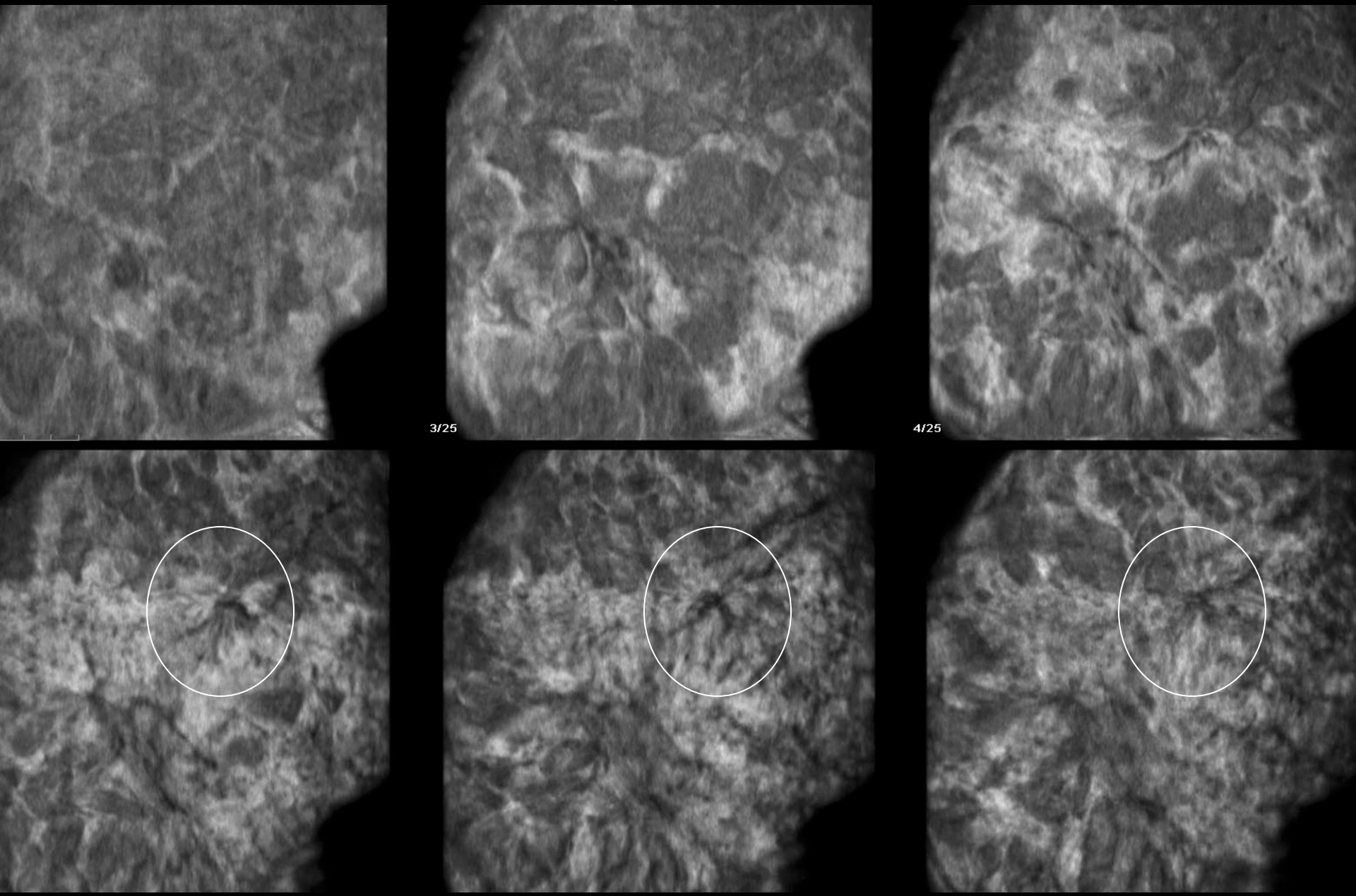
Bilateral scars following breast reduction surgery

3D automated ultrasound, 2 mm consecutive coronal sections

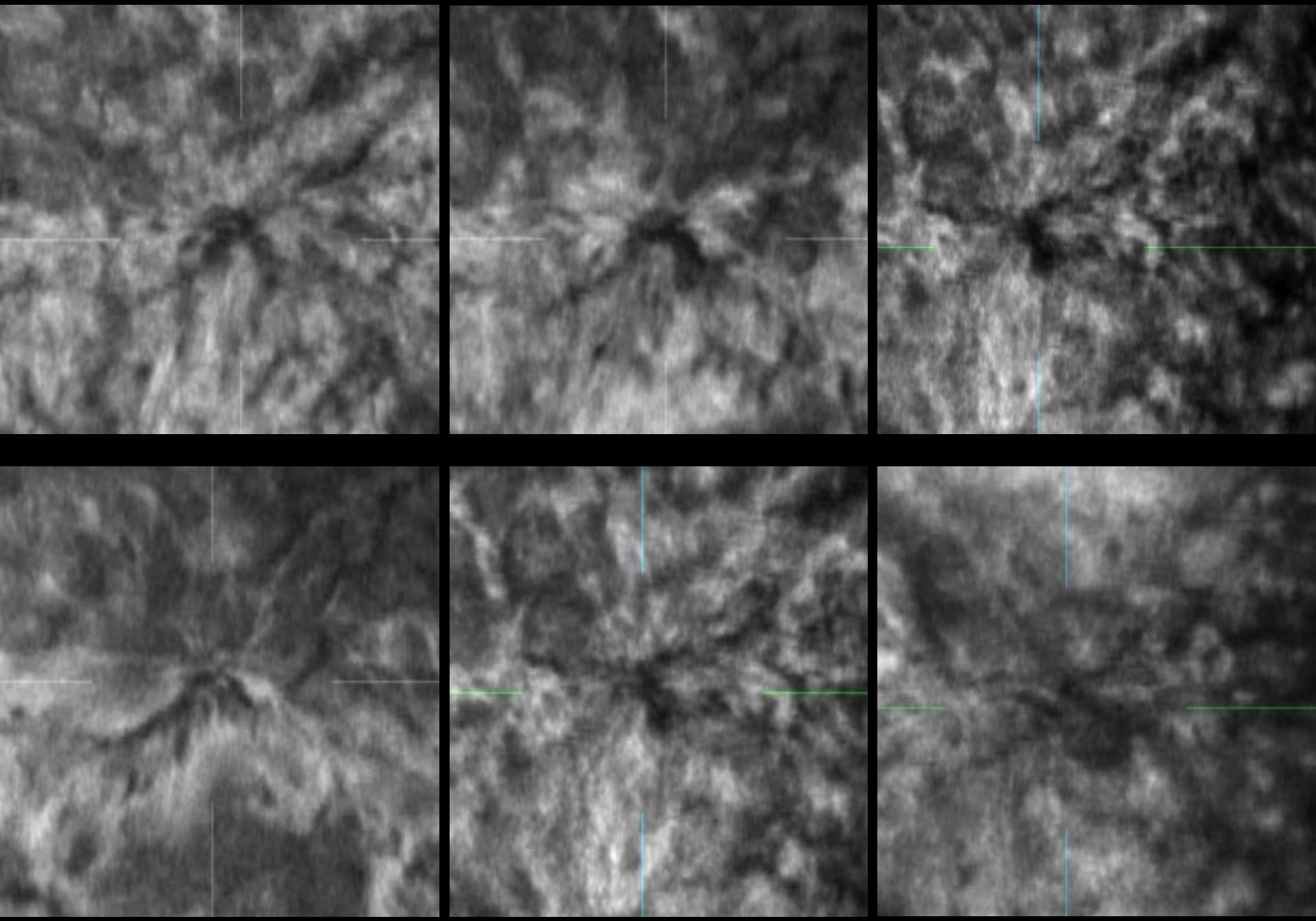


Multislice, left breast

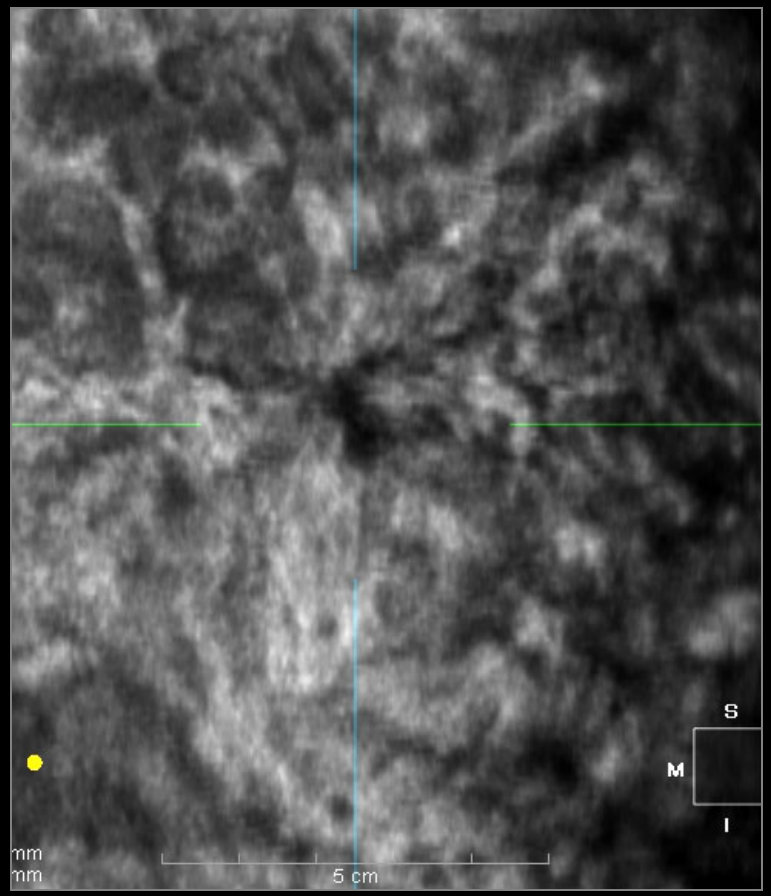
3D automated ultrasound, 2 mm consecutive coronal sections

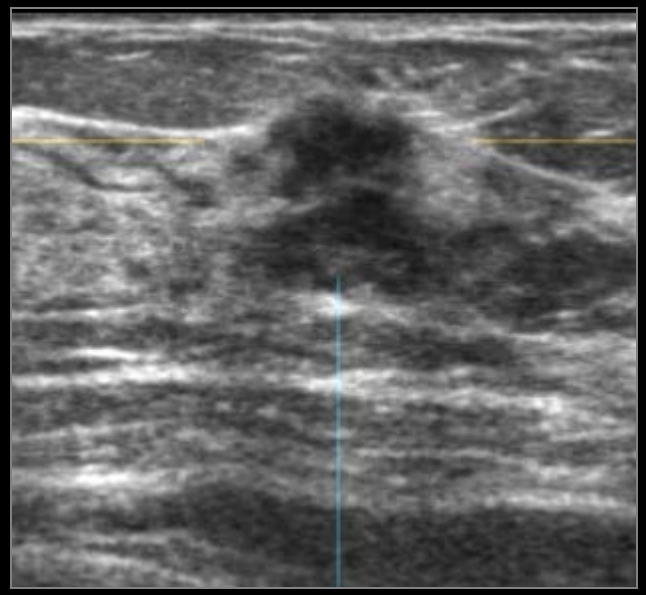


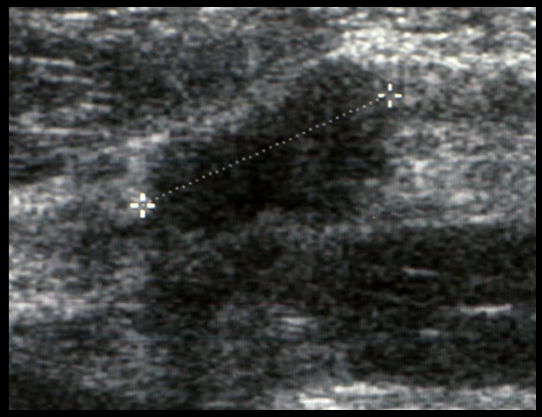
Multislice cont.



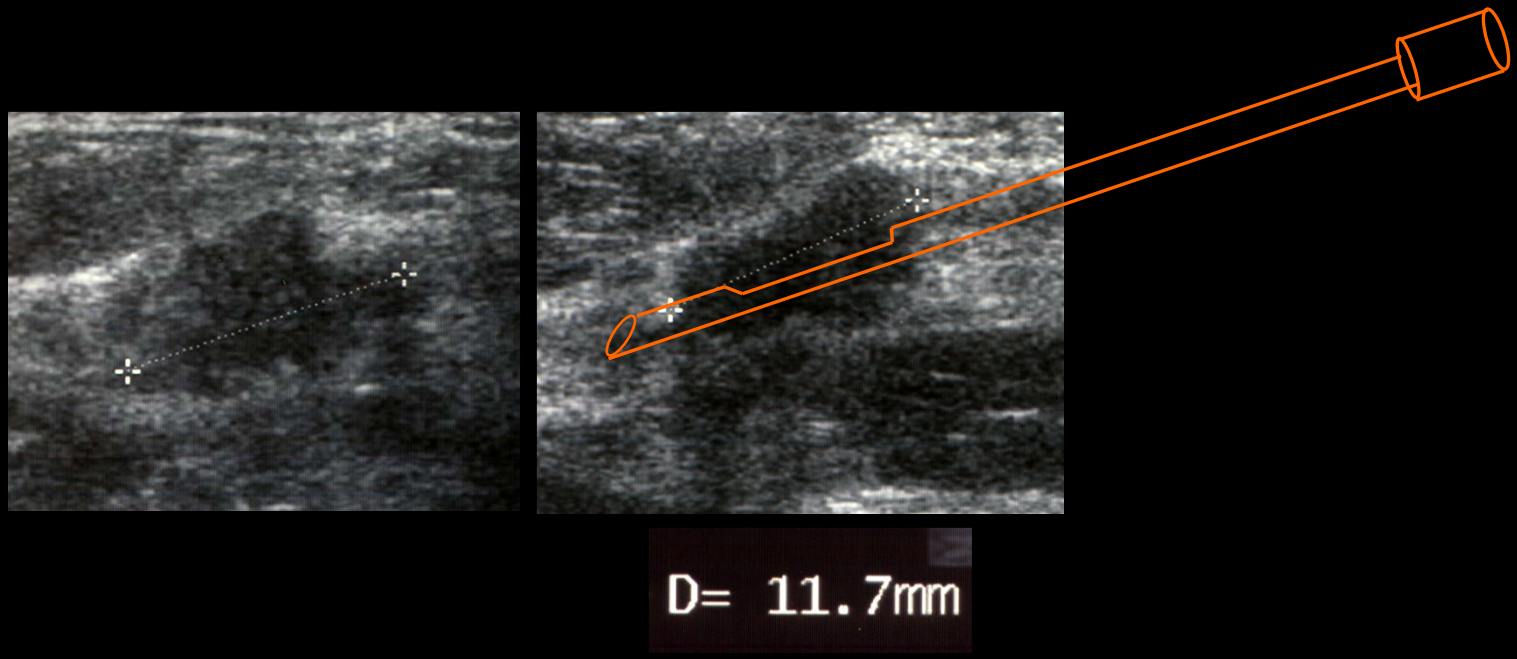
2 mm consecutive coronal sections





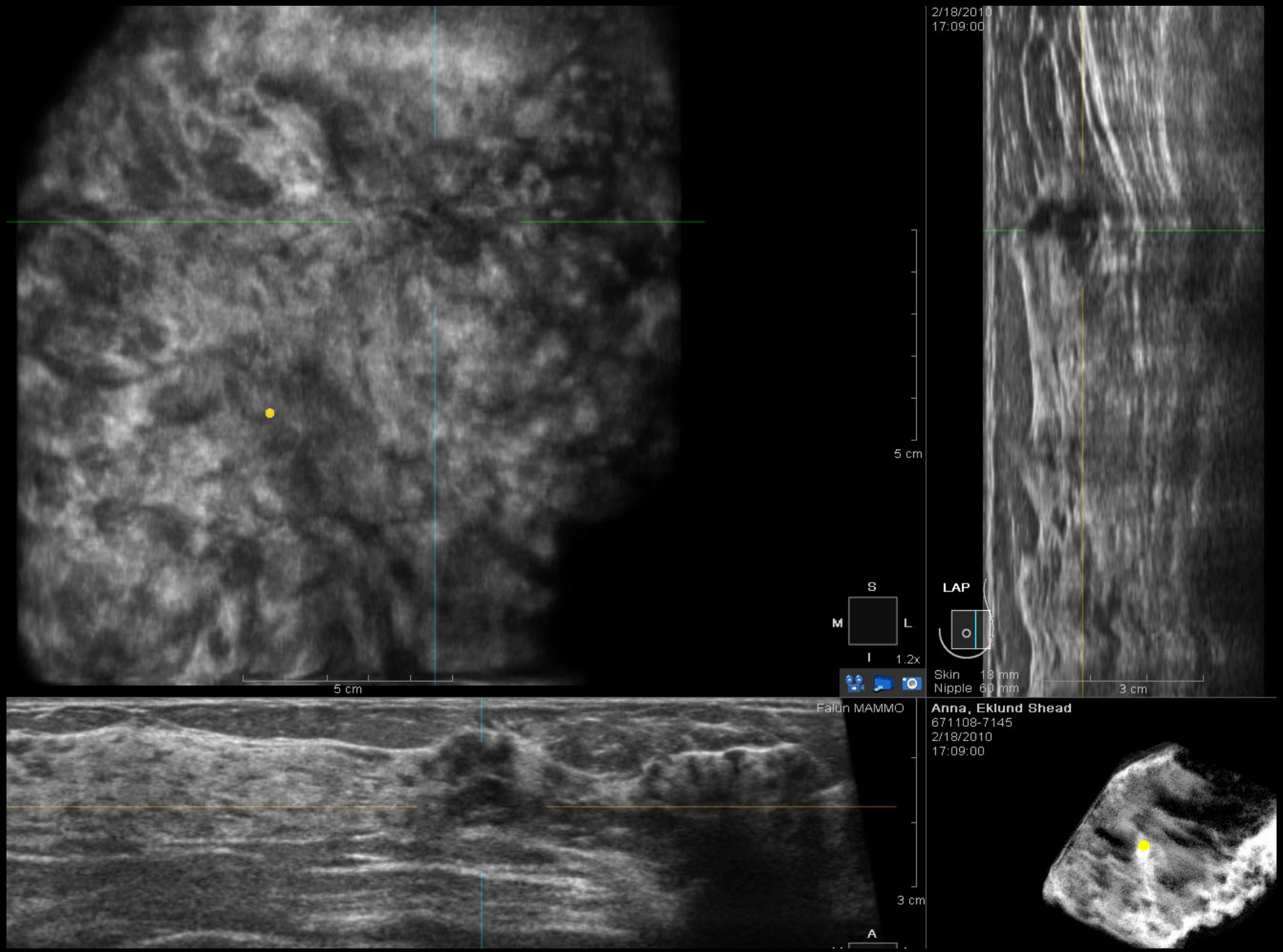


Conformation of the finding



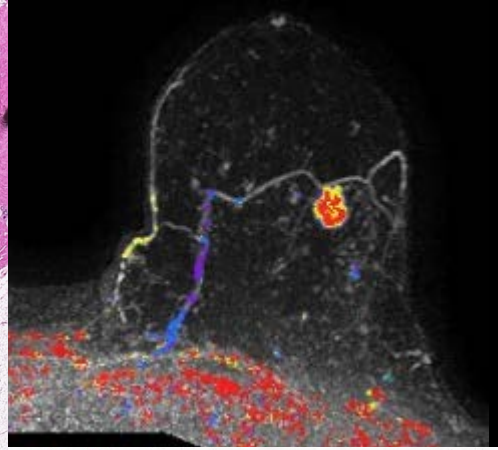
Histology of the 14-gauge core biopsy: Invasive ductal carcinoma

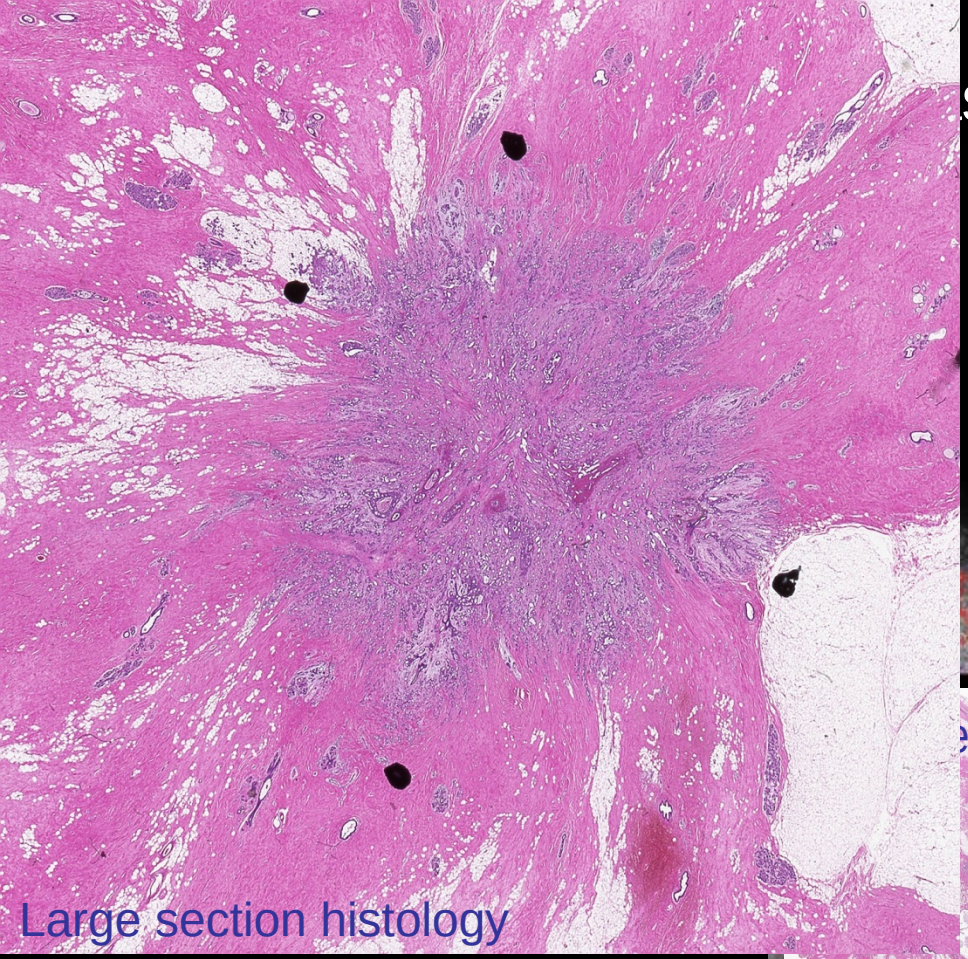
Hand-held ultrasound guided 14-g core biopsy



Conformation of the finding

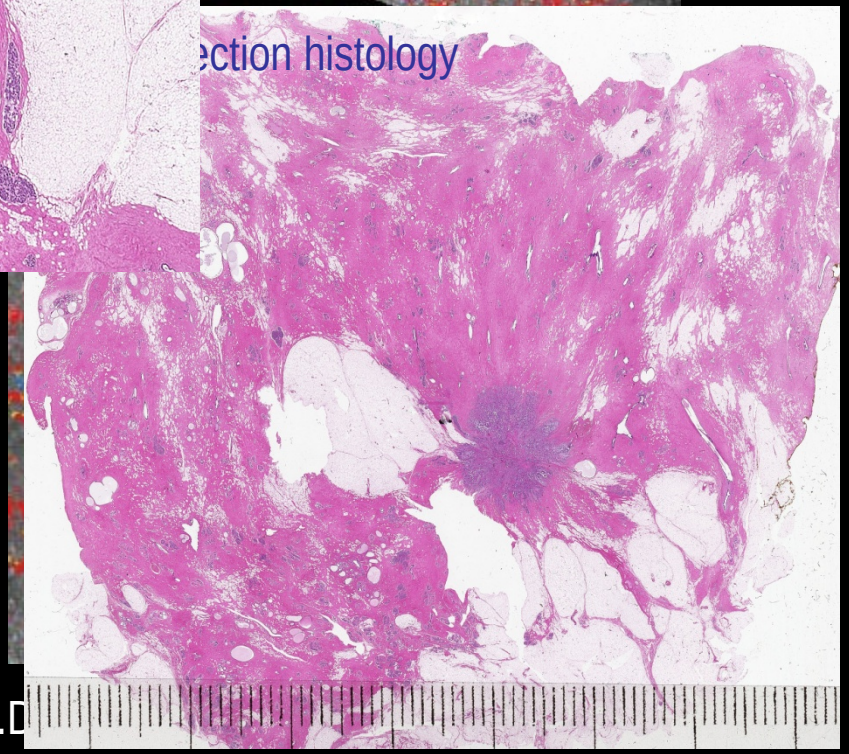
st MRI



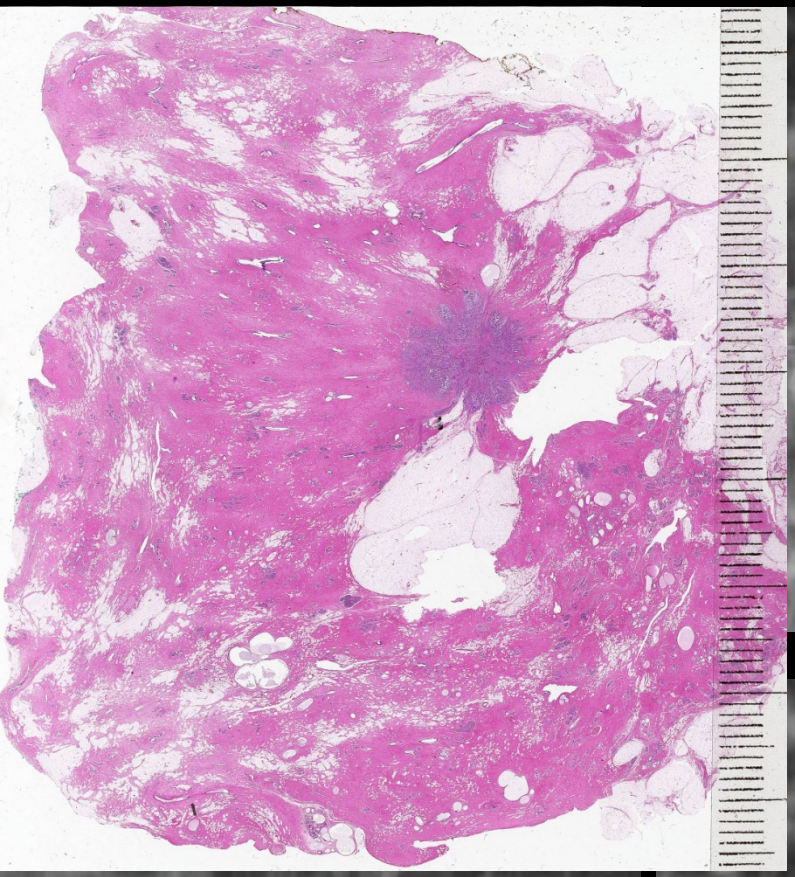
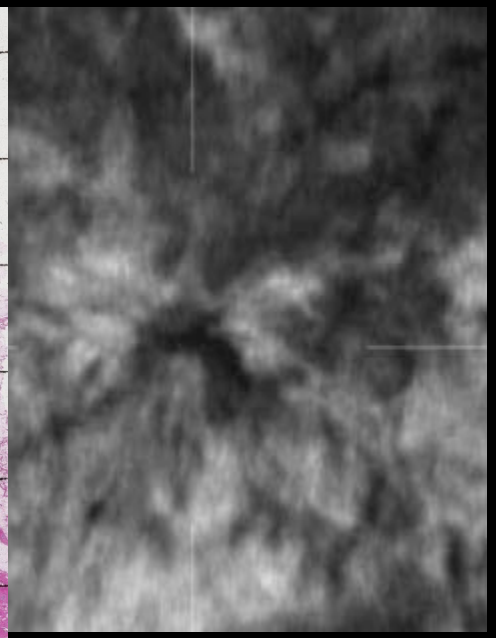
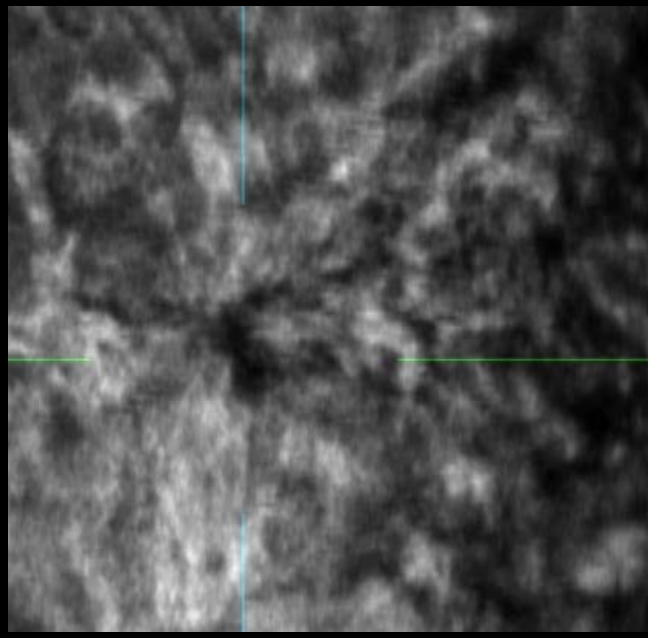
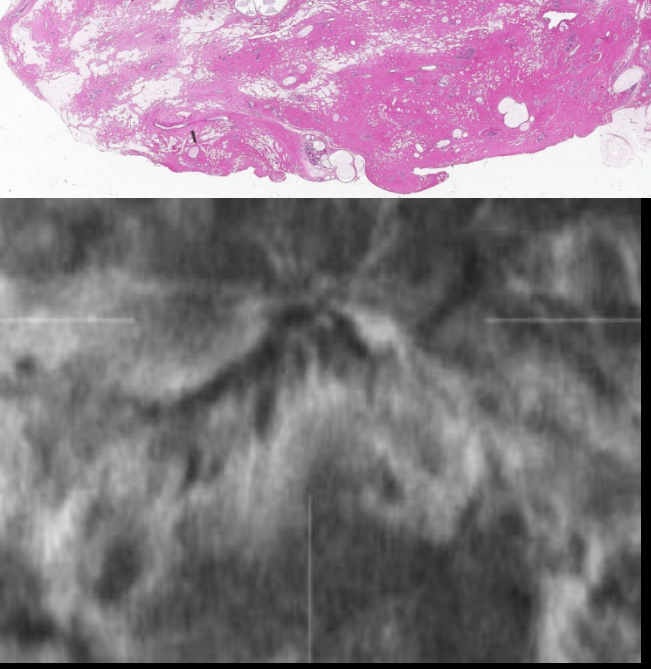
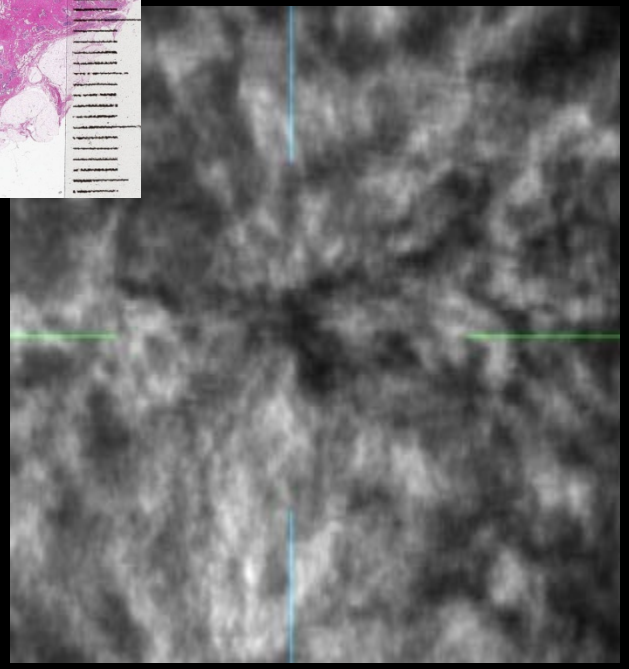
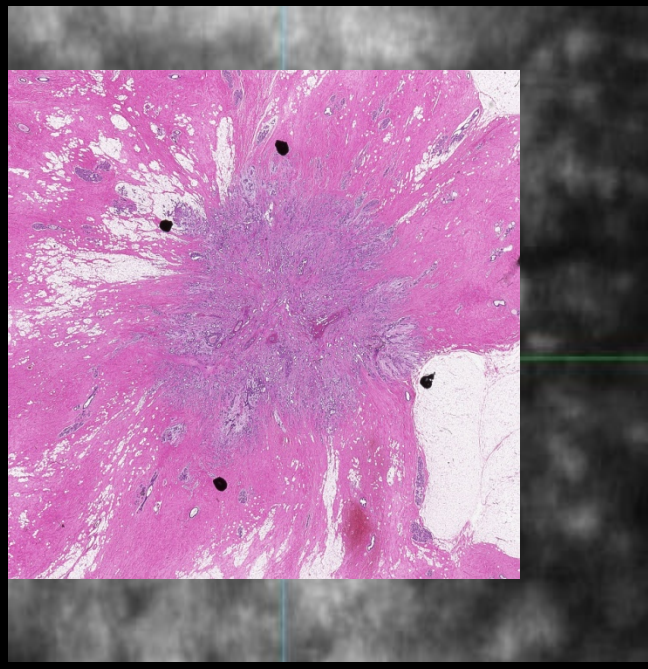


Large section histology

ction histology



MRI exam courtesy: Mats Ingvarsson, M.D

2 mm consecutive coronal sections

Histology

12x11 mm solitary, well differentiated, ER/PR receptor positive invasive breast cancer, associated with Grade 2 *in situ* carcinoma.
Total disease extent: 14x11 mm.

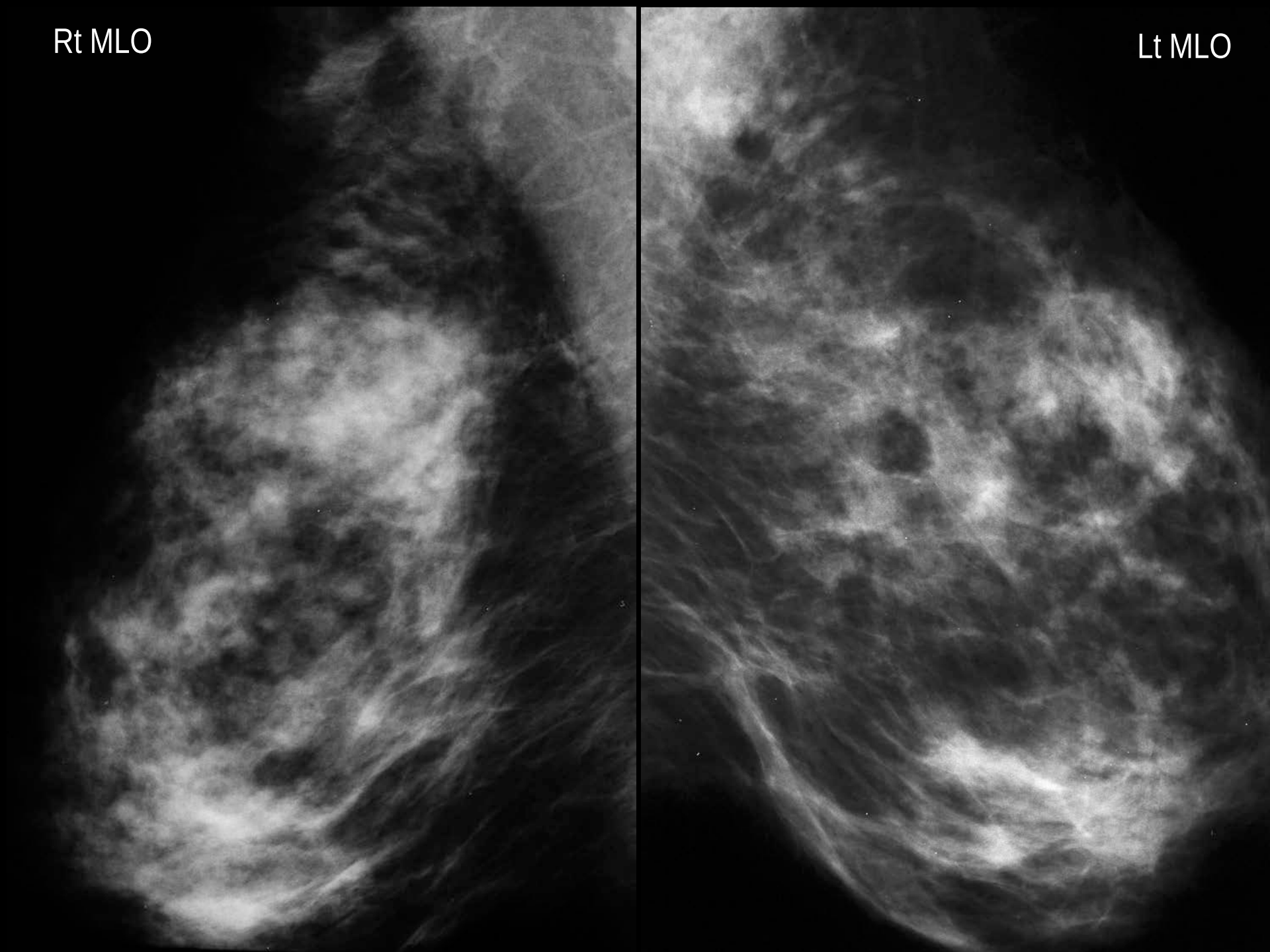
No LVI, pN 0/2

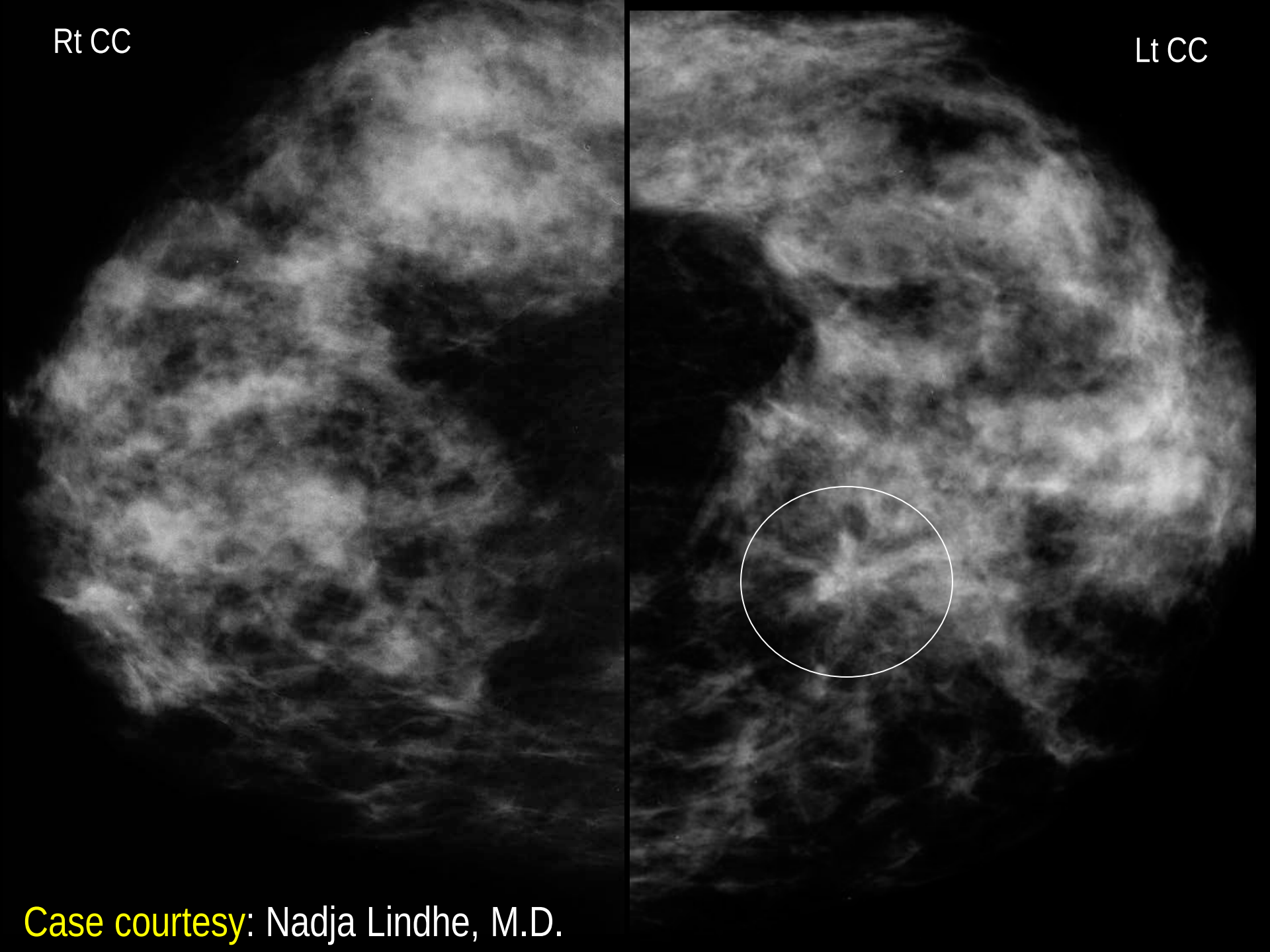
49 year old woman, called back from mammography screening for assessment of a stellate lesion in the medial portion of the left breast

From the Departments of Mammography *and* Clinical Pathology

Falun Central Hospital, Sweden

Example 4


Rt MLO
Lt MLO

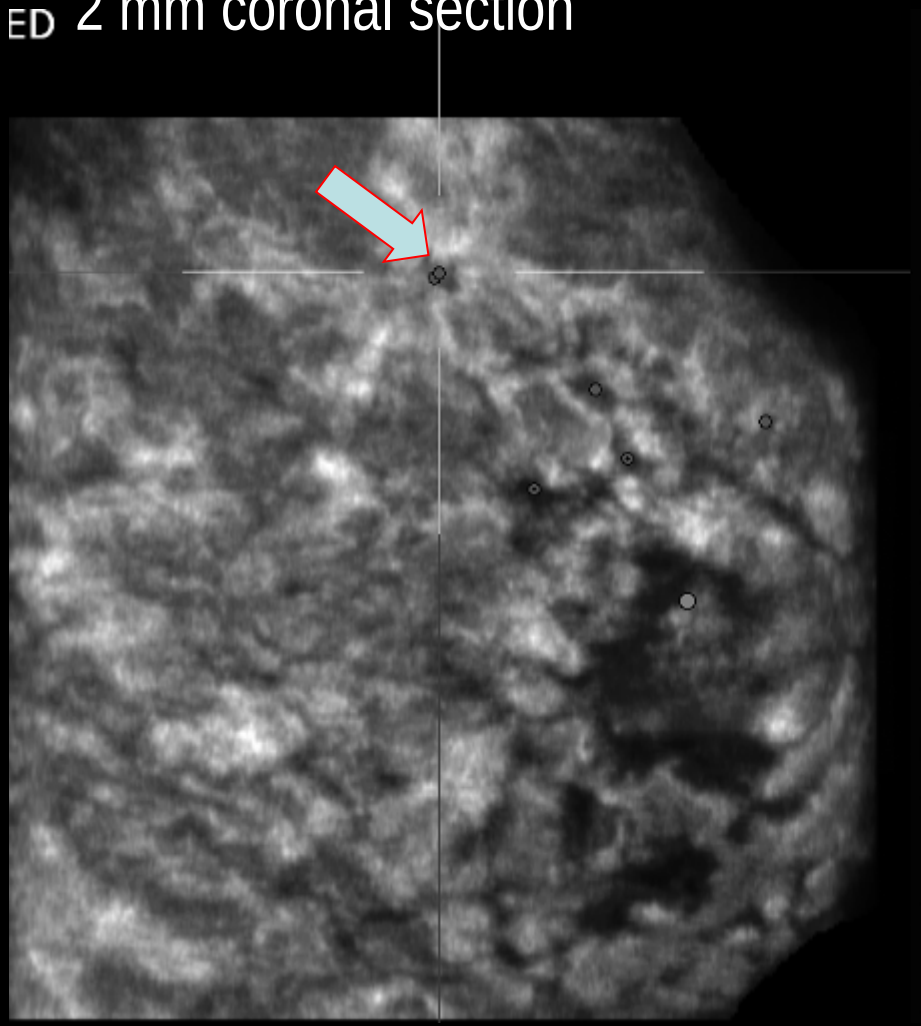


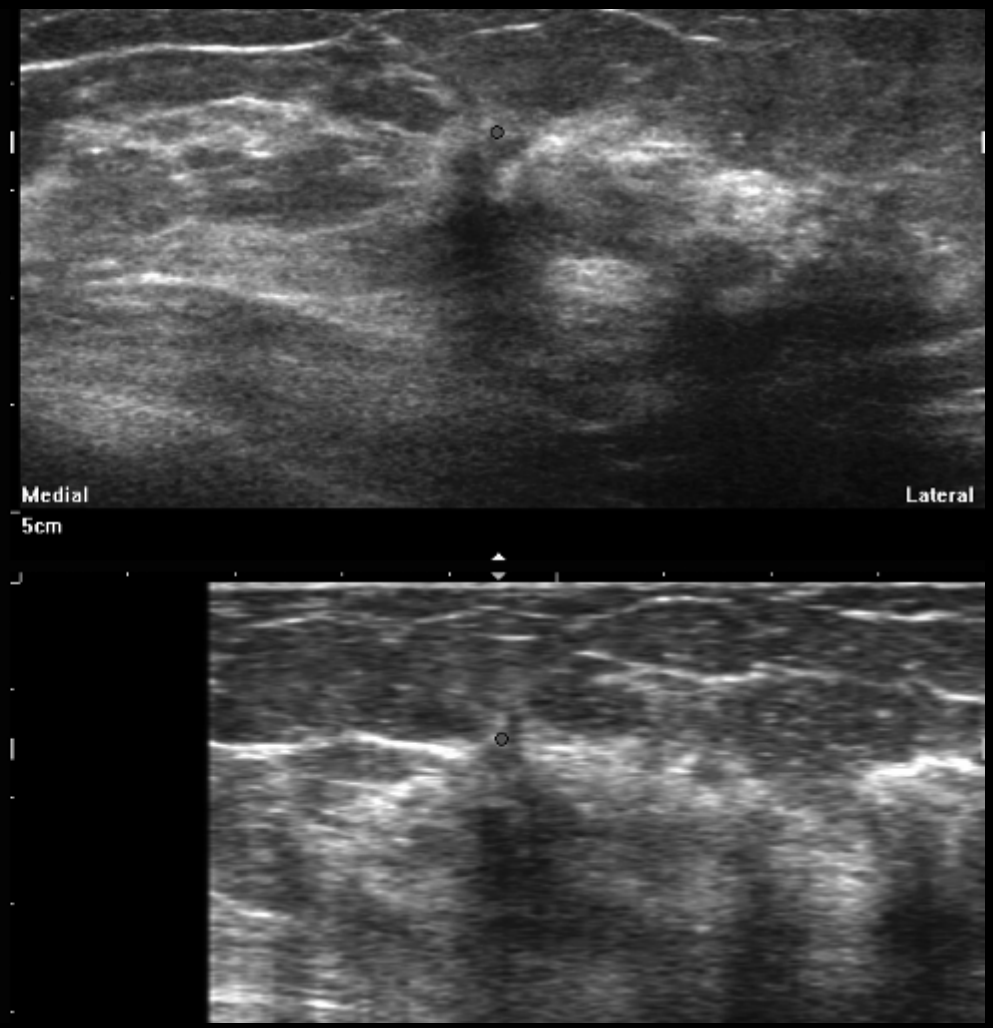
Case courtesy: Nadja Lindhe, M.D.


Lt CC


Microfocus magnification

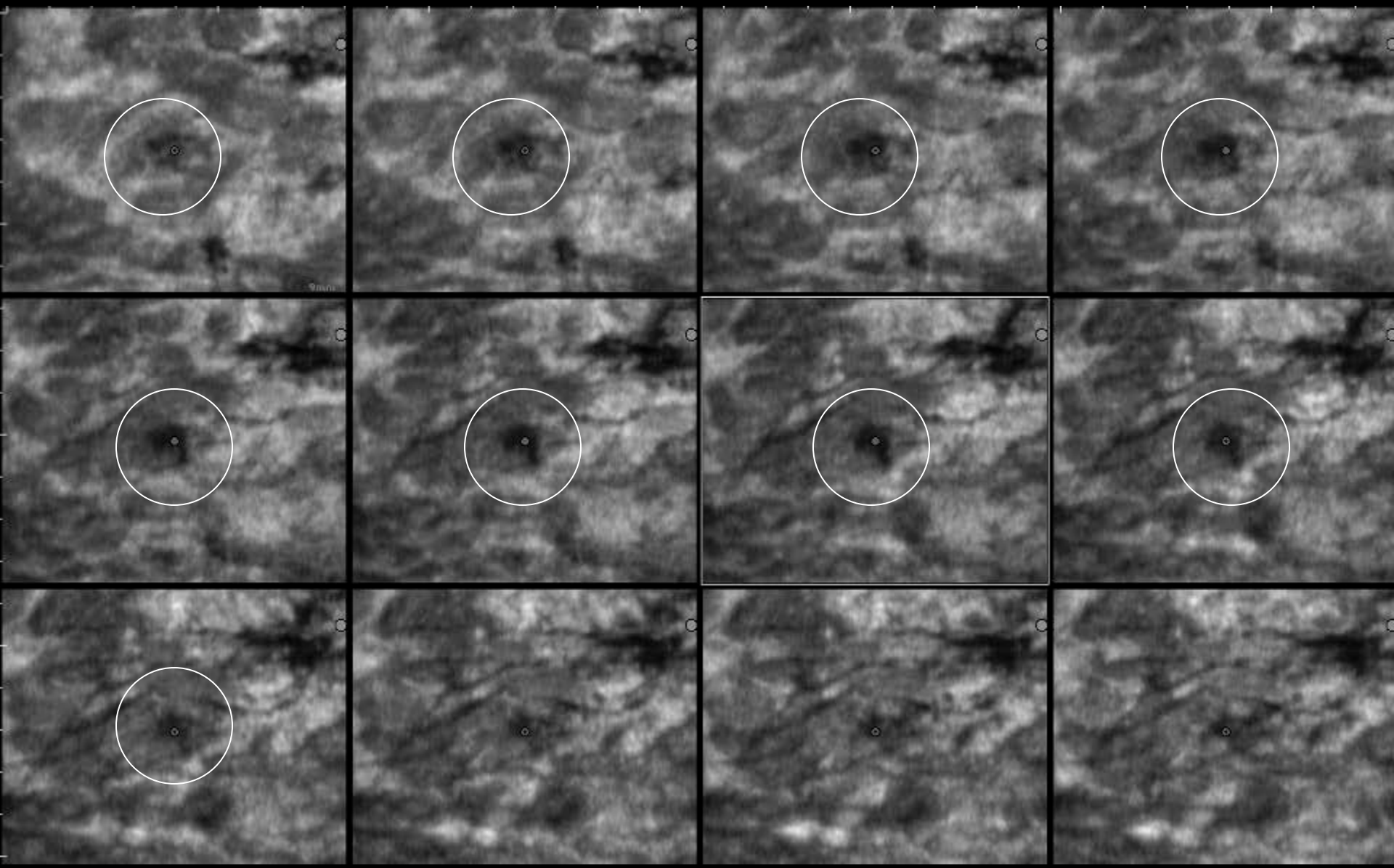
3D automated ultrasound,
2 mm coronal section





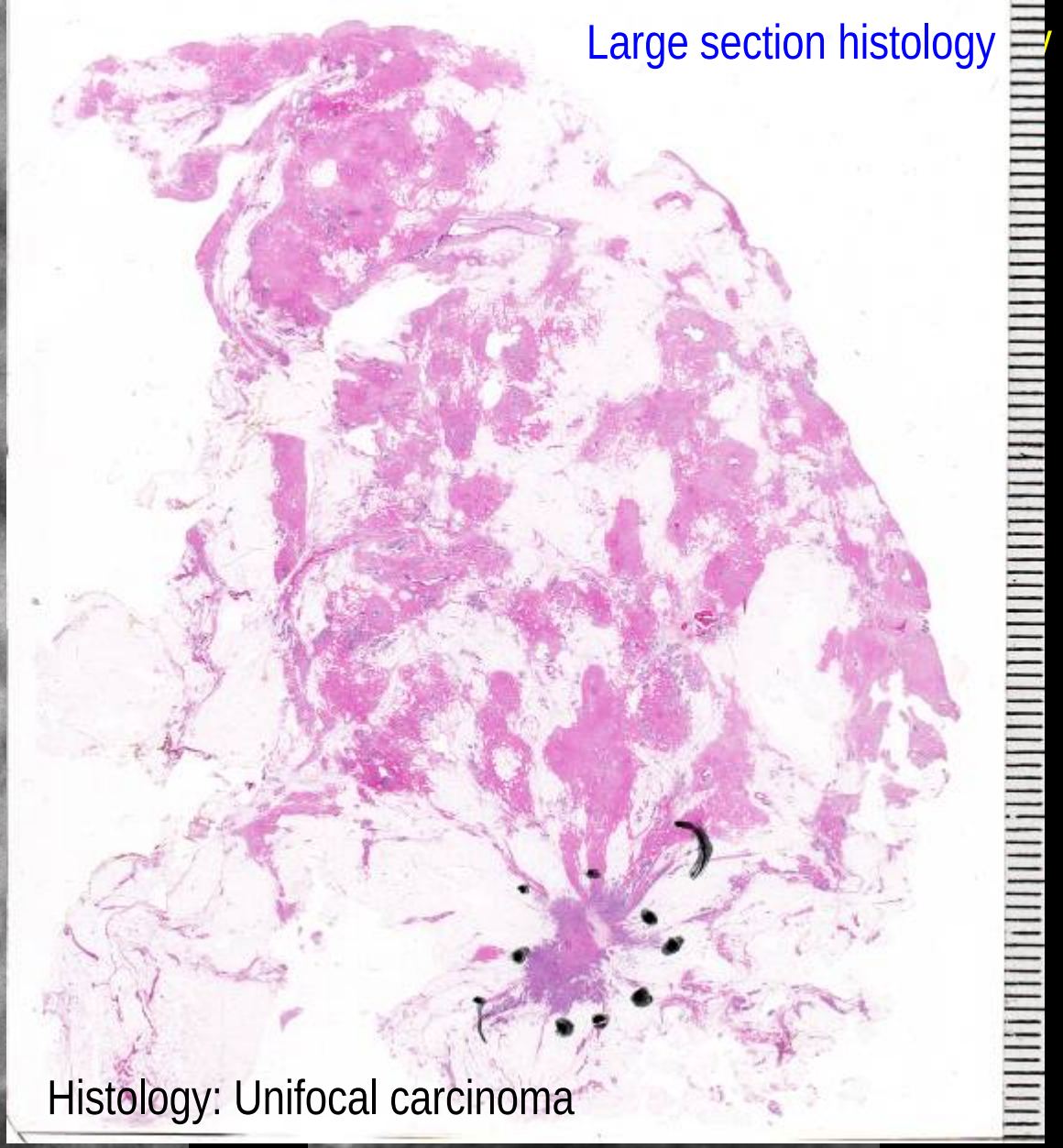
Confirmation of suspected focus

3D automated ultrasound, 2 mm coronal section series

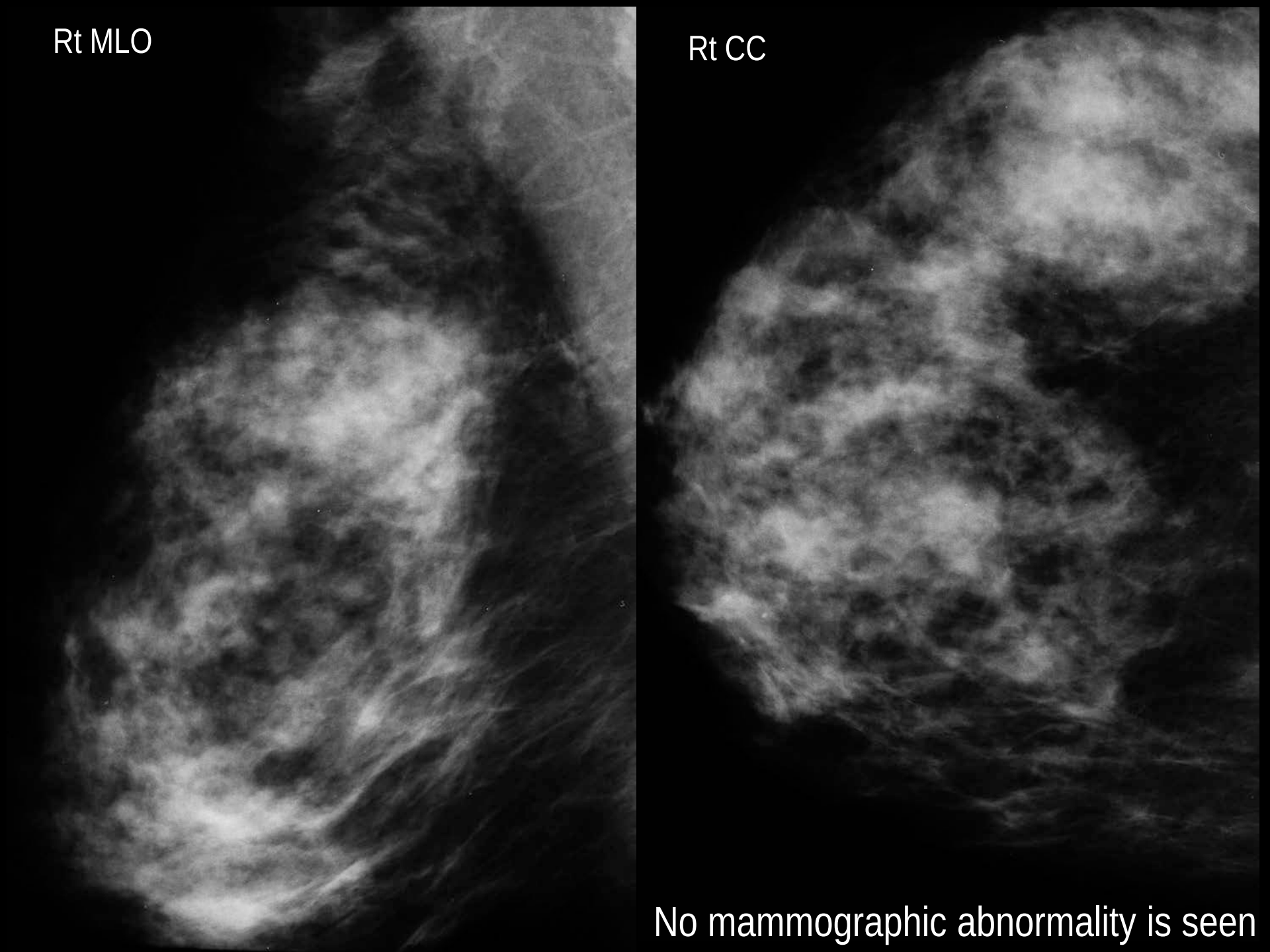


Multislice

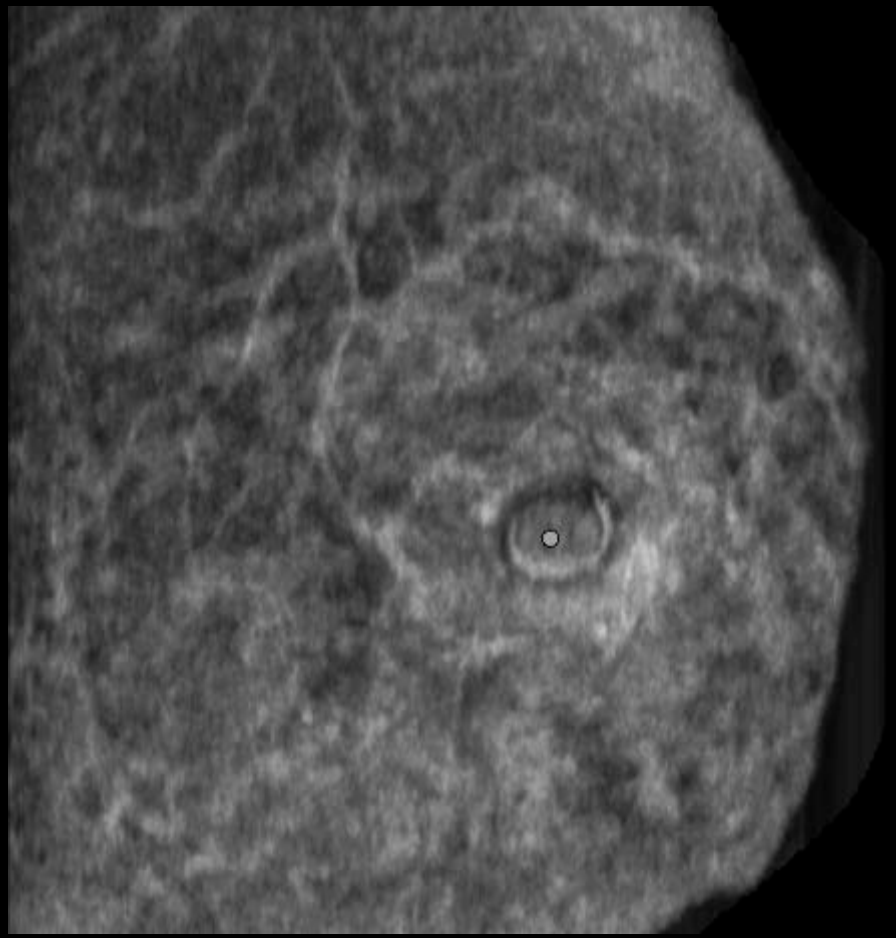
Large section histology

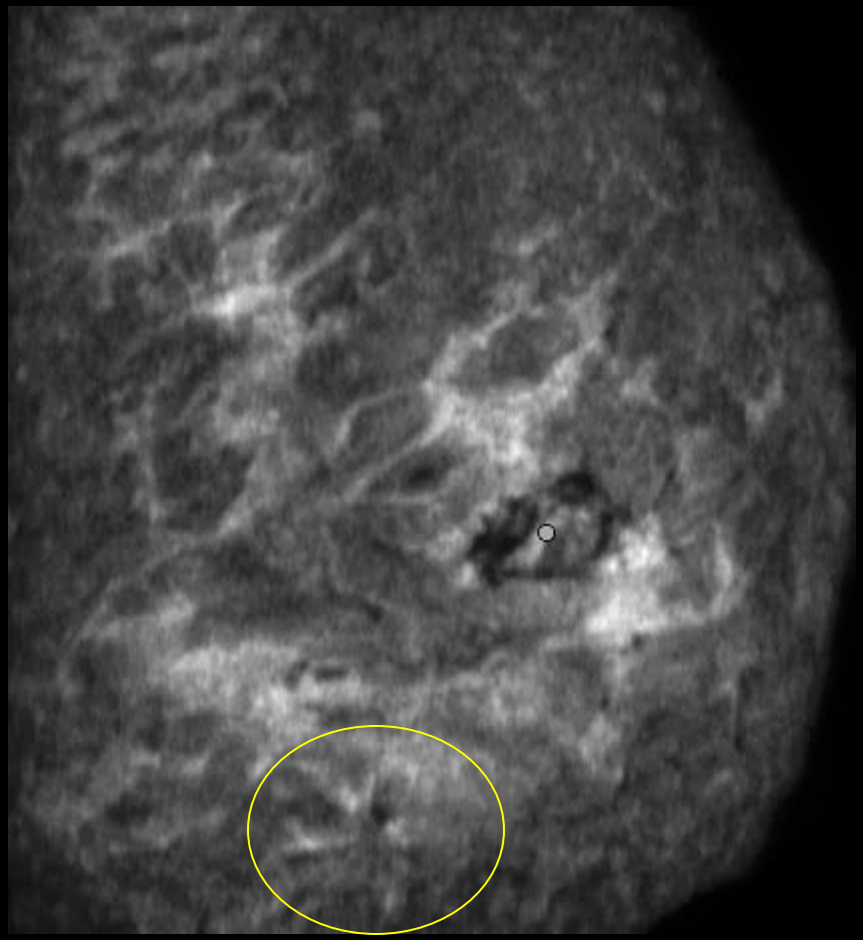


Histology: Unifocal carcinoma


Rt MLO
Rt CC
No mammographic abnormality is seen

Right breast, 3D automated ultrasound exam, reconstructed, coronal slices

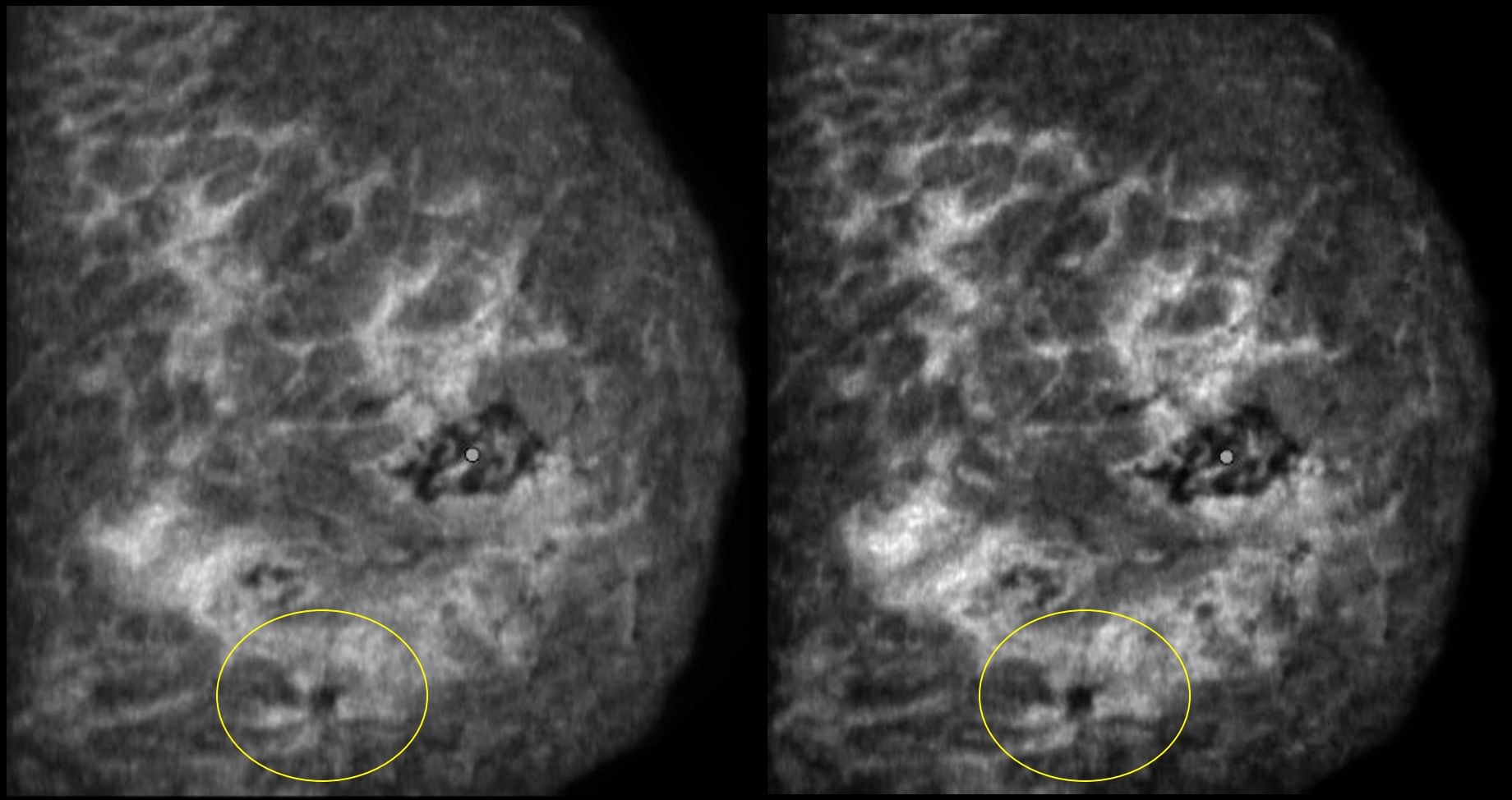




Rt breast, lateral view, skin level

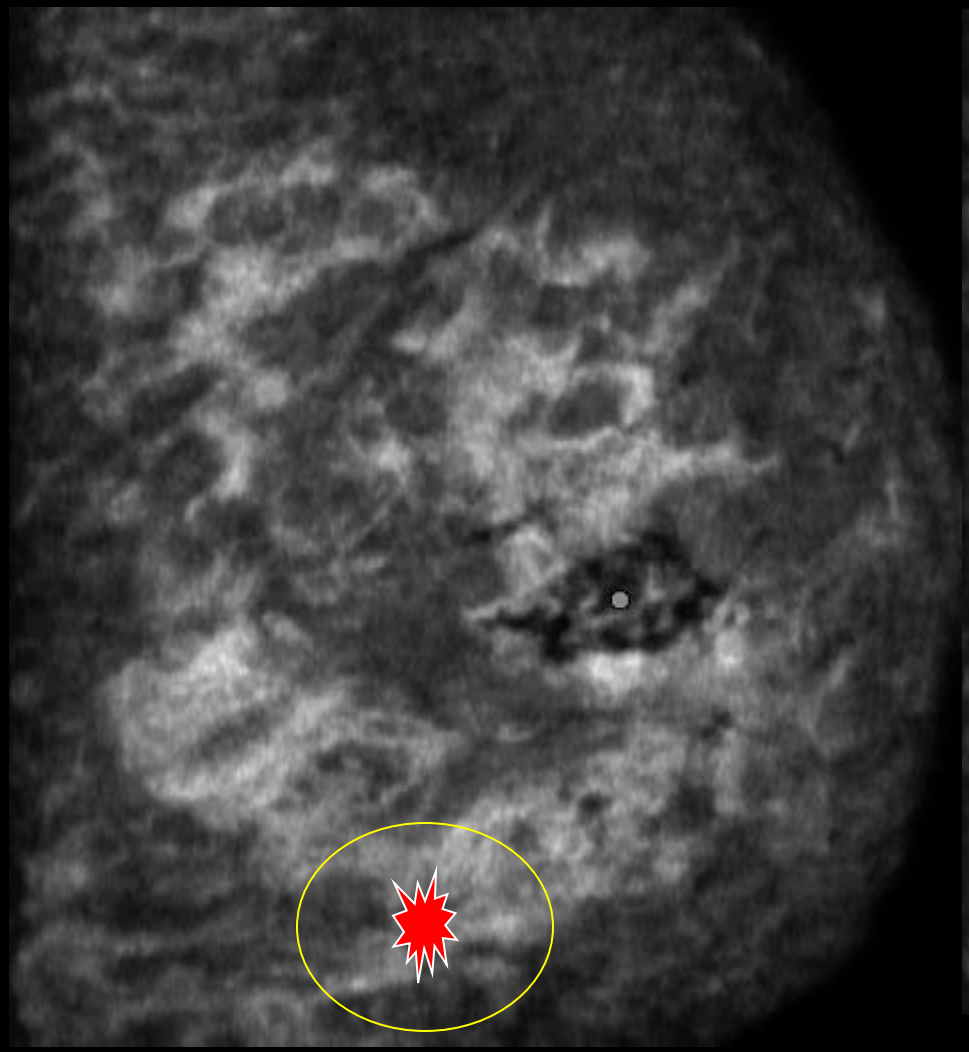
2 mm deep to the skin

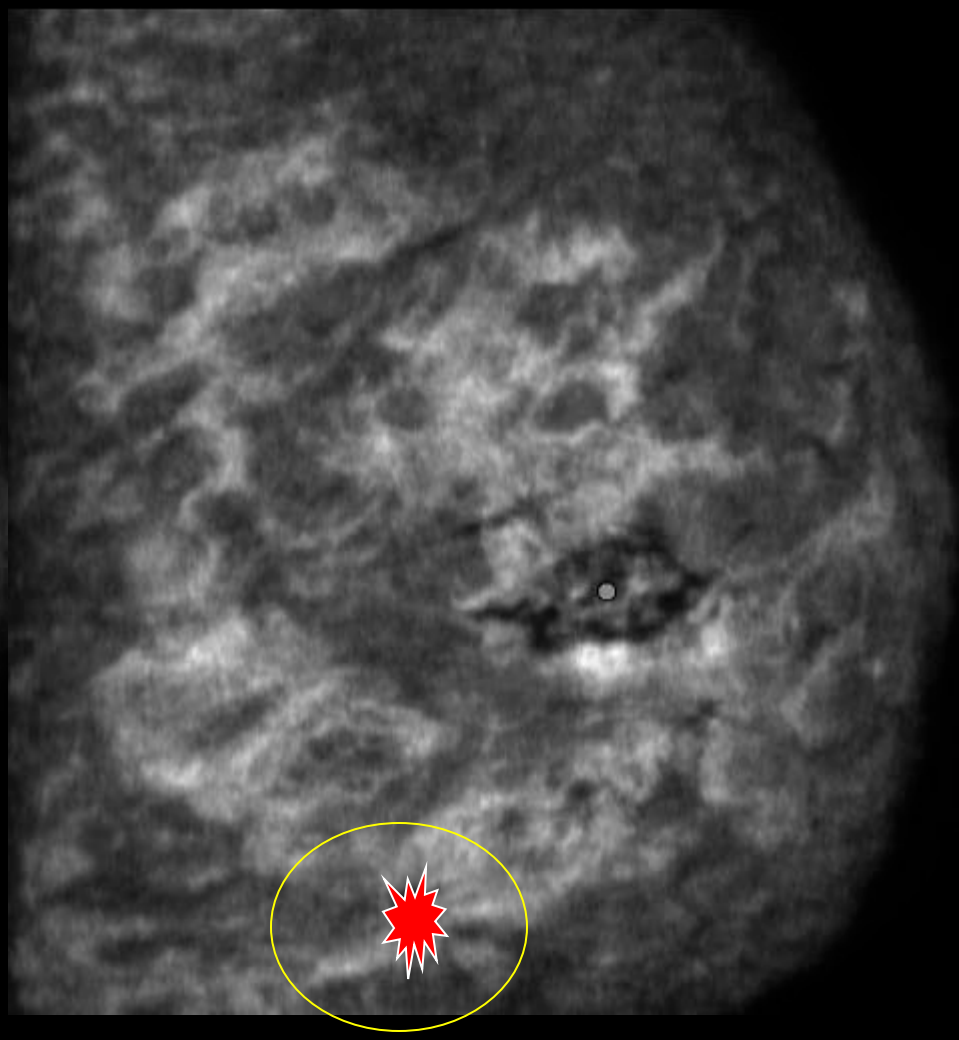
Right breast, 3D automated ultrasound exam, reconstructed, coronal slices



Detected by 3D automated ultrasound exam, mammographically occult

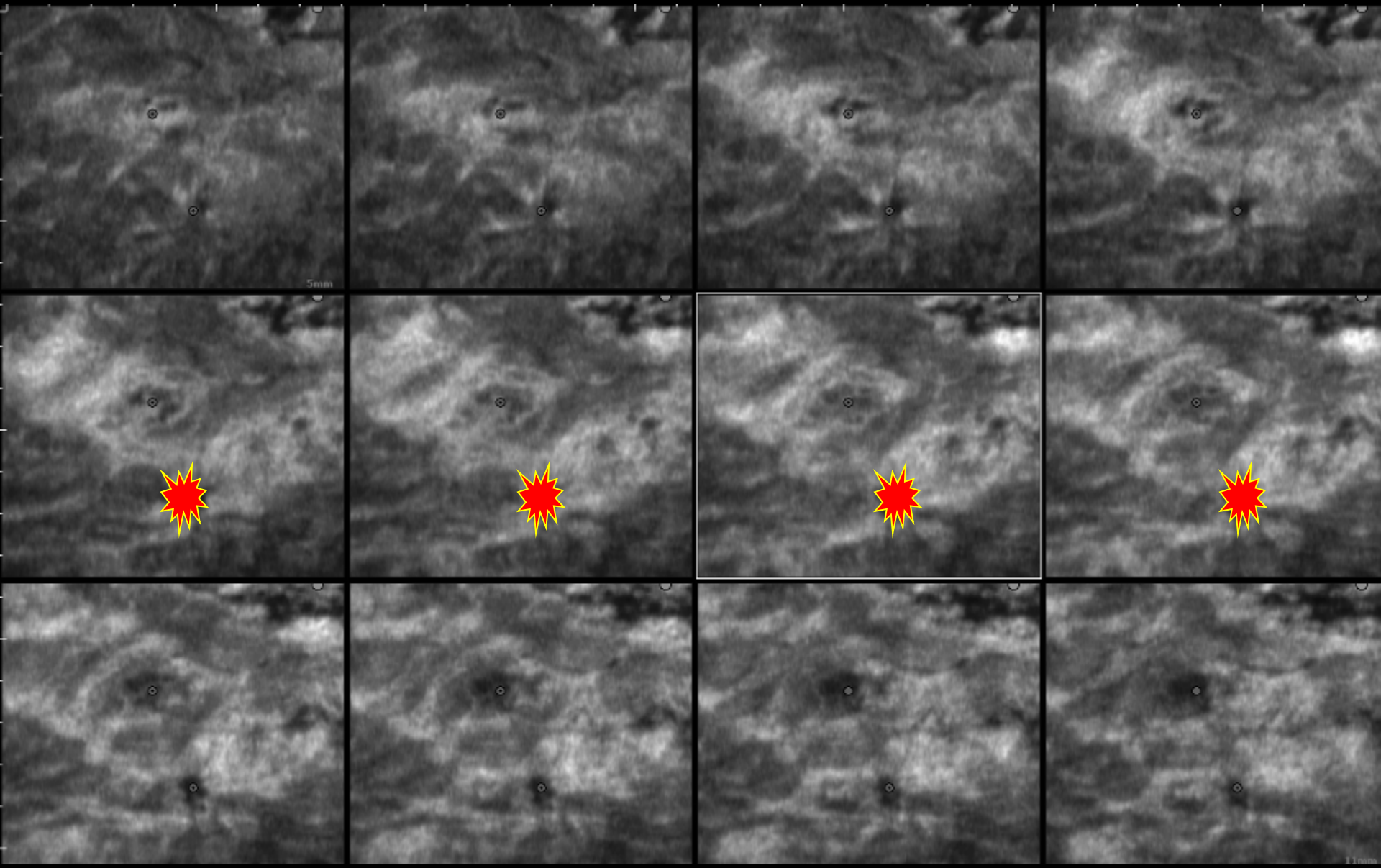
Right breast, 3D automated ultrasound exam, reconstructed, coronal slices





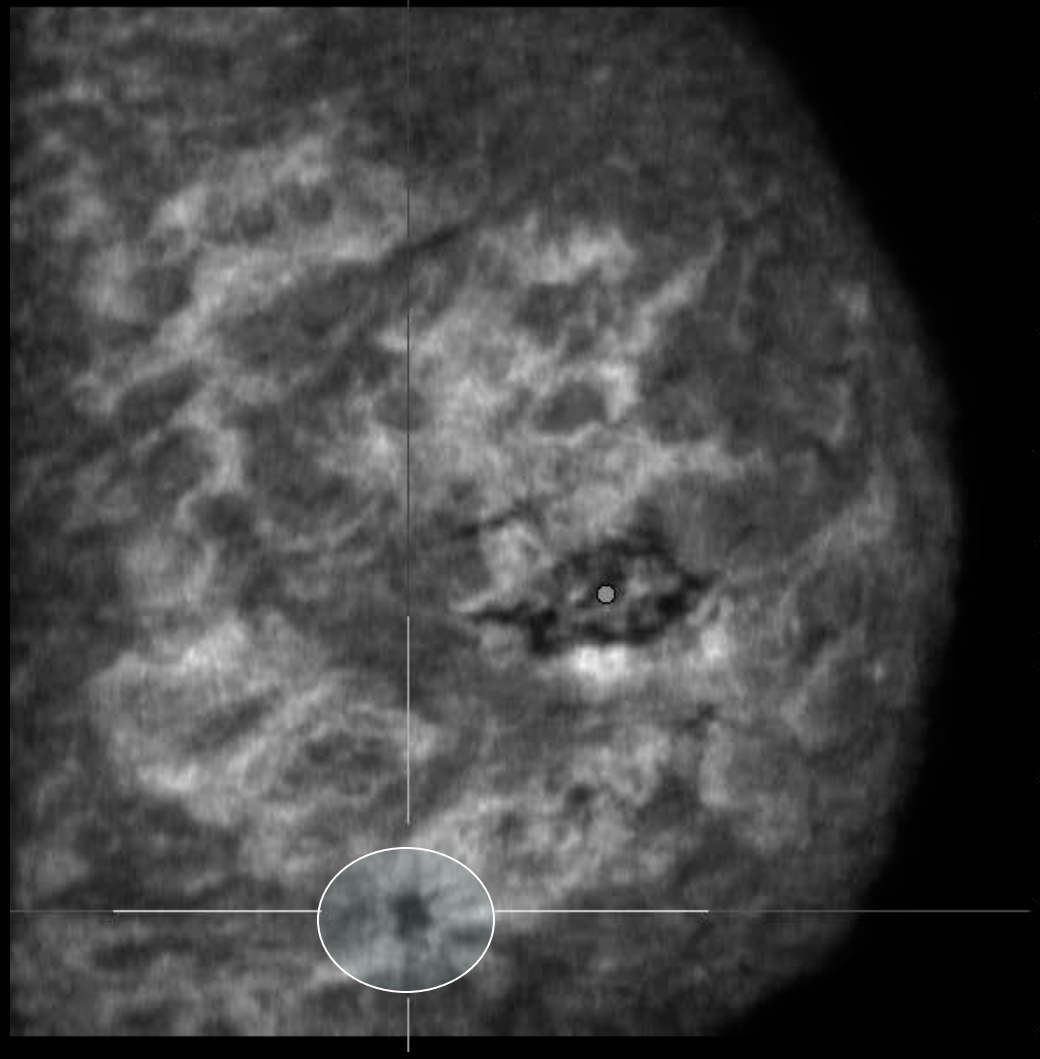
Detected by 3D automated ultrasound exam, mammographically occult

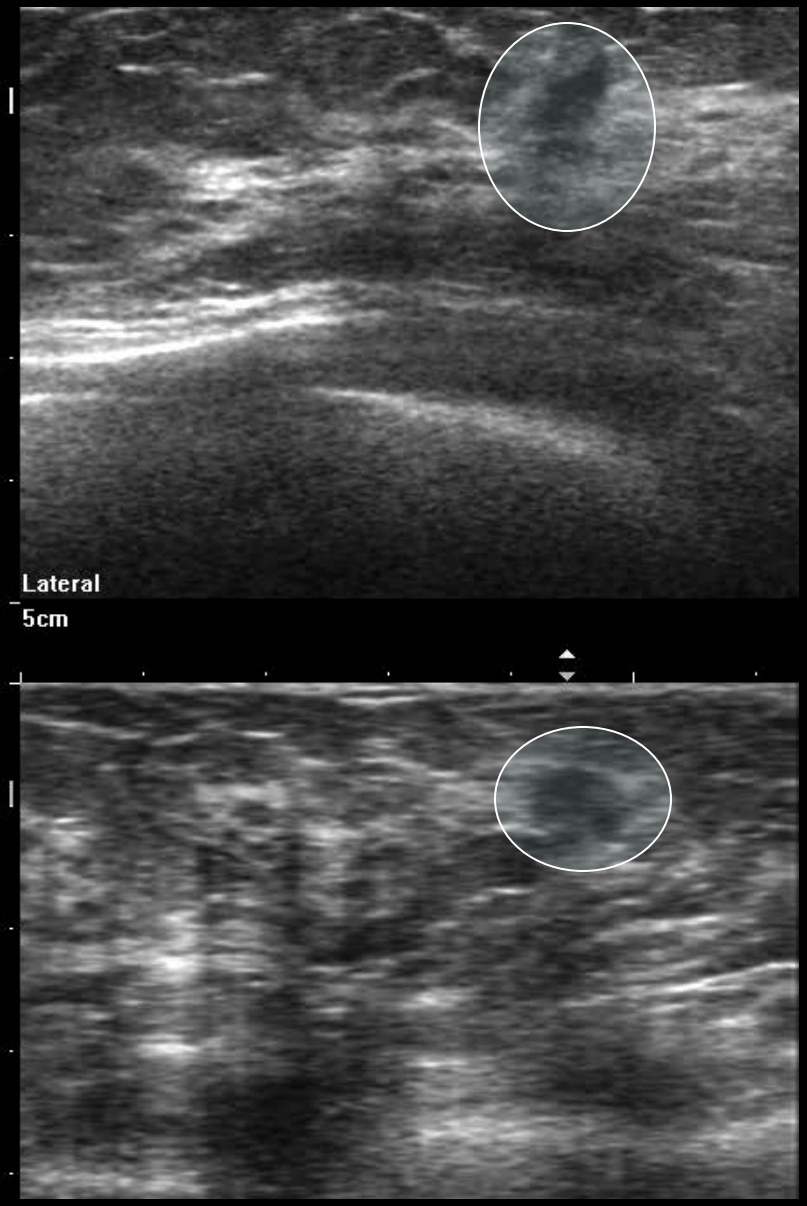
Right breast, 3D automated ultrasound exam, reconstructed, coronal slices



Multislice 02

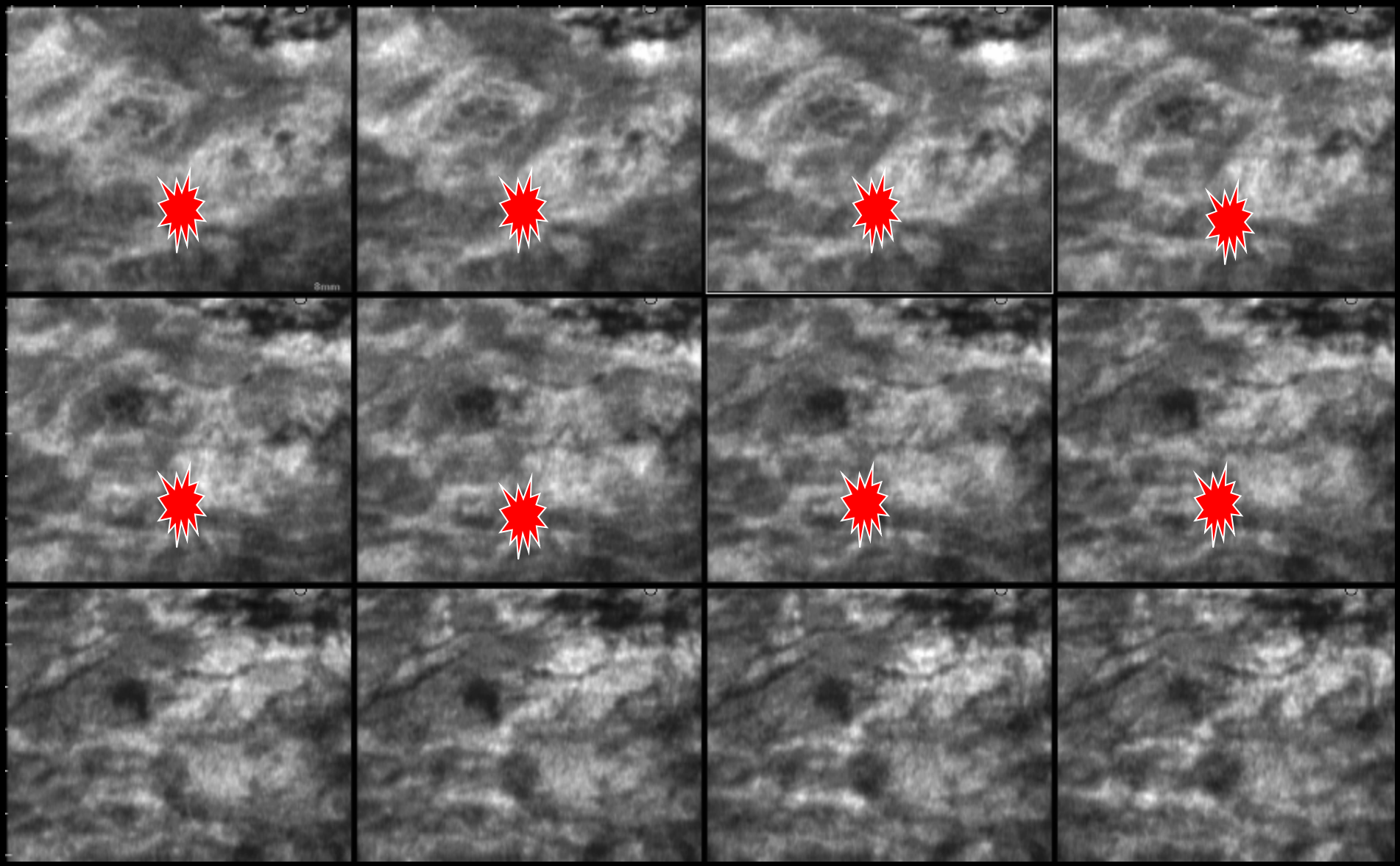
3D automated ultrasound,
2 mm coronal section





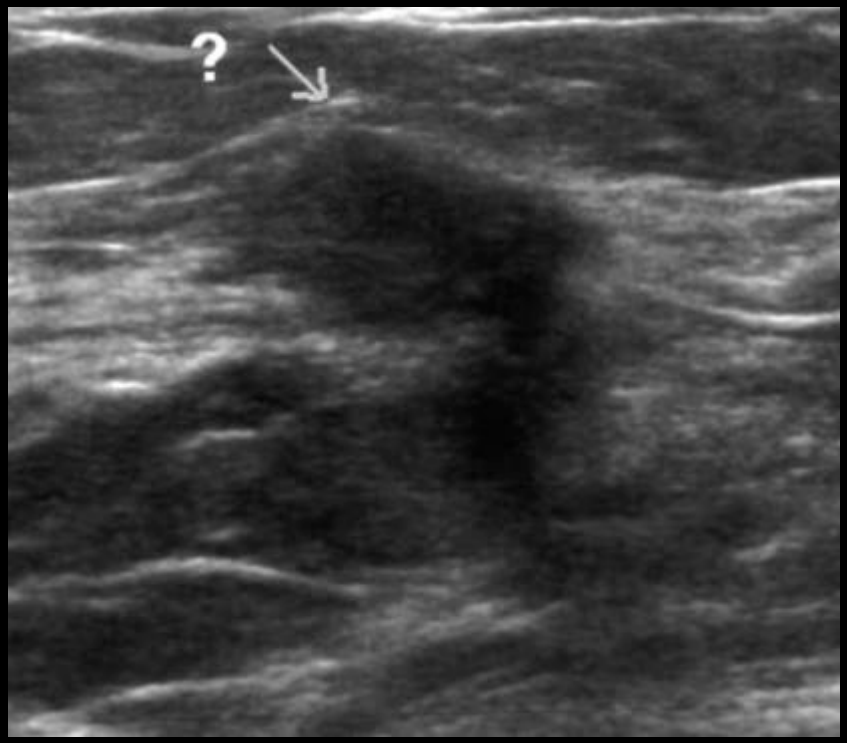
Right breast, confirmation of the tumor focus

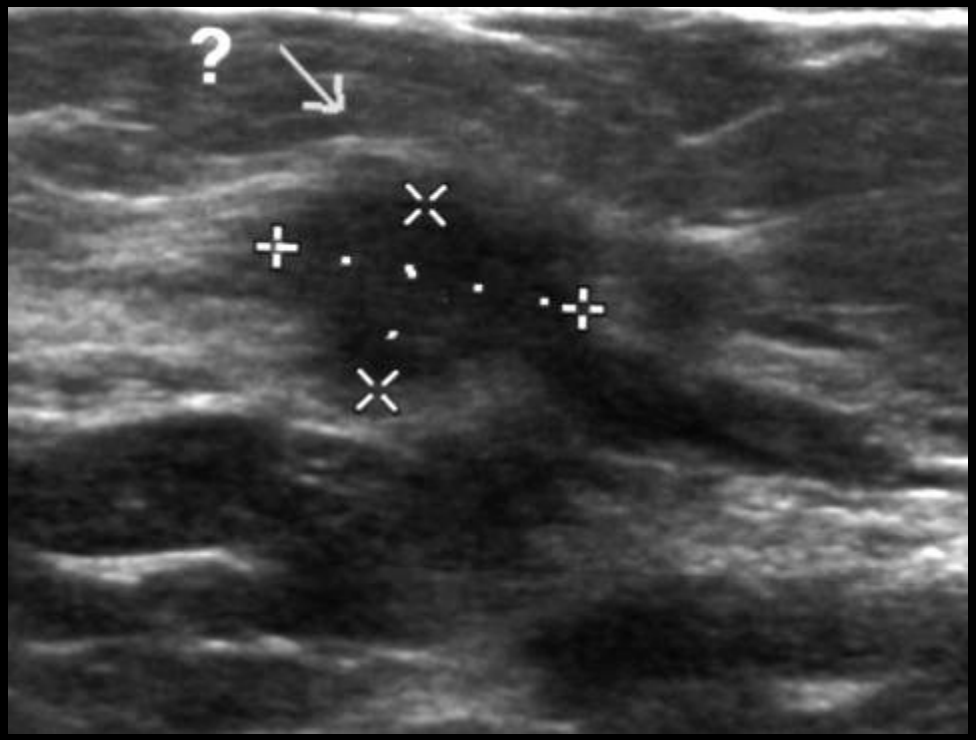
Right breast, 3D automated ultrasound exam, reconstructed, coronal slices



Multislice 02

Hand-held ultrasound



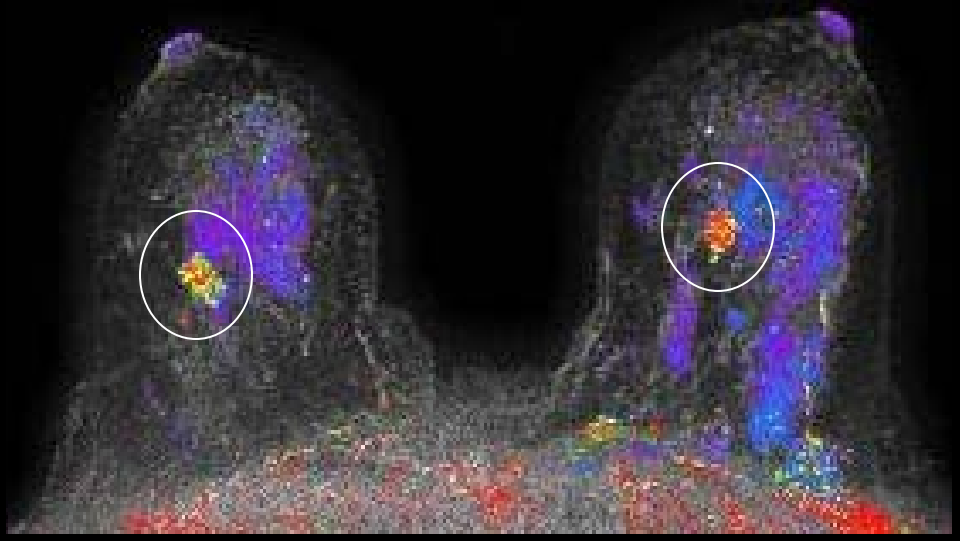


Breast MRI

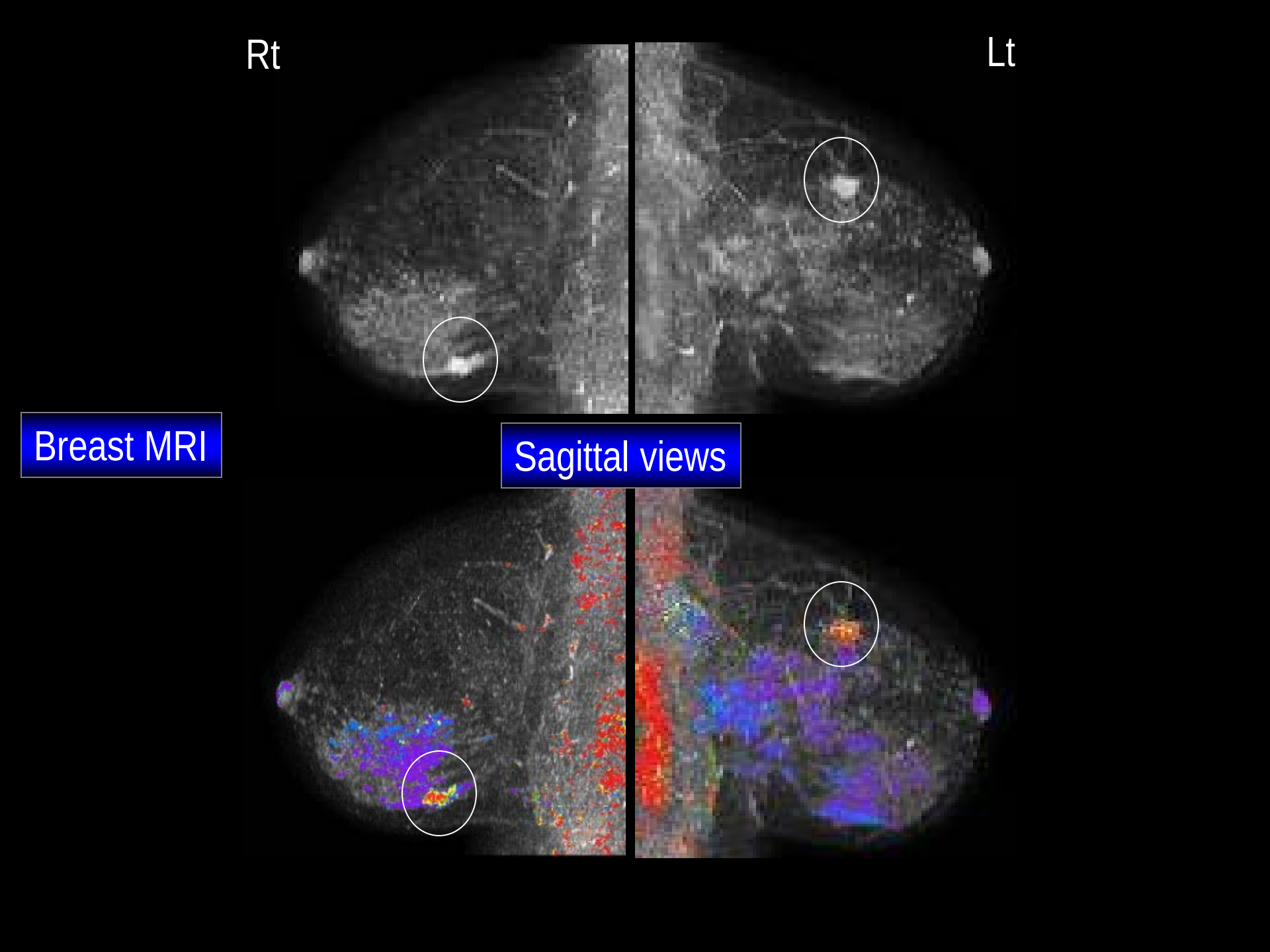
Rt

Lt

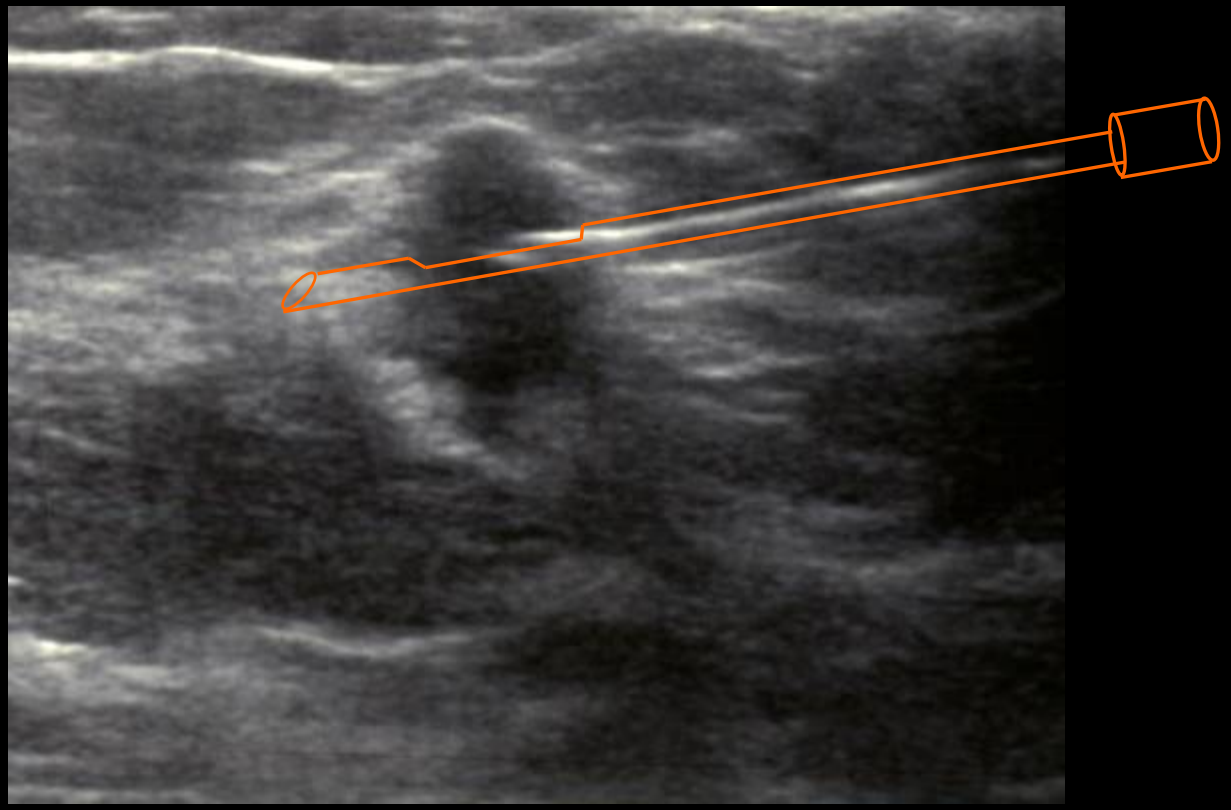
Bilateral unifocal breast cancers



MRI exam courtesy: Mats Ingvarsson, M.D.

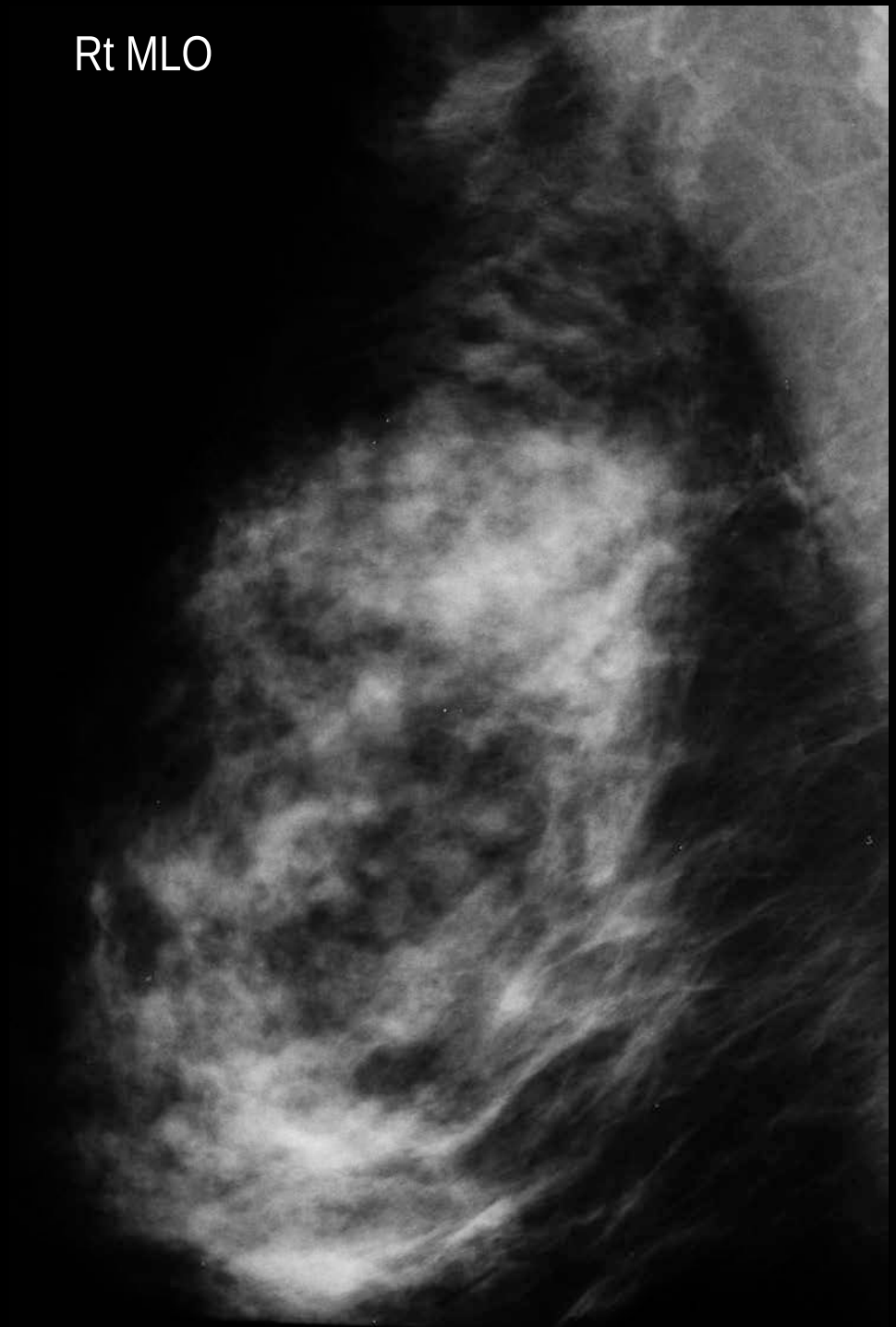

Rt
Lt
Breast MRI
Sagittal views

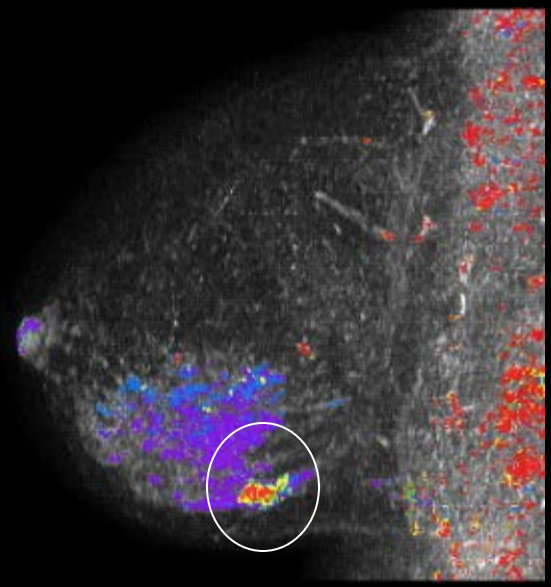
14-gauge core biopsy, right breast



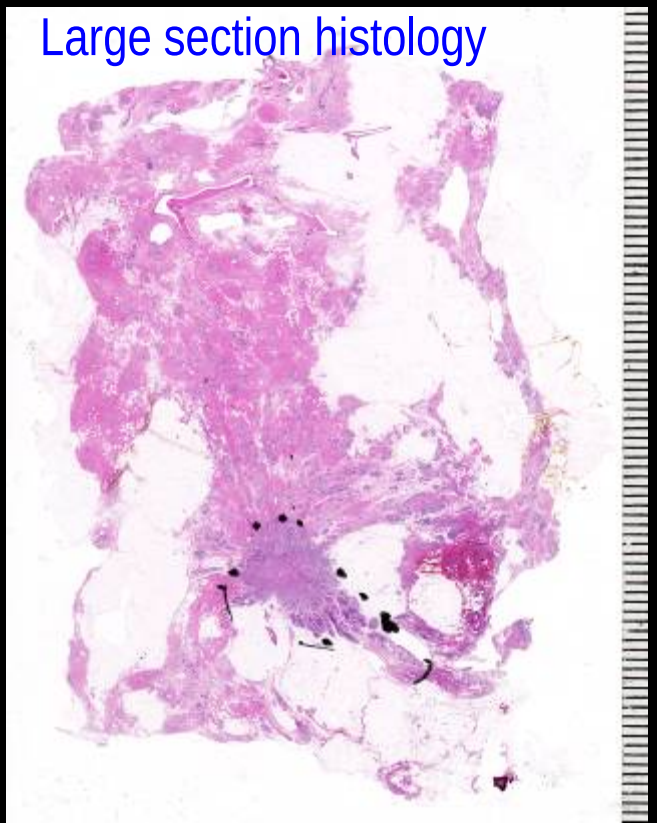
Histology: 7 mm invasive ductal carcinoma

Rt MLO





Large section histology

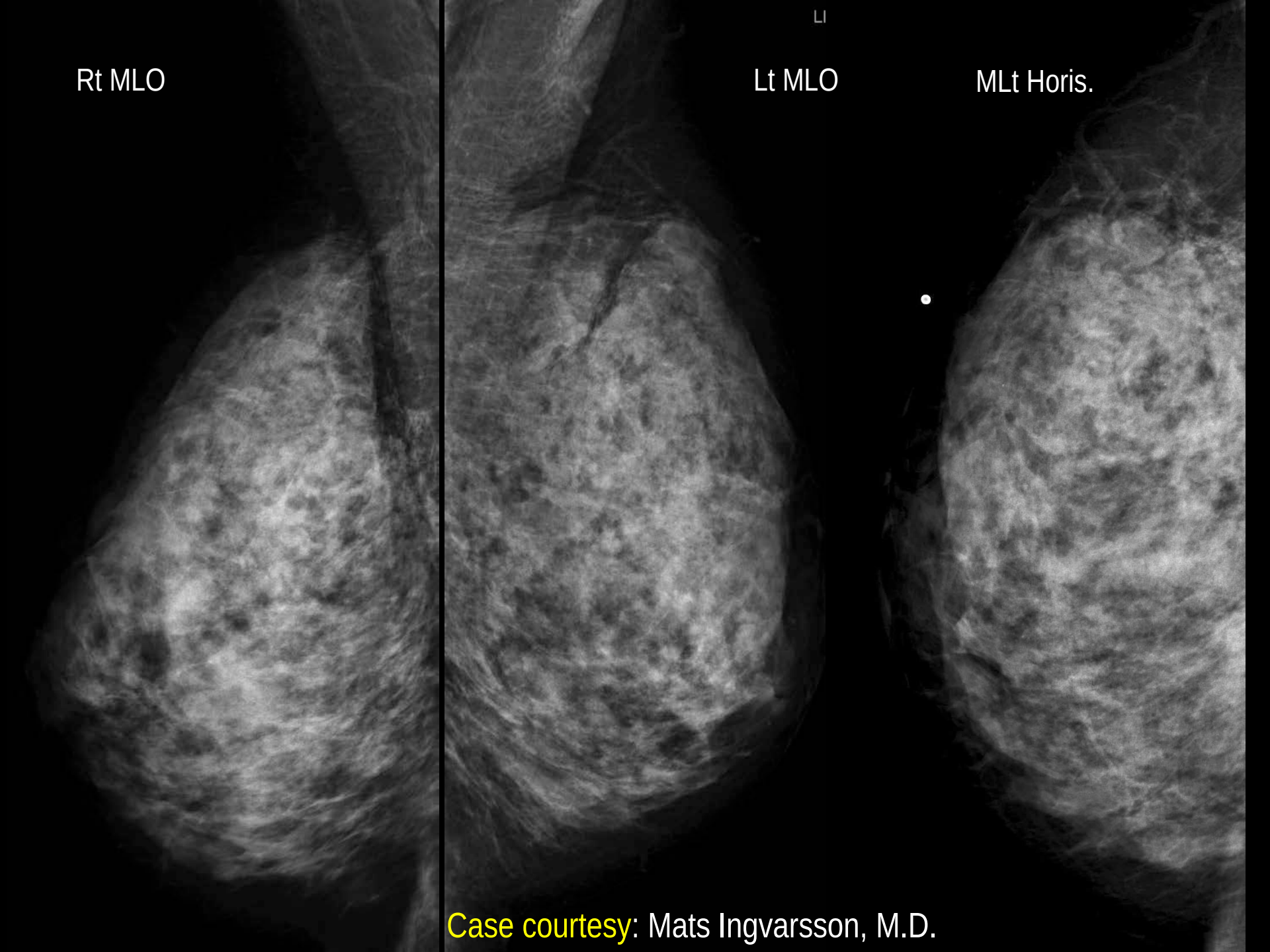


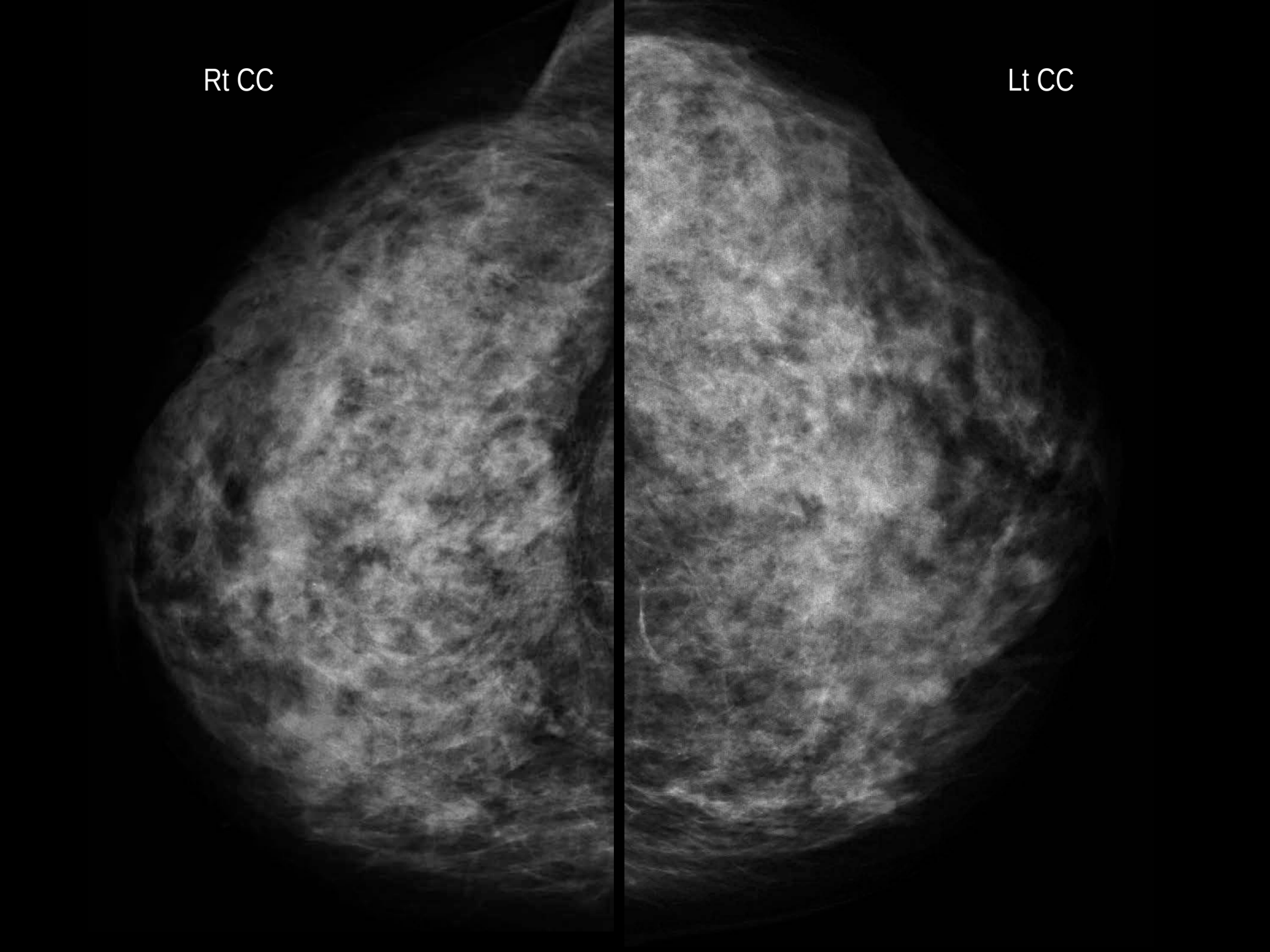
Description of the problem *and* presentation of a potential solution to the difficulty in perception in Pattern IV, using 3D automated ultrasound technique (2 mm coronal sections)

This 46 year old woman, with no family history for breast cancer, felt a thickening in the upper portion of her right breast.

From the Departments of Mammography,
Clinical Pathology and Surgery
Falun Central Hospital, Sweden

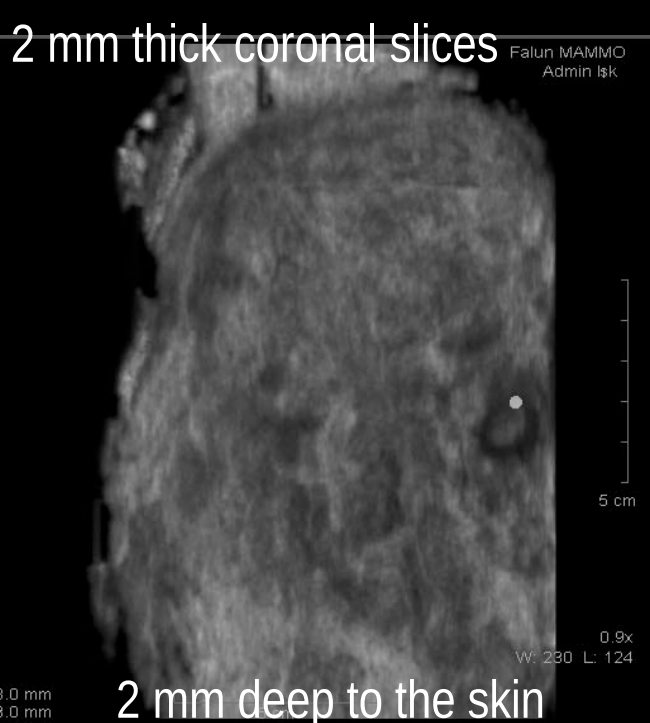
Example 1


Rt MLO
Lt MLO
MLt Horis.
Case courtesy: Mats Ingvarsson, M.D.

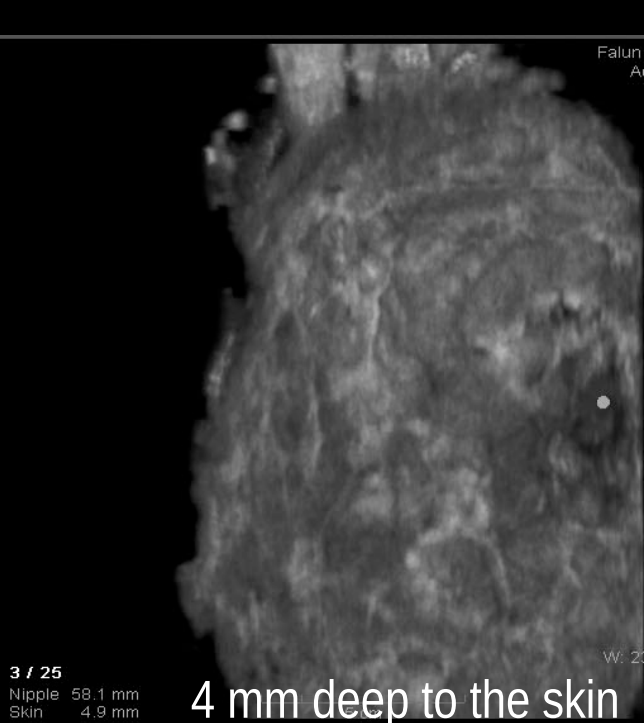

Rt CC
Lt CC

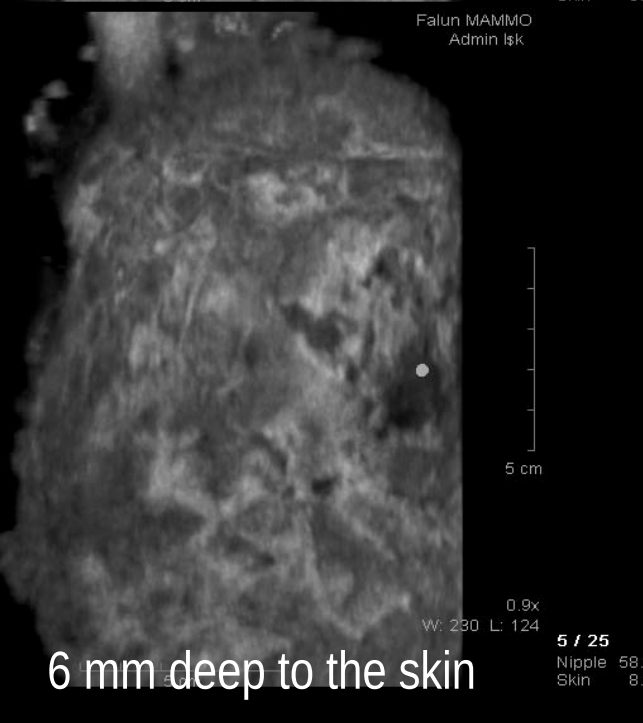
3D automated ultrasound. 2 mm thick coronal slices

Skin level



2 mm deep to the skin


4 mm deep to the skin



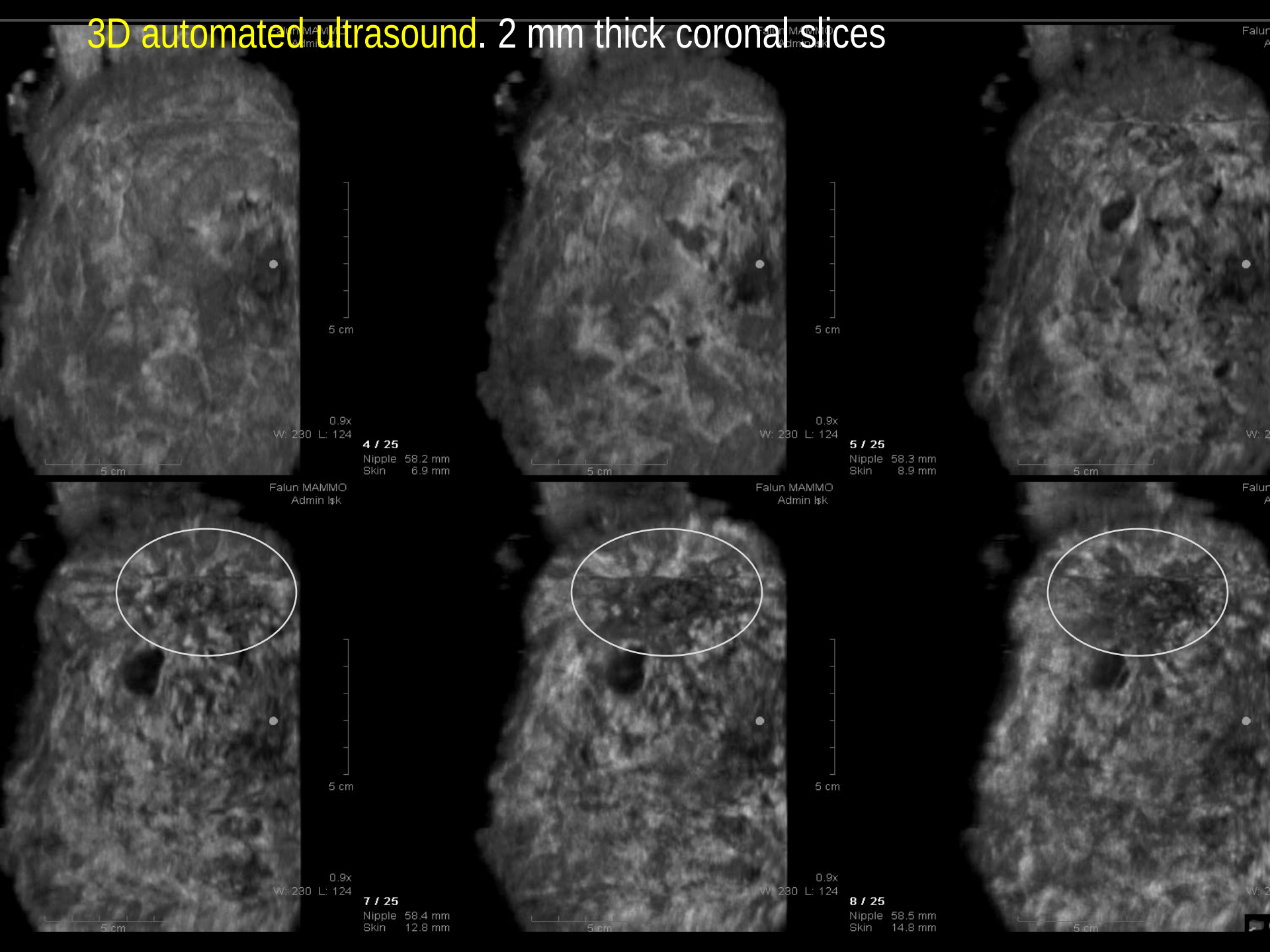
6 mm deep to the skin

cyst

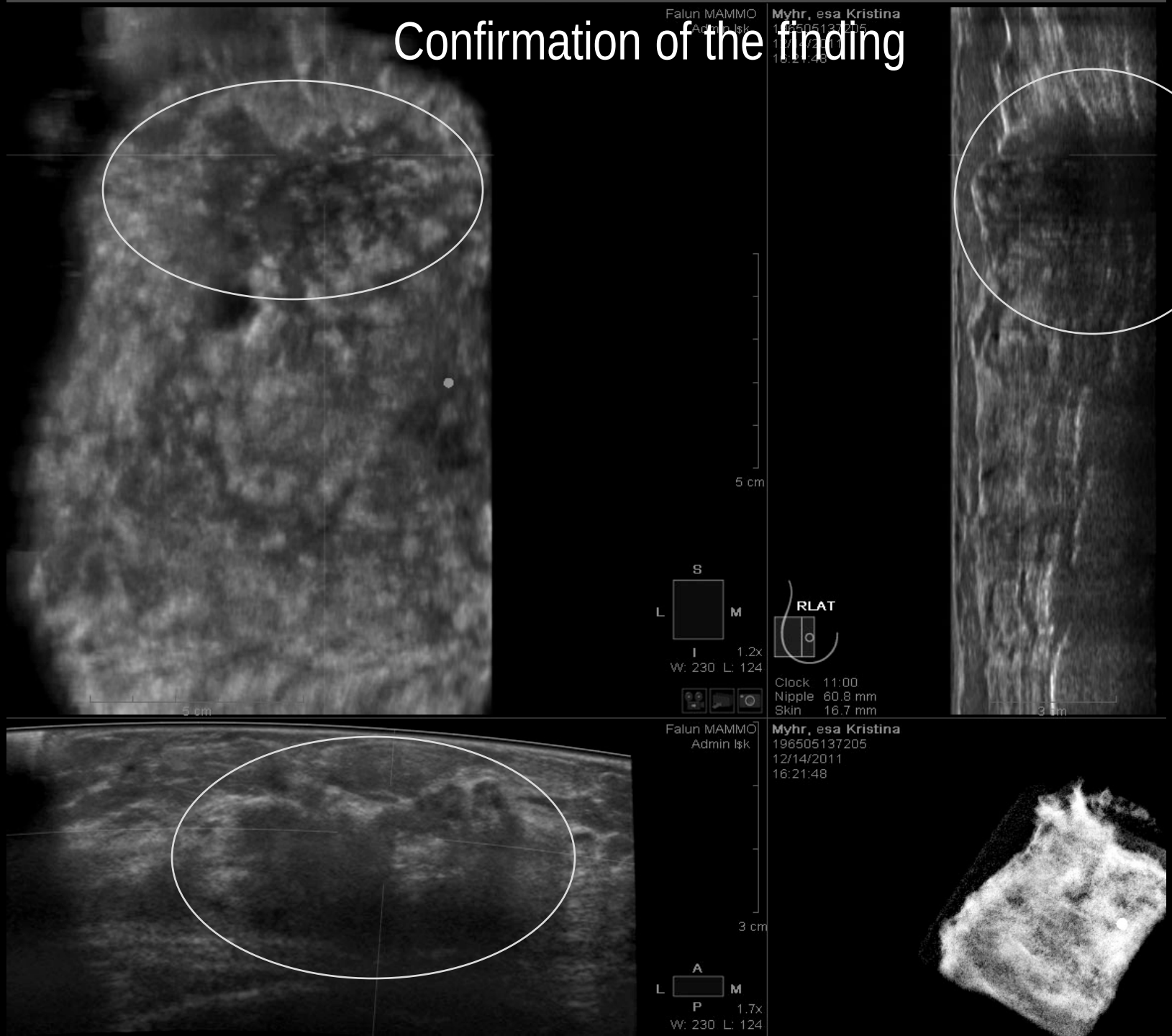
8 mm deep to the skin

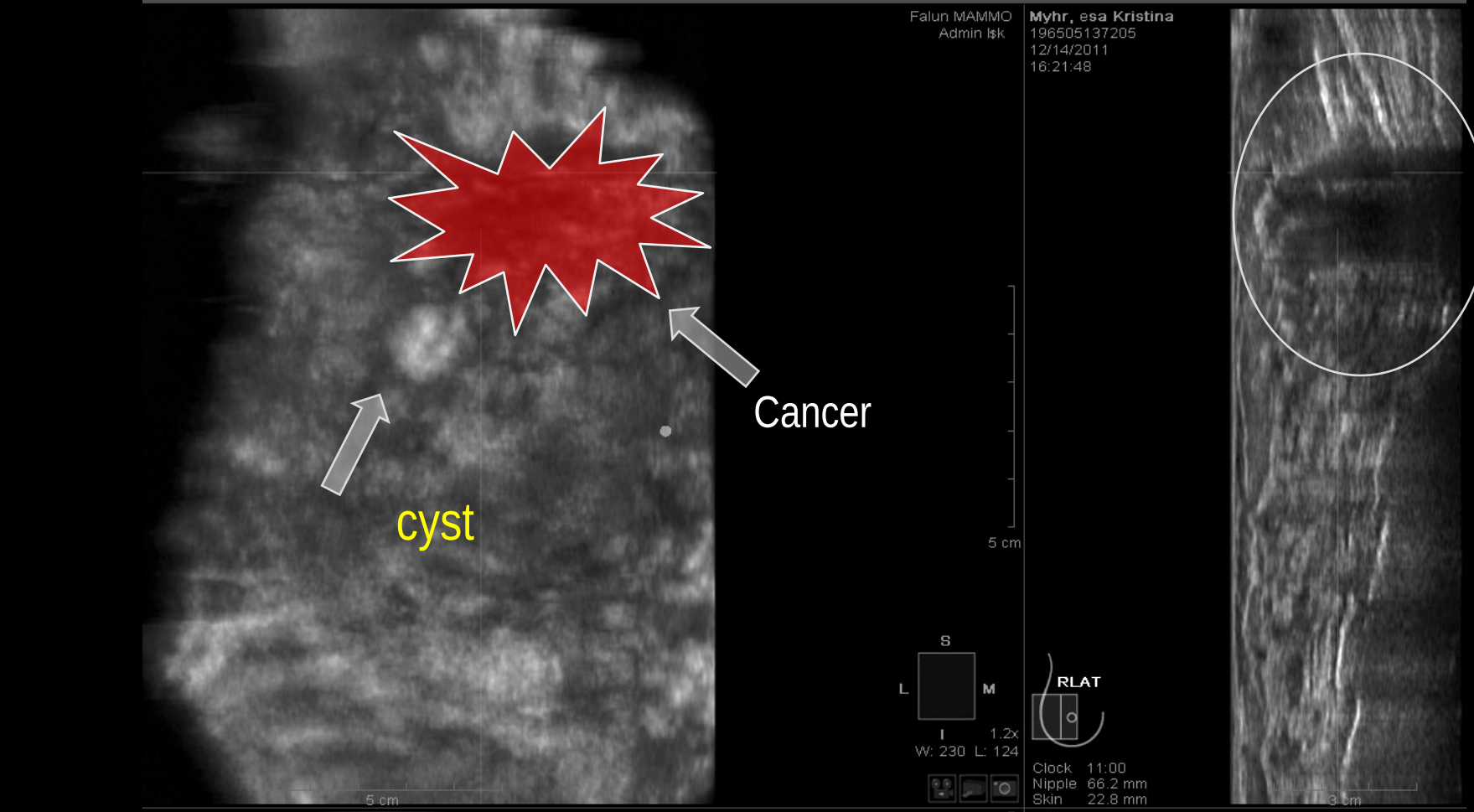

10 mm deep to the skin

3D automated ultrasound. 2 mm thick coronal slices



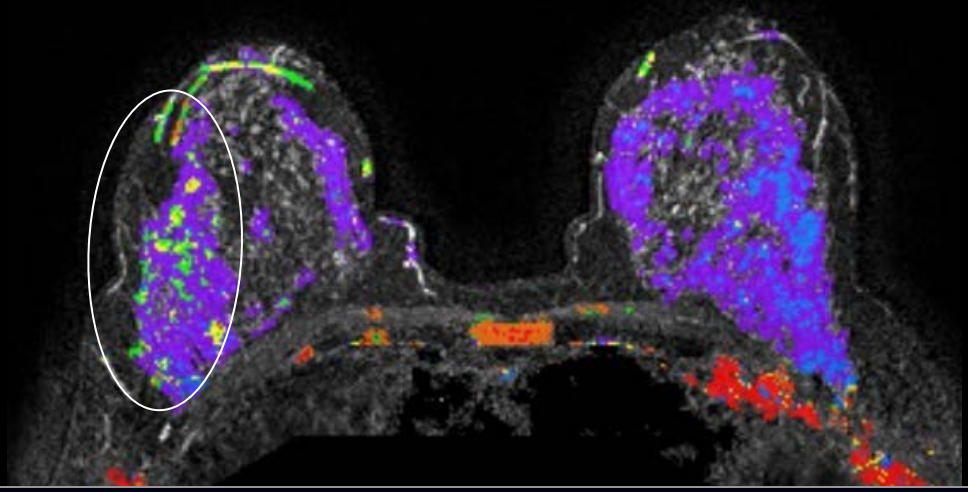
Confirmation of the finding



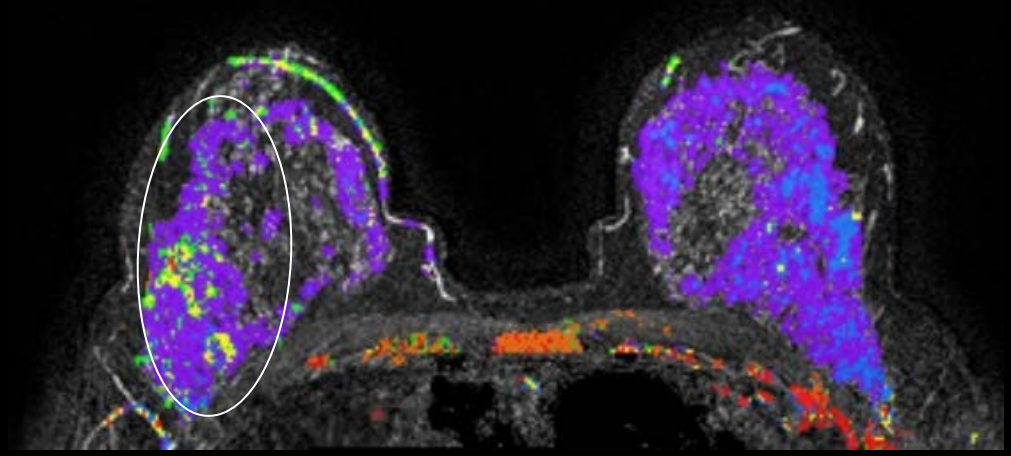

Falun MAMMO
Admin Isk
Myhr, esa Kristina
196505137205
12/14/2011
16:21:48
Cancer
cyst
5 cm
S
L
M
I
1.2x
W: 230 L: 124
RLAT
Clock 11:00
Nipple 66.2 mm
Skin 22.8 mm
3 cm
5 cm


Falun MAMMO
Admin Isk
Myhr, esa Kristina
196505137205
12/14/2011
16:21:48
3 cm
A
L
M
P
1.7x
W: 230 L: 124
5 cm

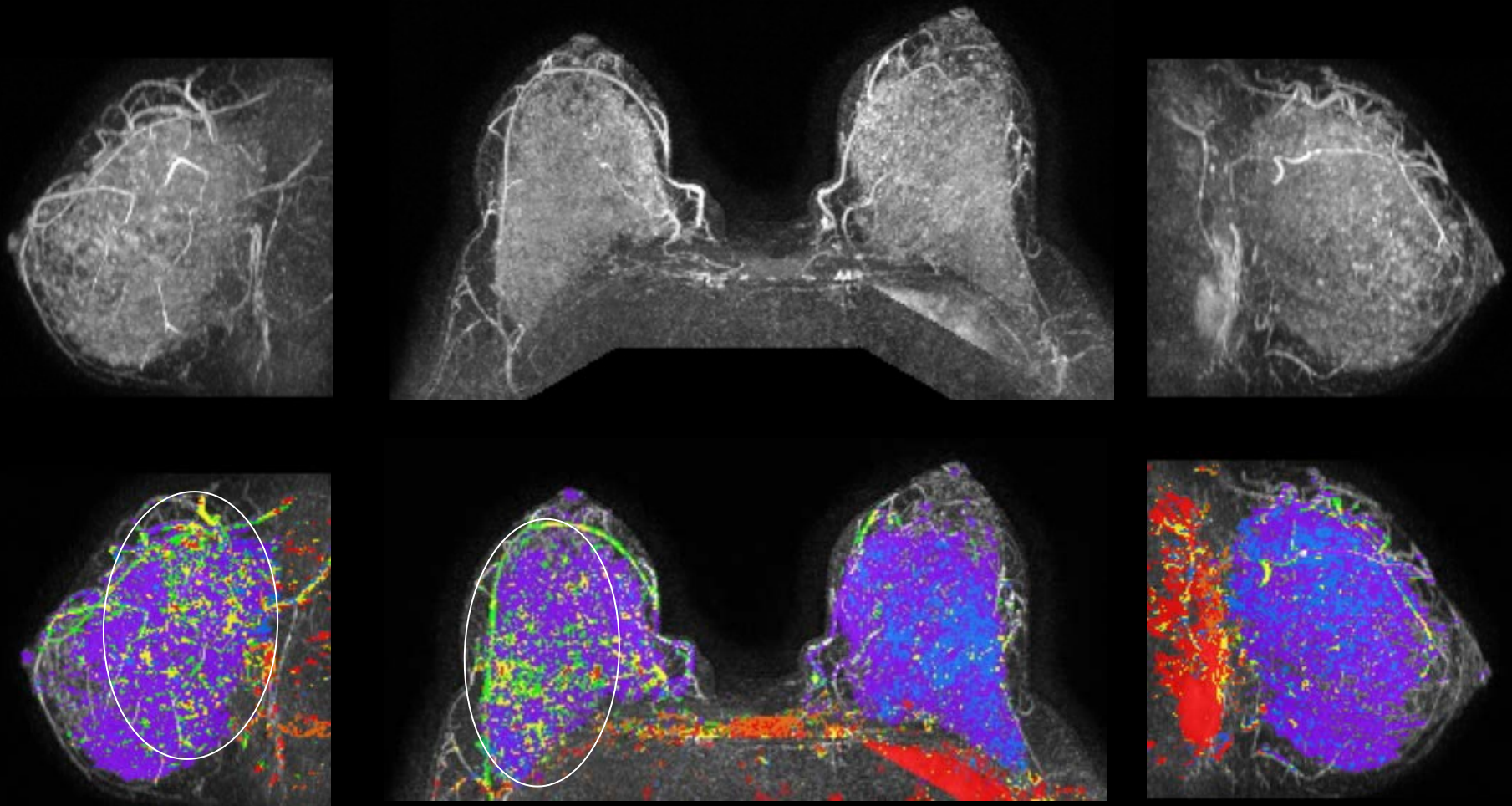
Breast MRI



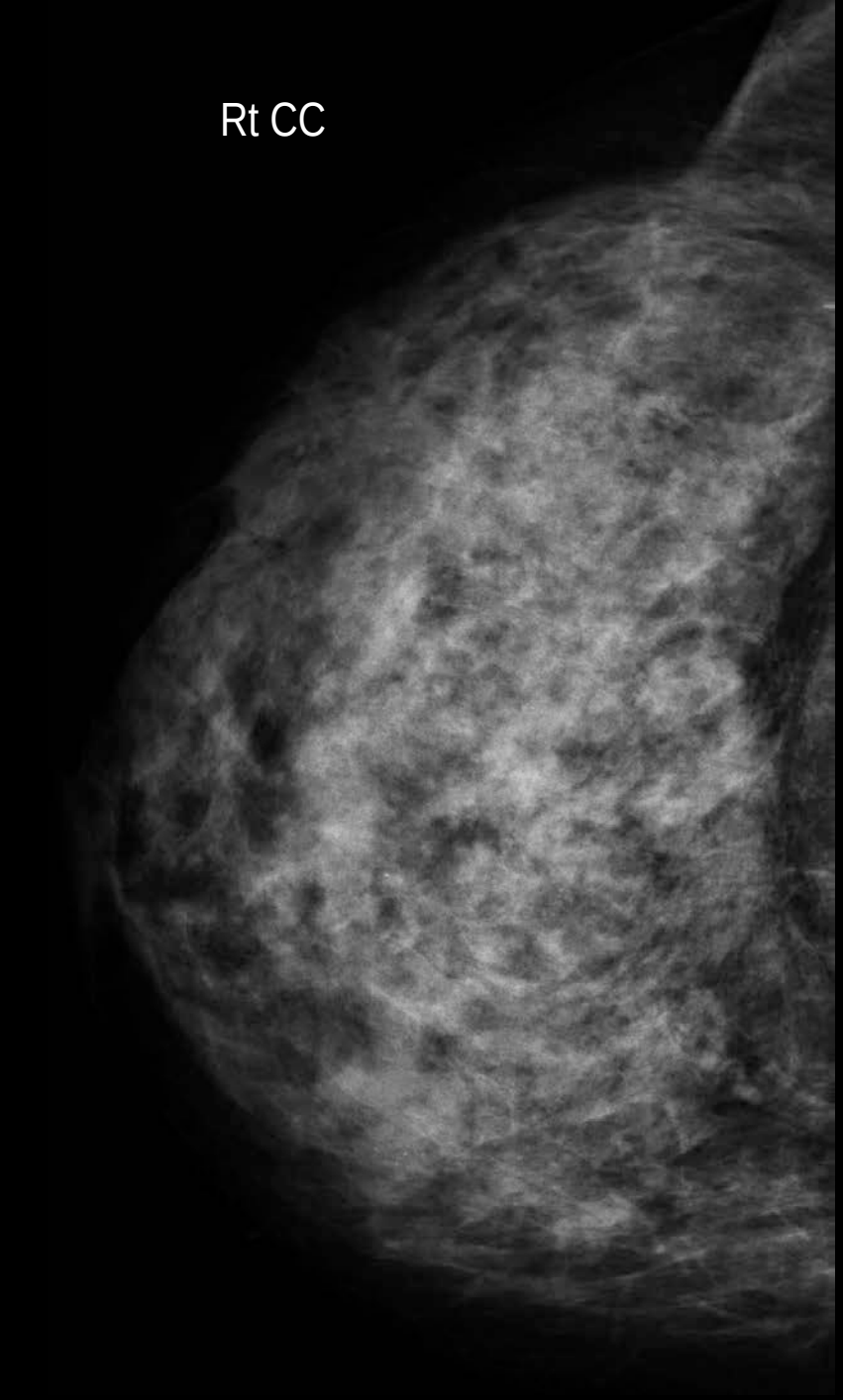
Right breast: 1) OU quadrant breast cysts 2) 80x67x100 mm multiple foci and diffuse enhancement, malignant tumor.
No pathologic axillary lymph nodes.

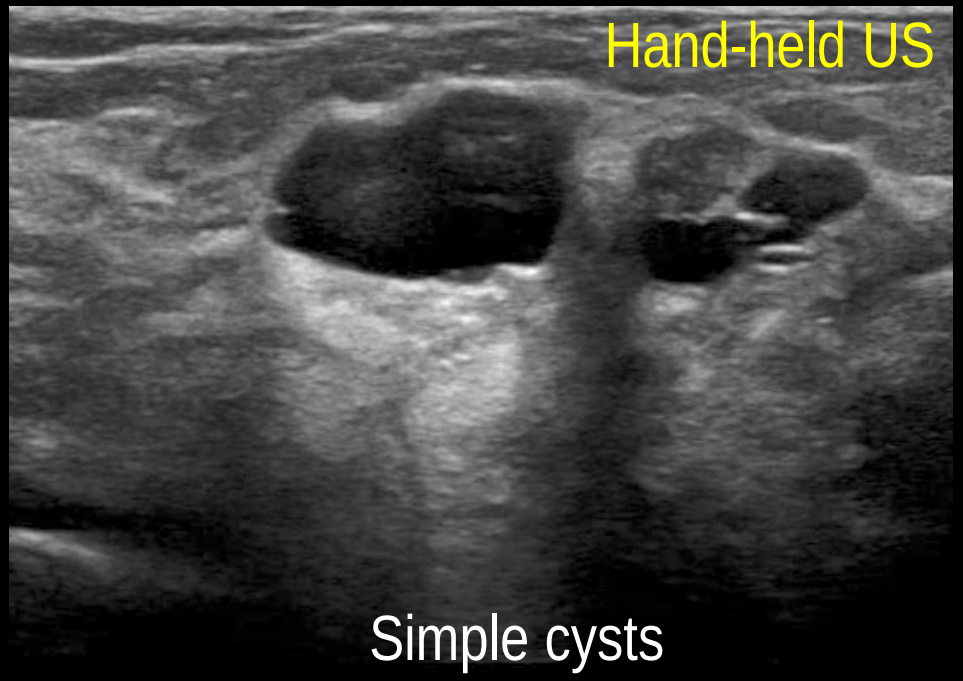


Breast MRI

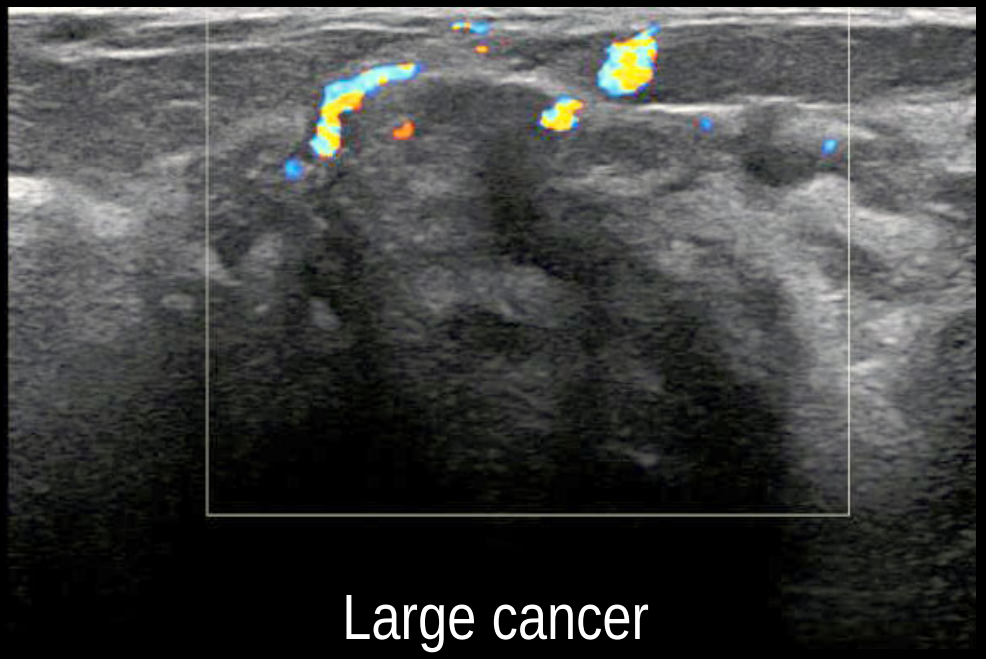


MRI exam courtesy: Nadja Lindhe, M.D.

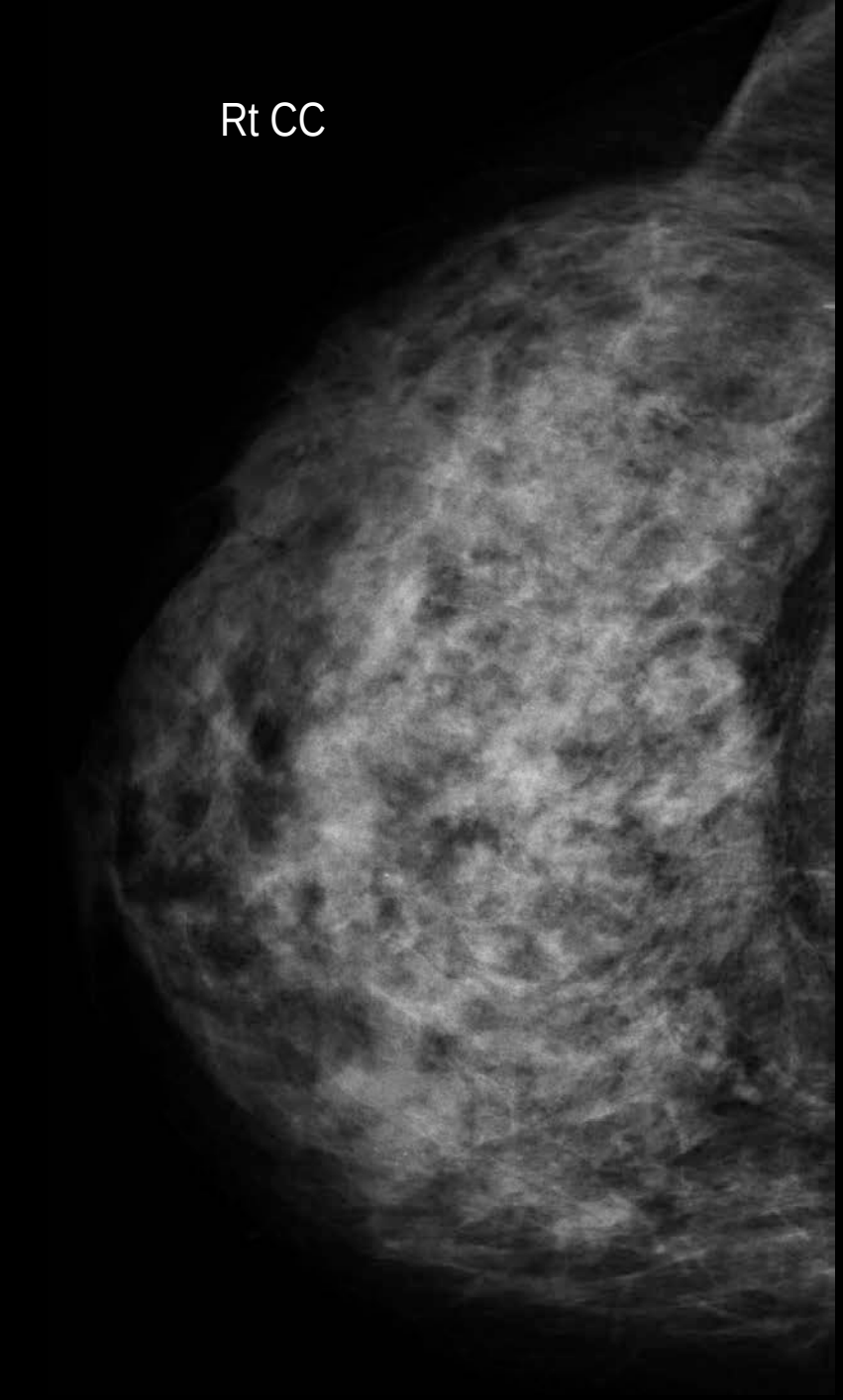


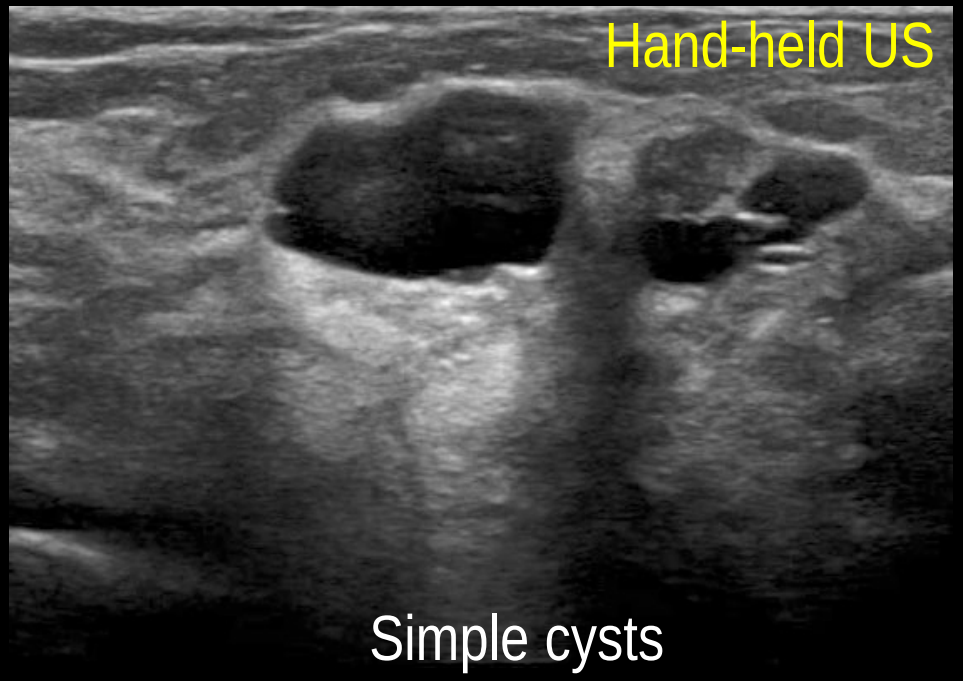


Simple cysts

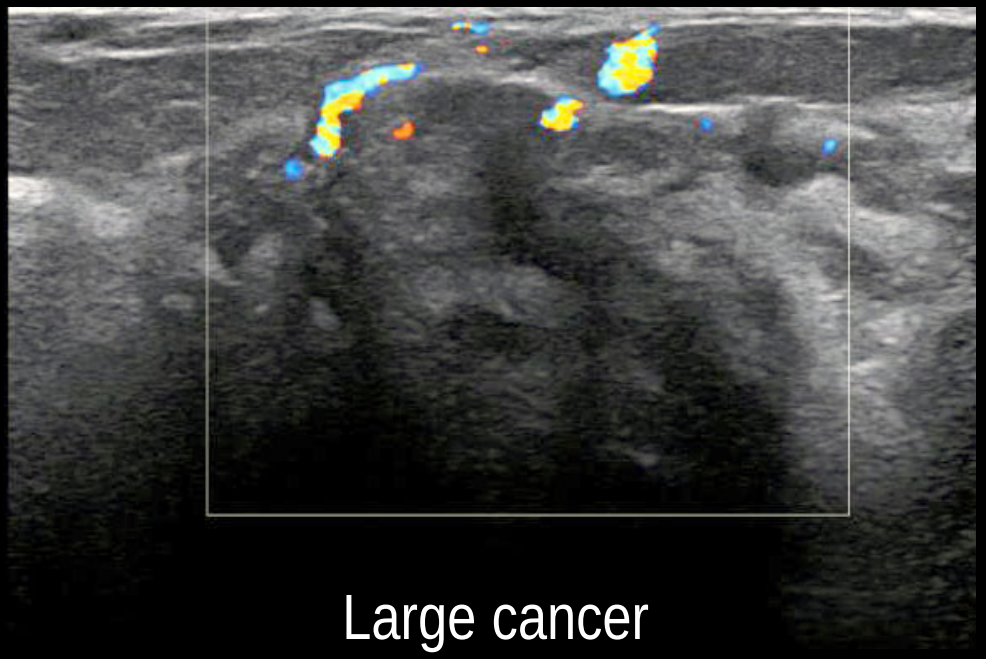


Large cancer

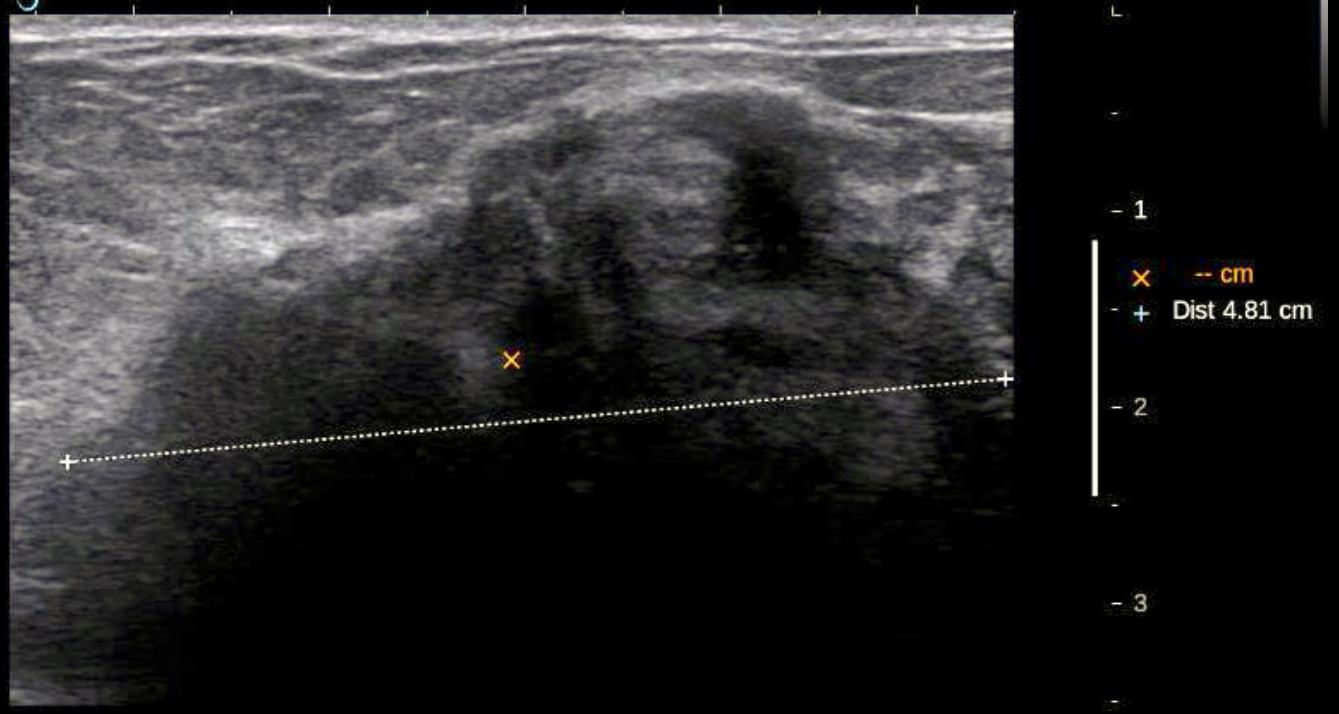


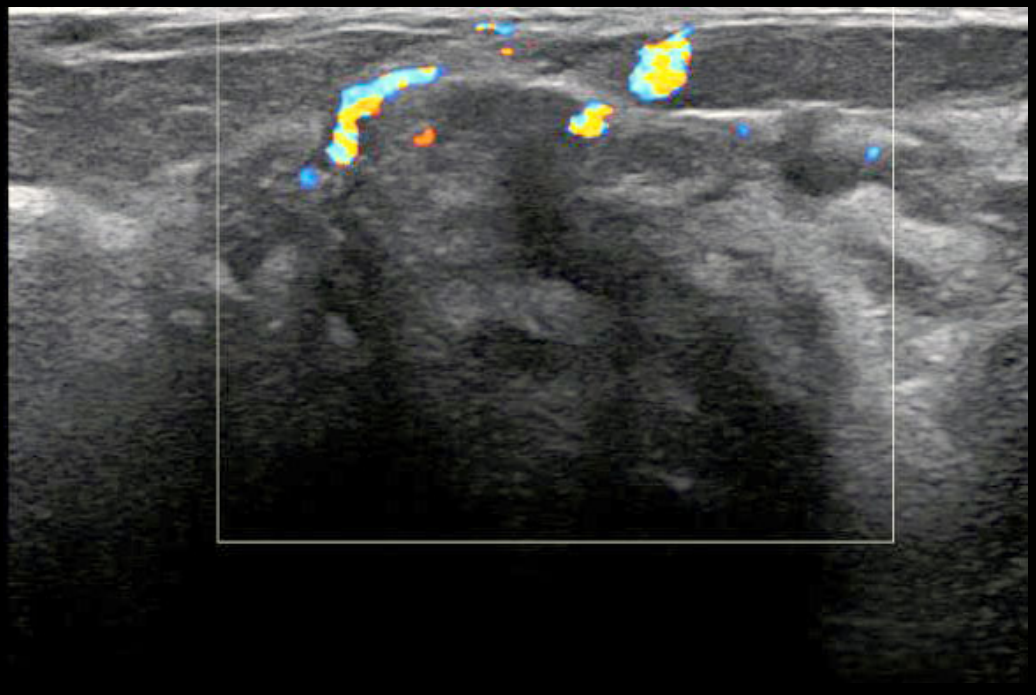


Simple cysts

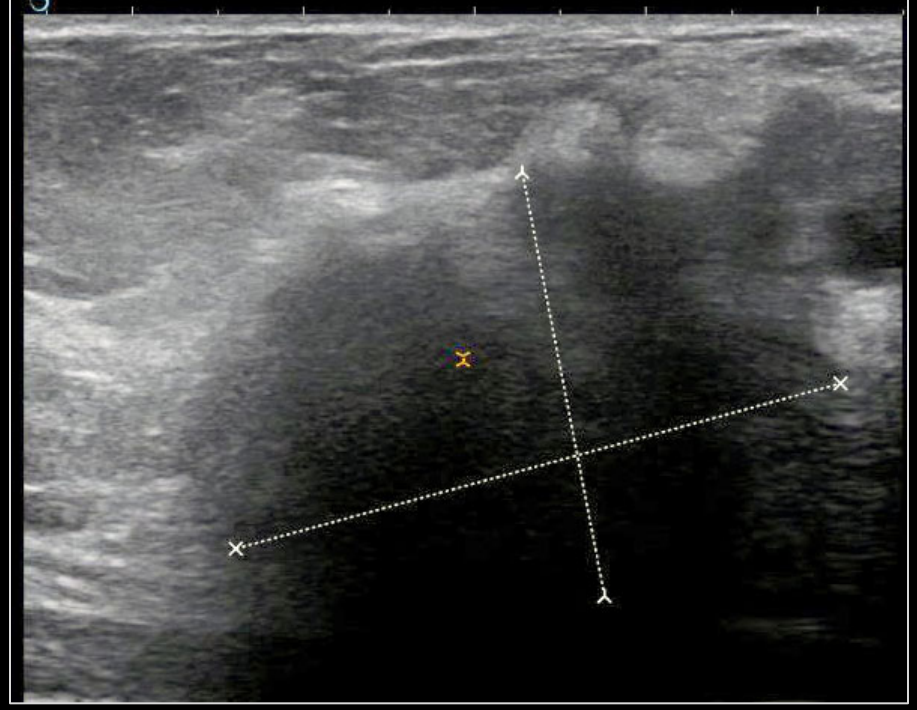


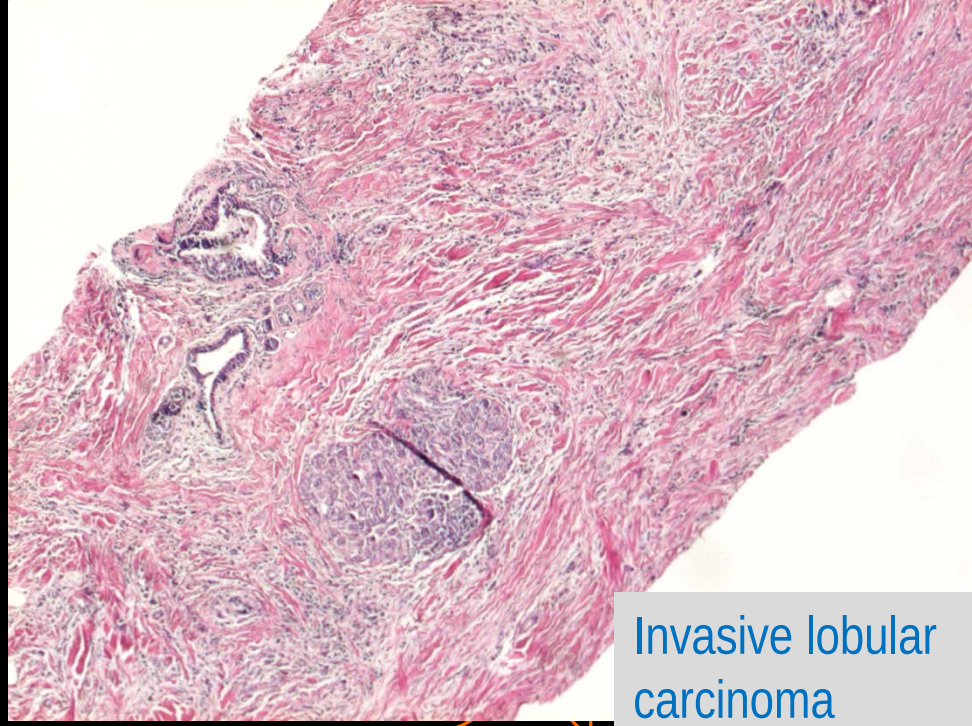
Large cancer





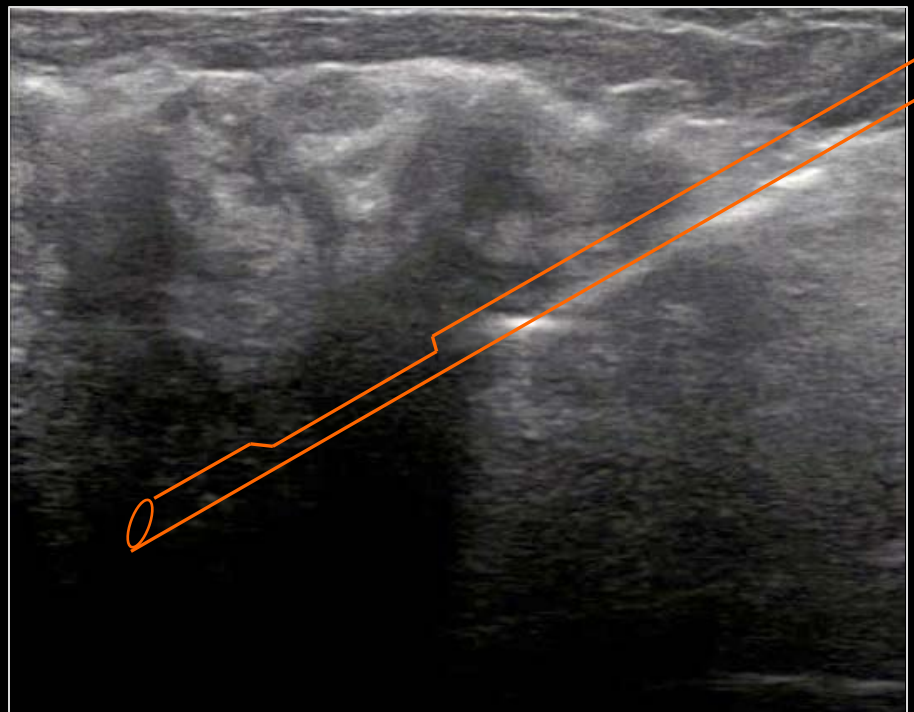
Hand-held US:
Tumor diameter
4.81 cm





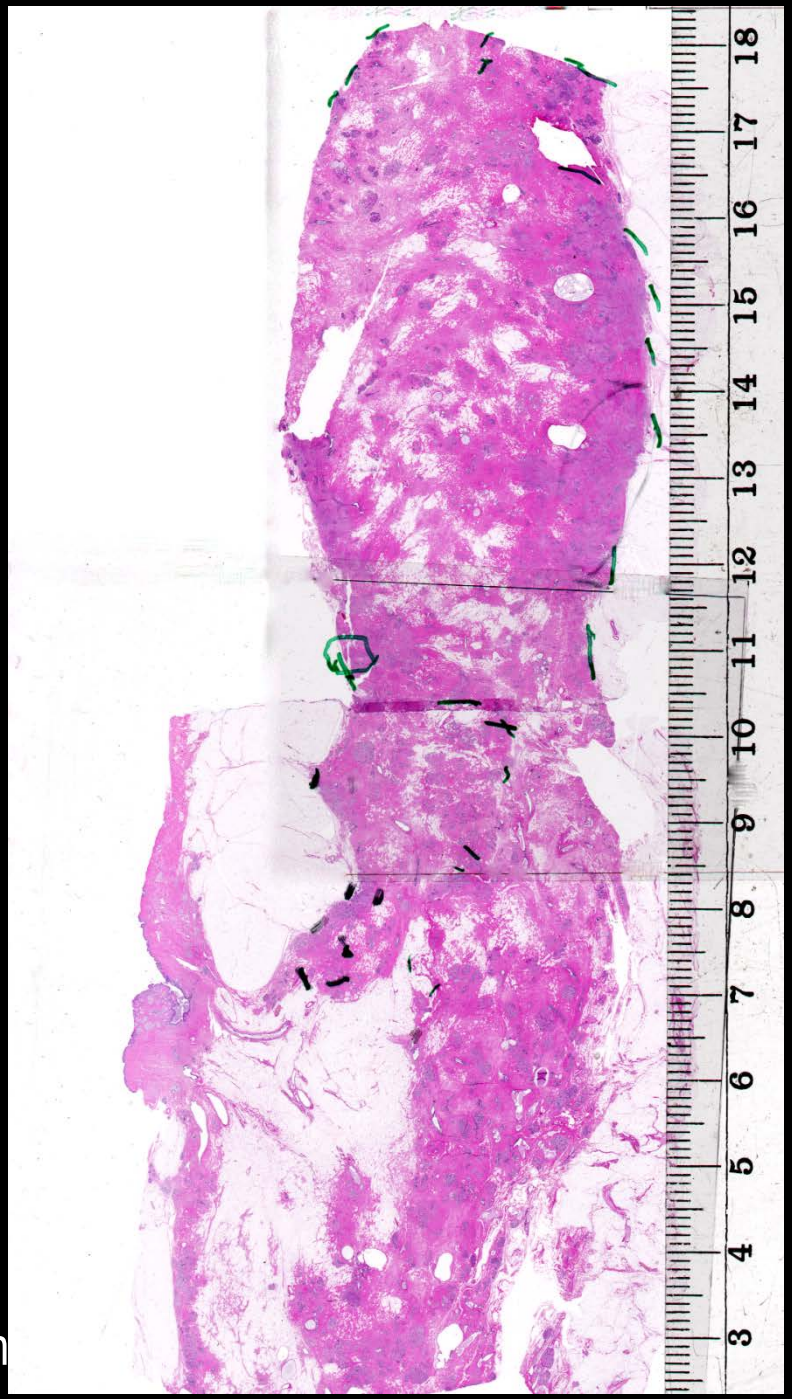
Invasive lobular carcinoma

Hand-held US

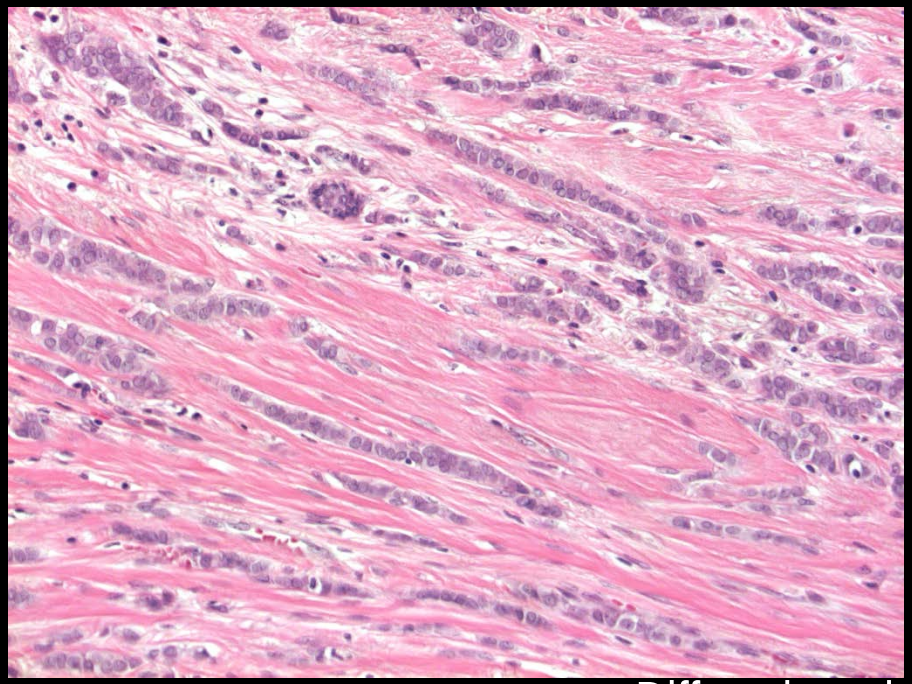
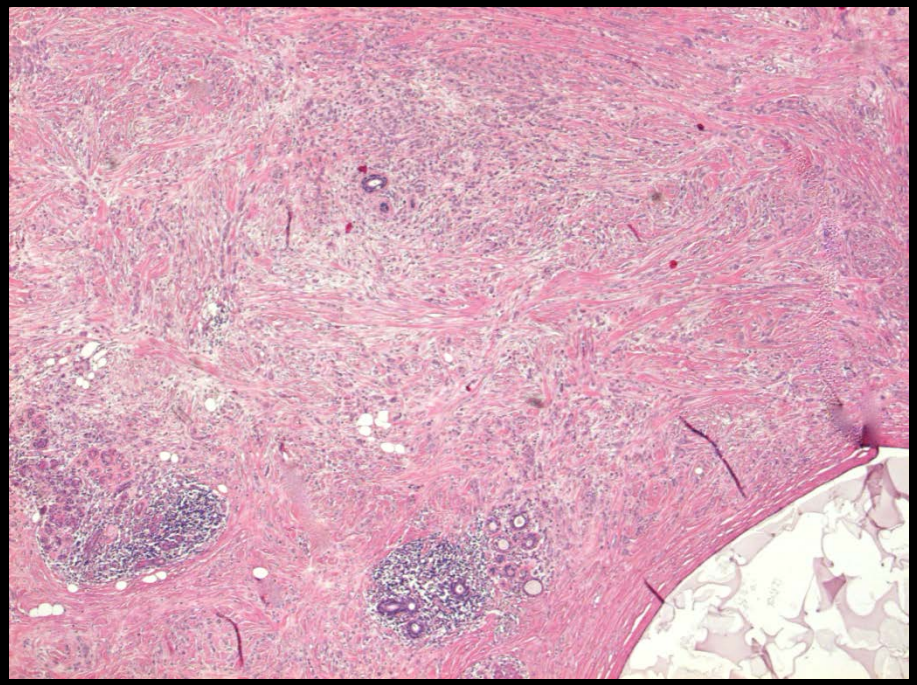


14-gauge core biopsy

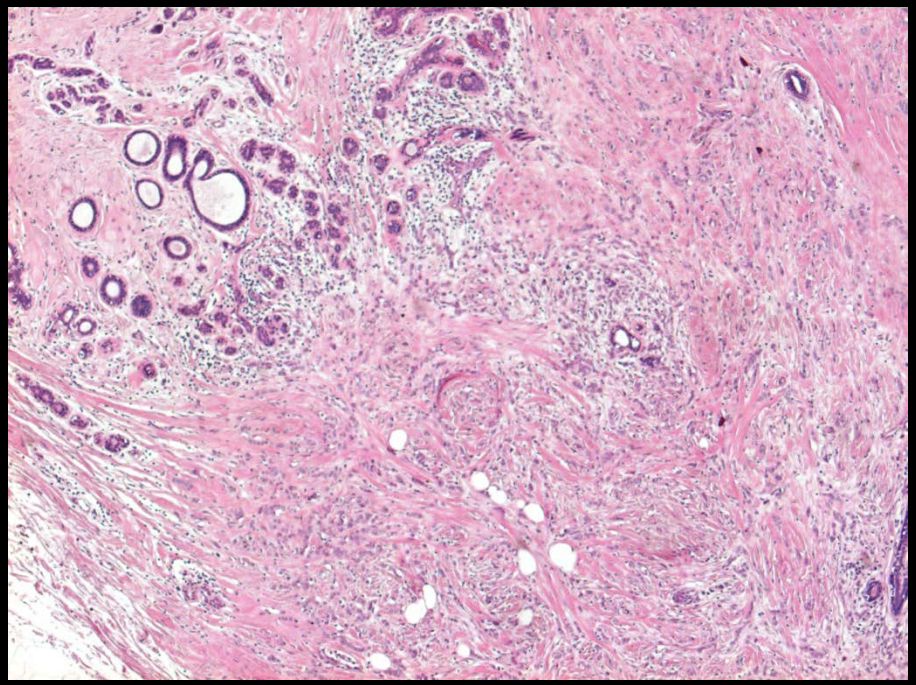
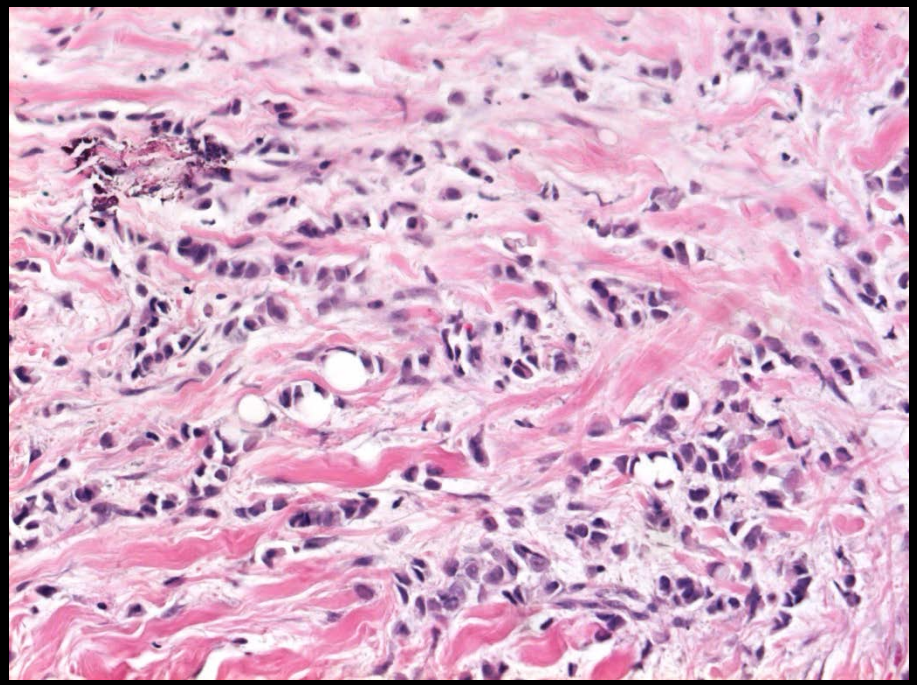
Rt MLO

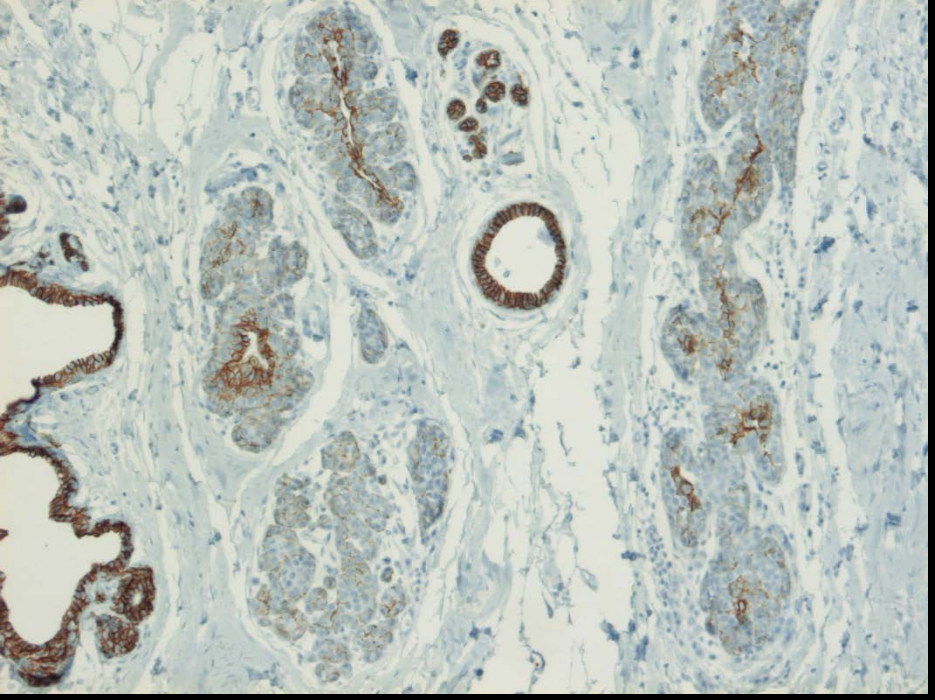


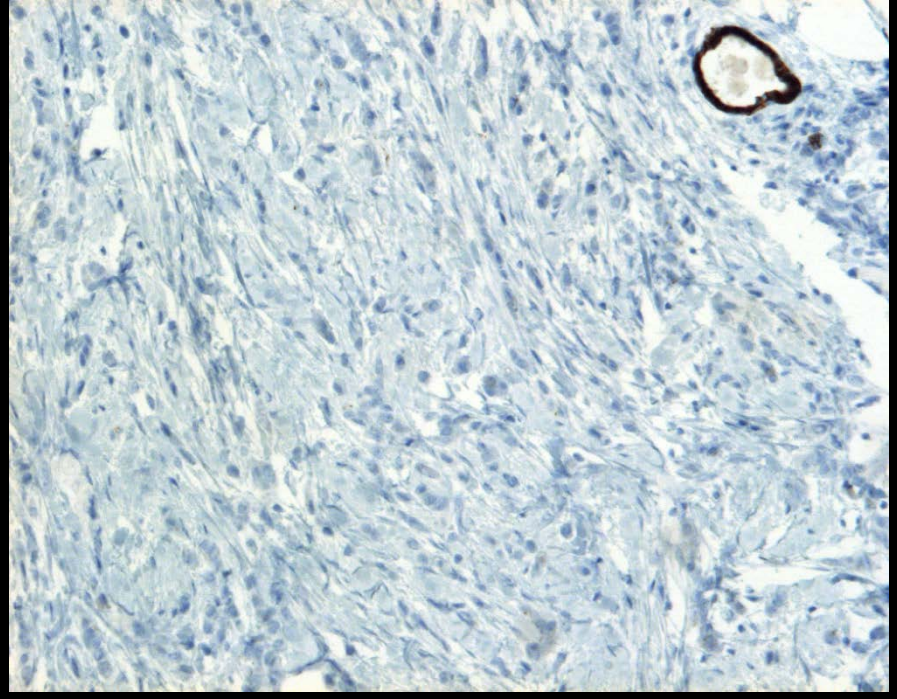
Mammography-large section histology correlation

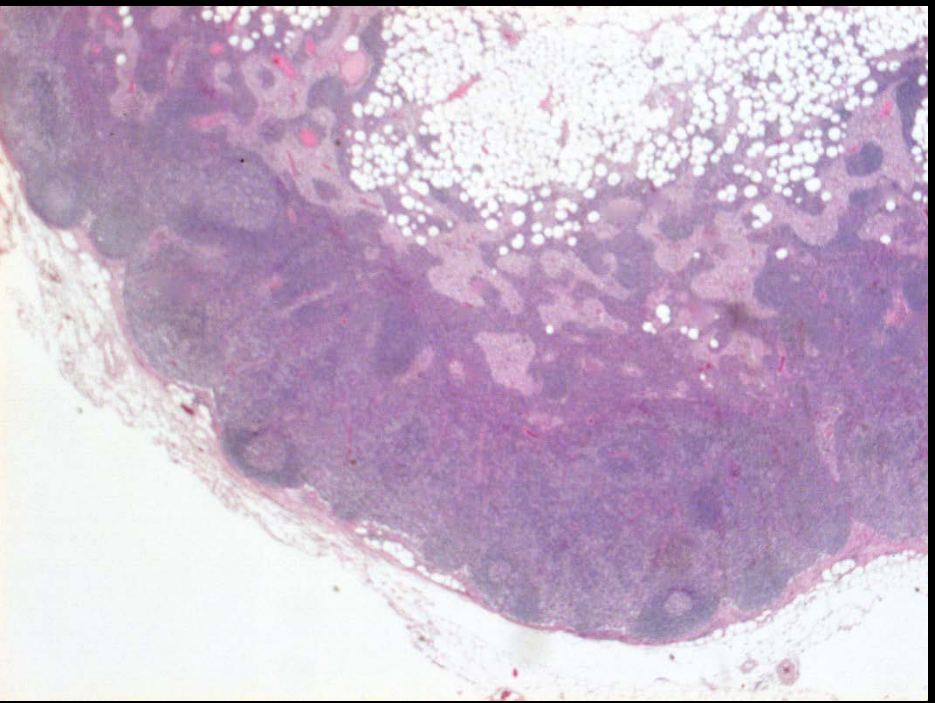



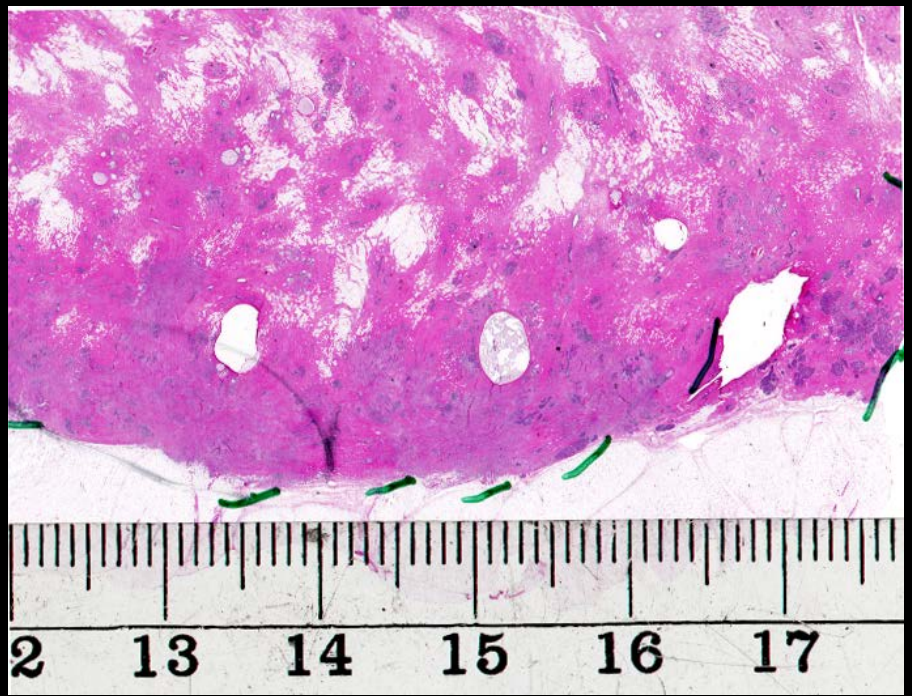
Diffuse invasive lobular carcinoma



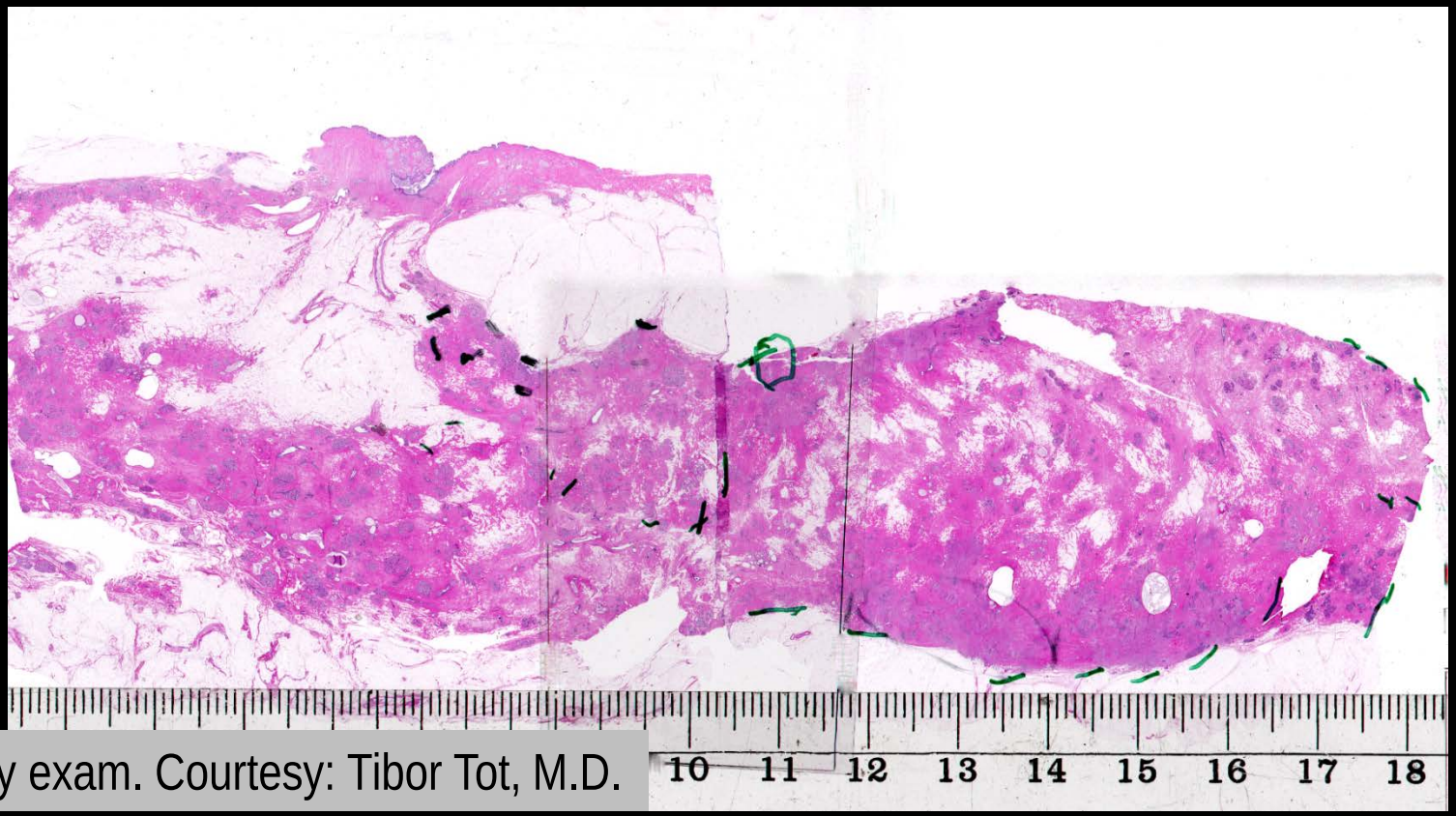





2
13
14
15
16
17

Histology

80x40 mm ER/PR positive diffuse and multifocal invasive lobular carcinoma, classic type. The posterior margin of the specimen is involved. pN 0/4

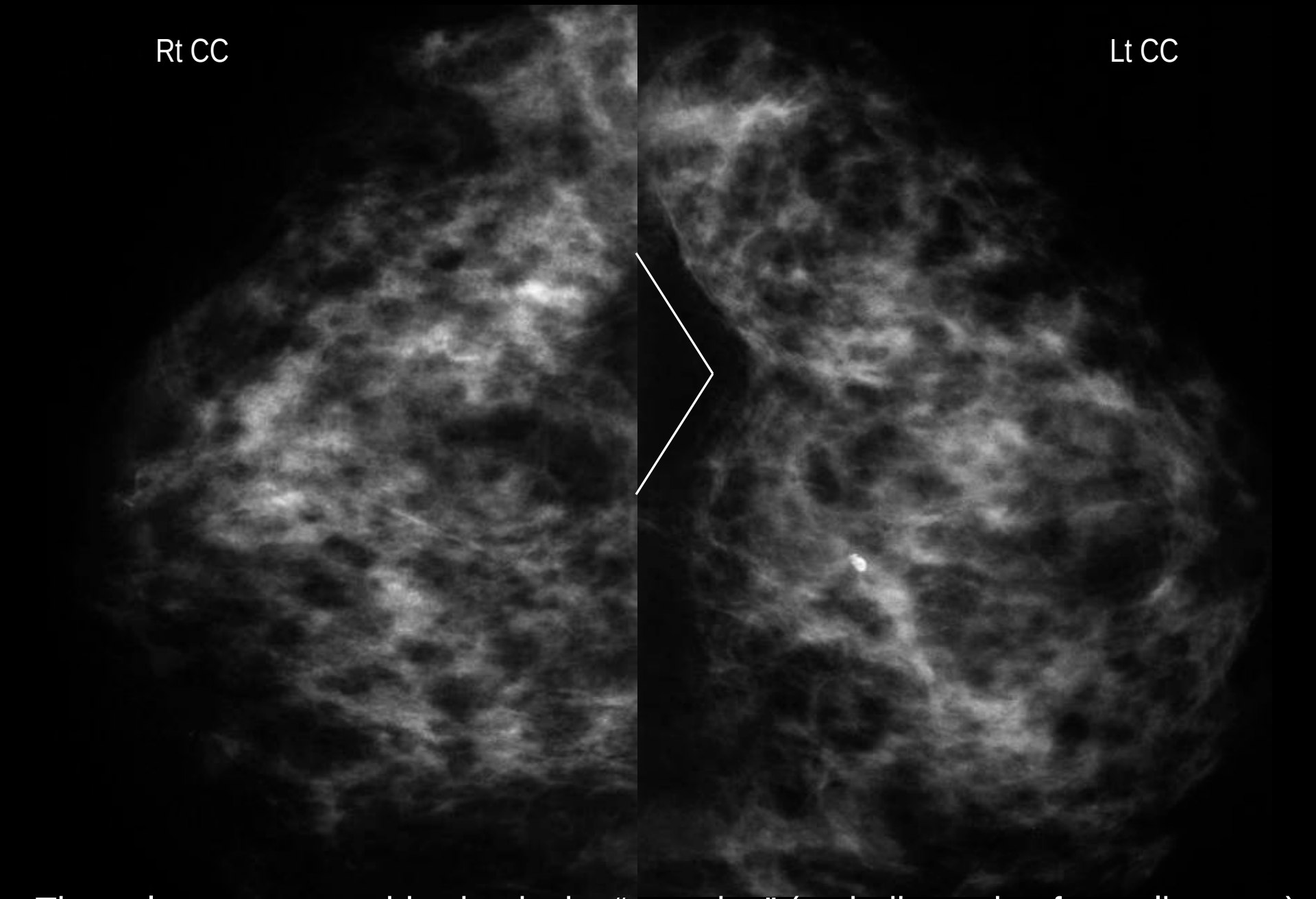


Histology exam. Courtesy: Tibor Tot, M.D.

53 year old woman, felt a thickening in the upper-outer quadrant of her left breast

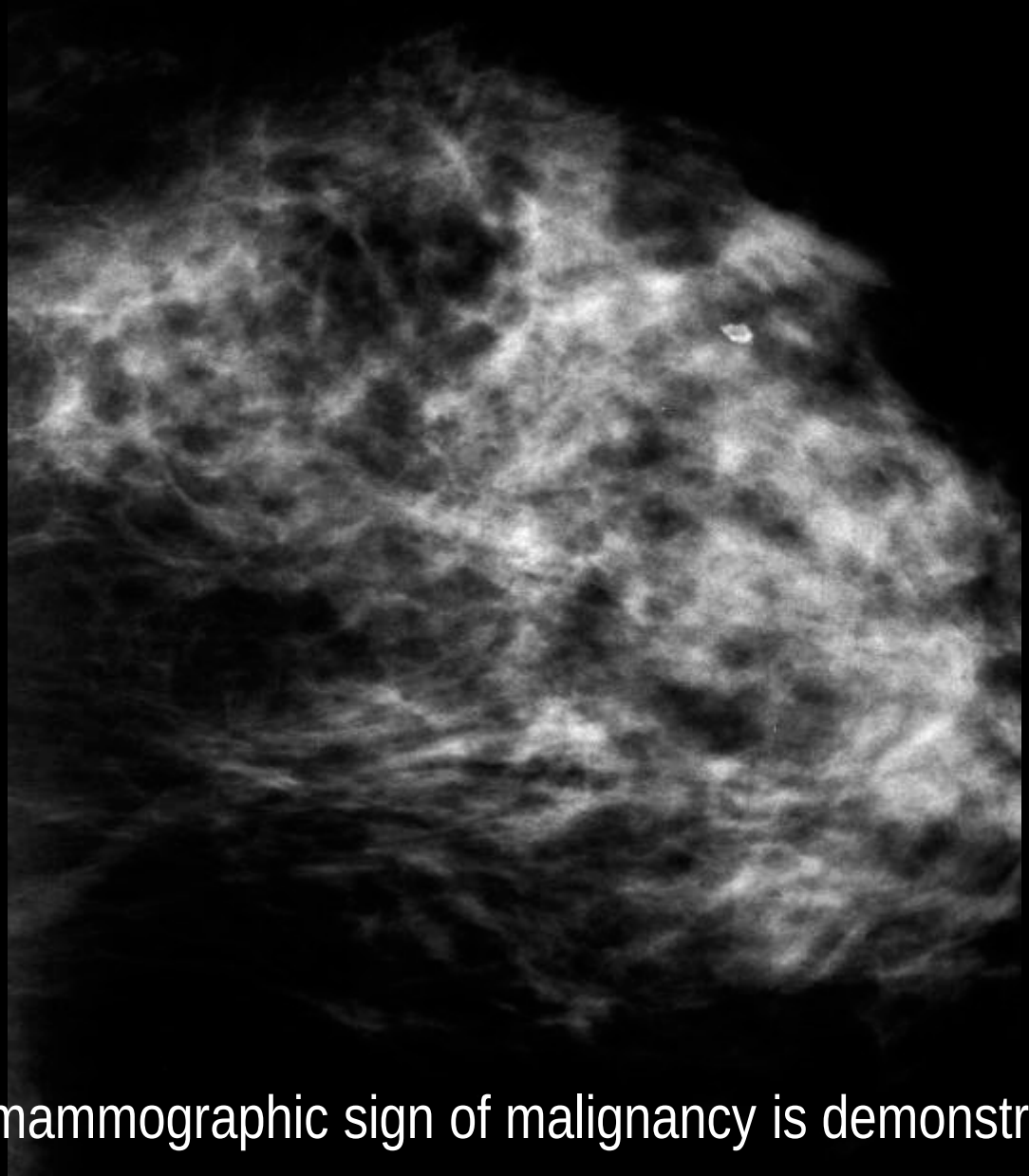
From the Department of Mammography
and Clinical Pathology
Falun Central Hospital, Sweden

Example 2

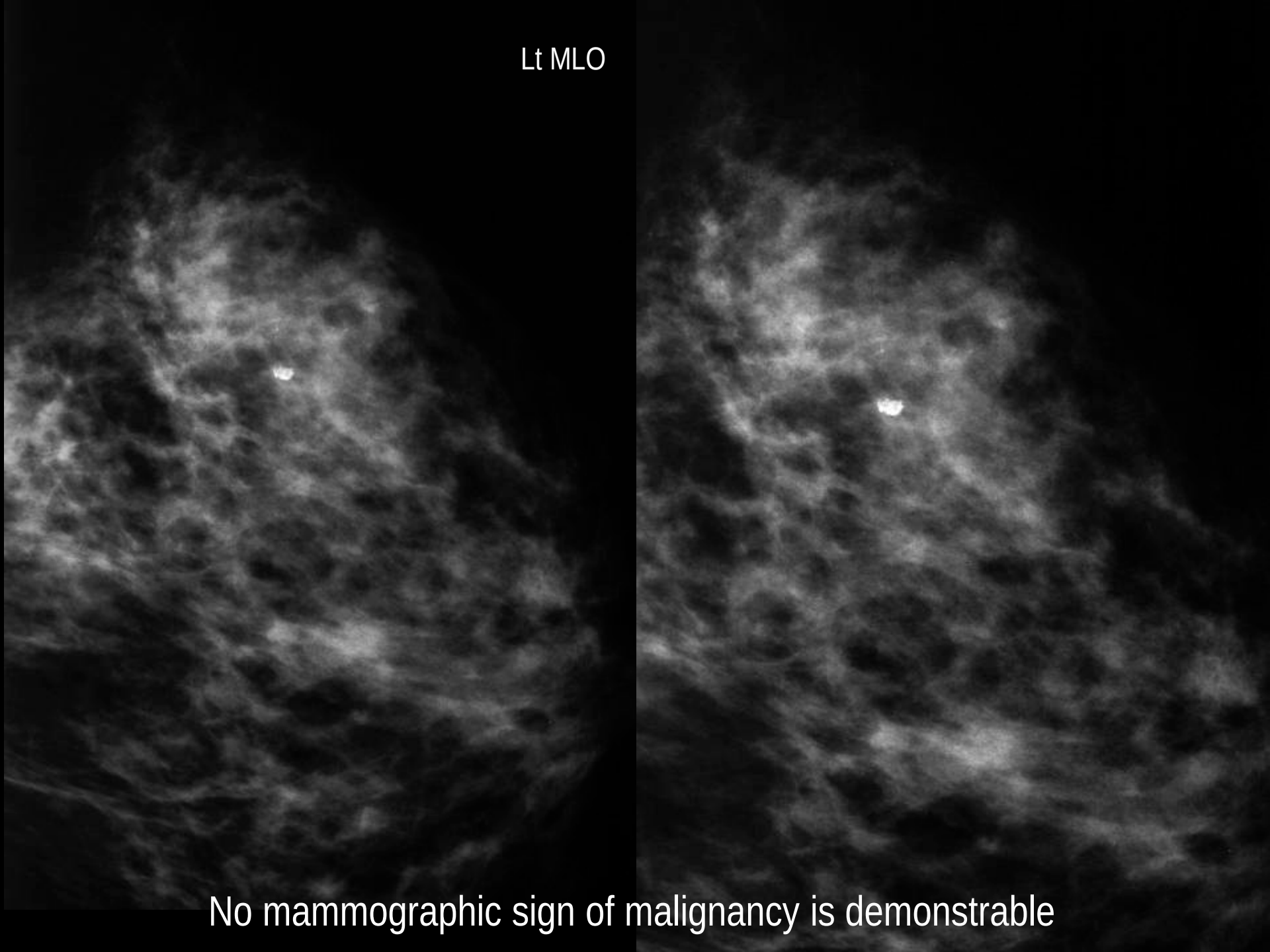


The only mammographic sign is the “tent-sign” (an indirect sign for malignancy)

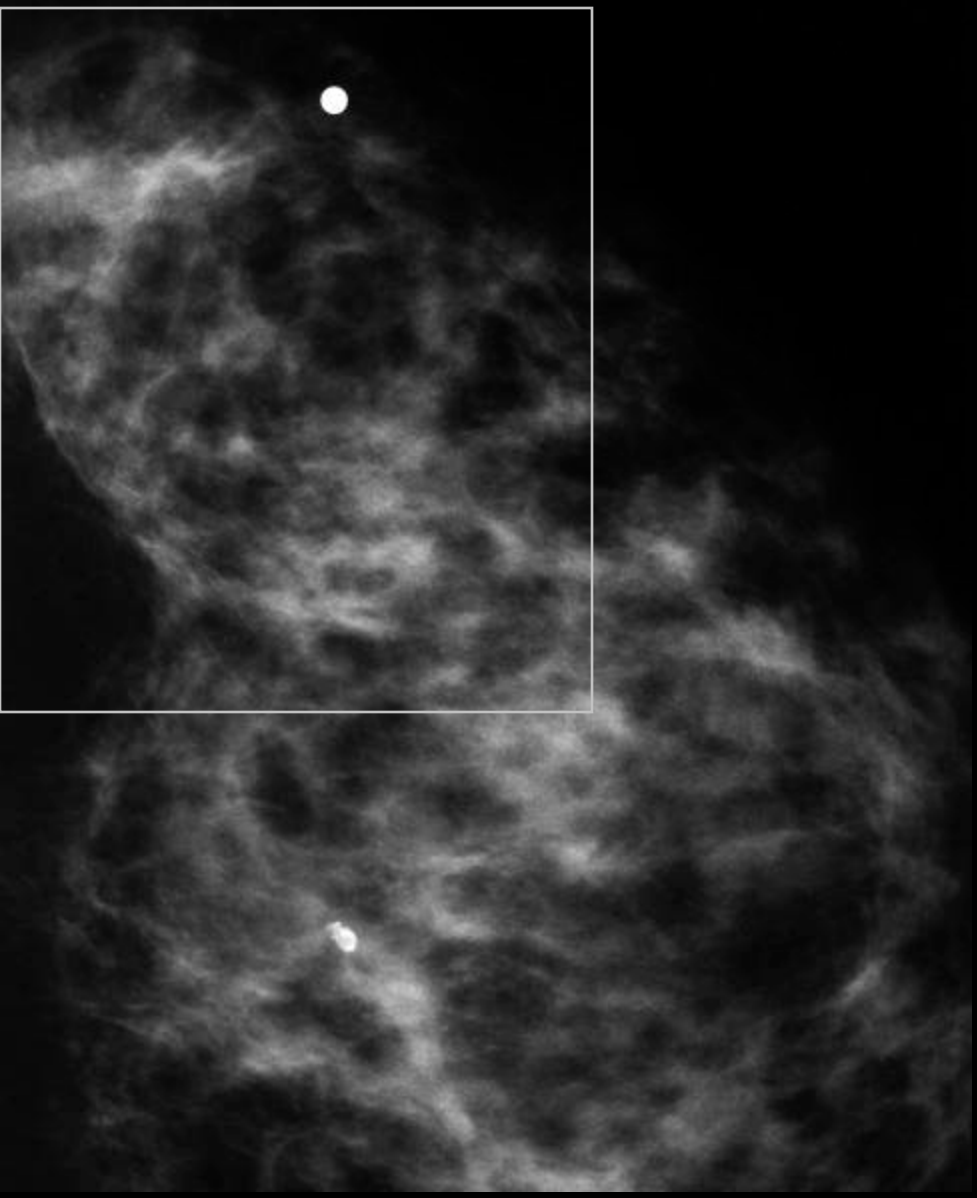
Lt MLO

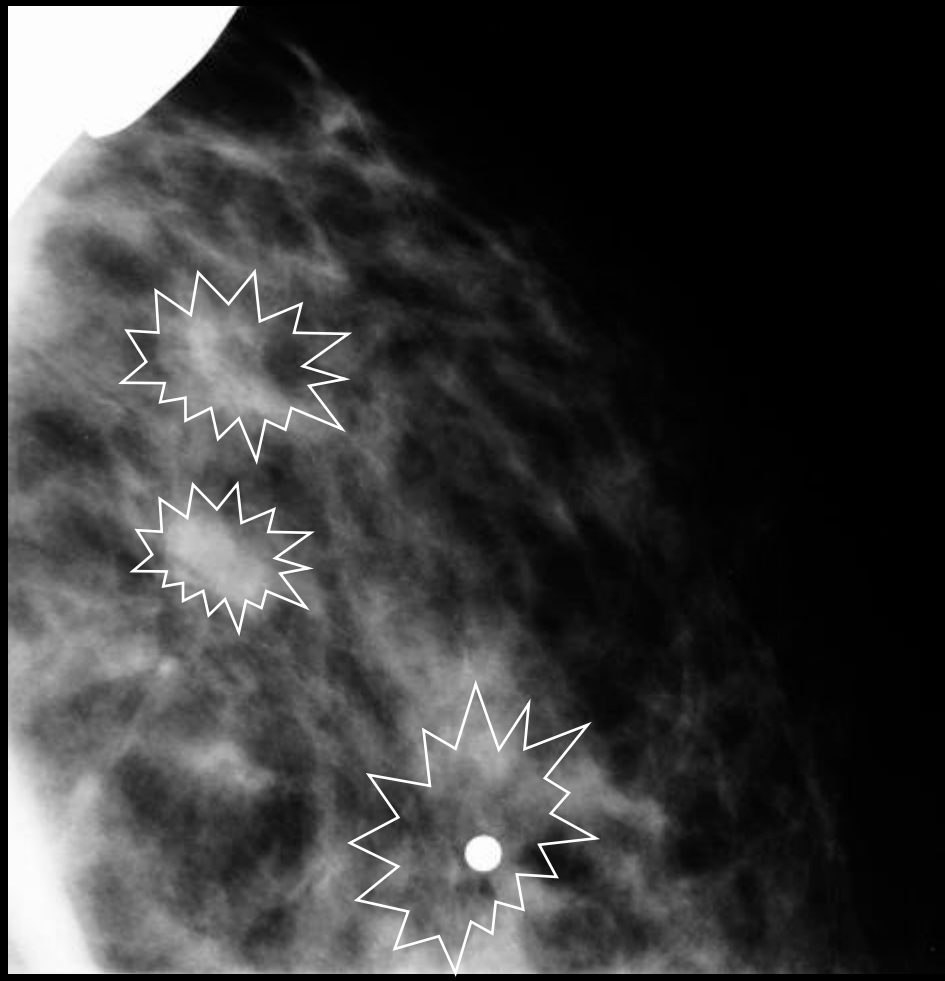


No mammographic sign of malignancy is demonstrable


Lt MLO
No mammographic sign of malignancy is demonstrable

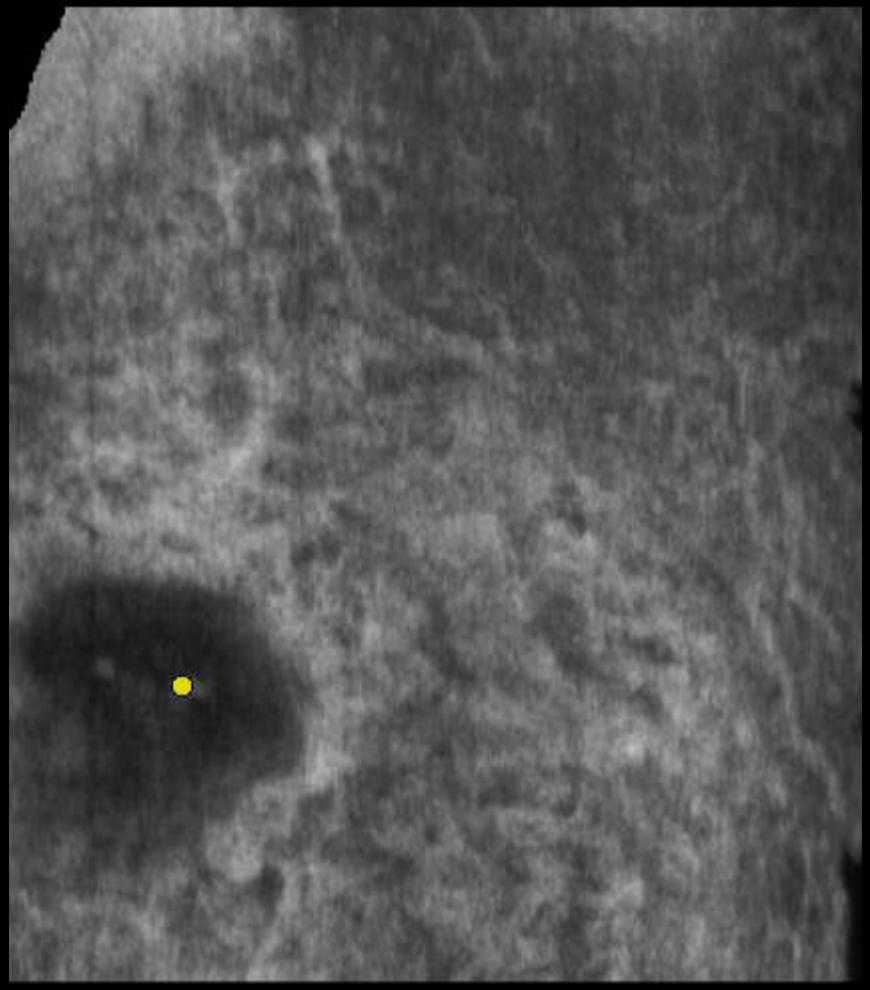
Lt CC



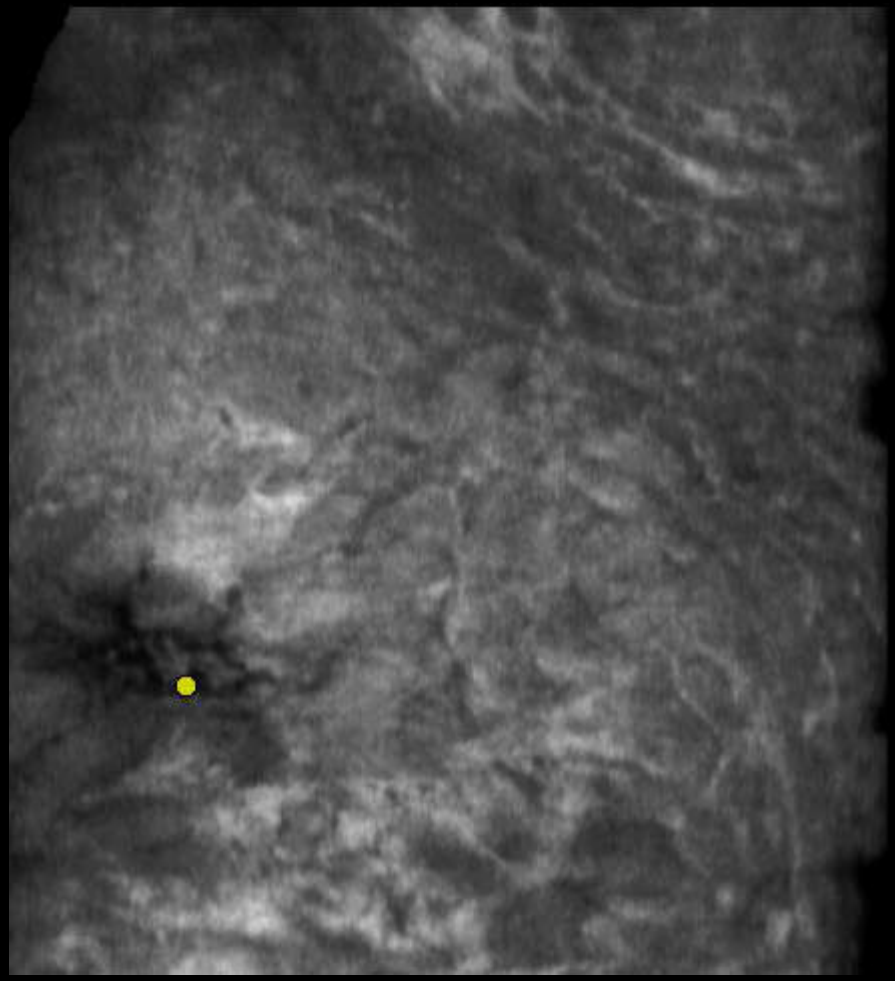


Spot compression *and* microfocus magnification: vague suspicion for malignancy

3D automated, reconstructed coronal images

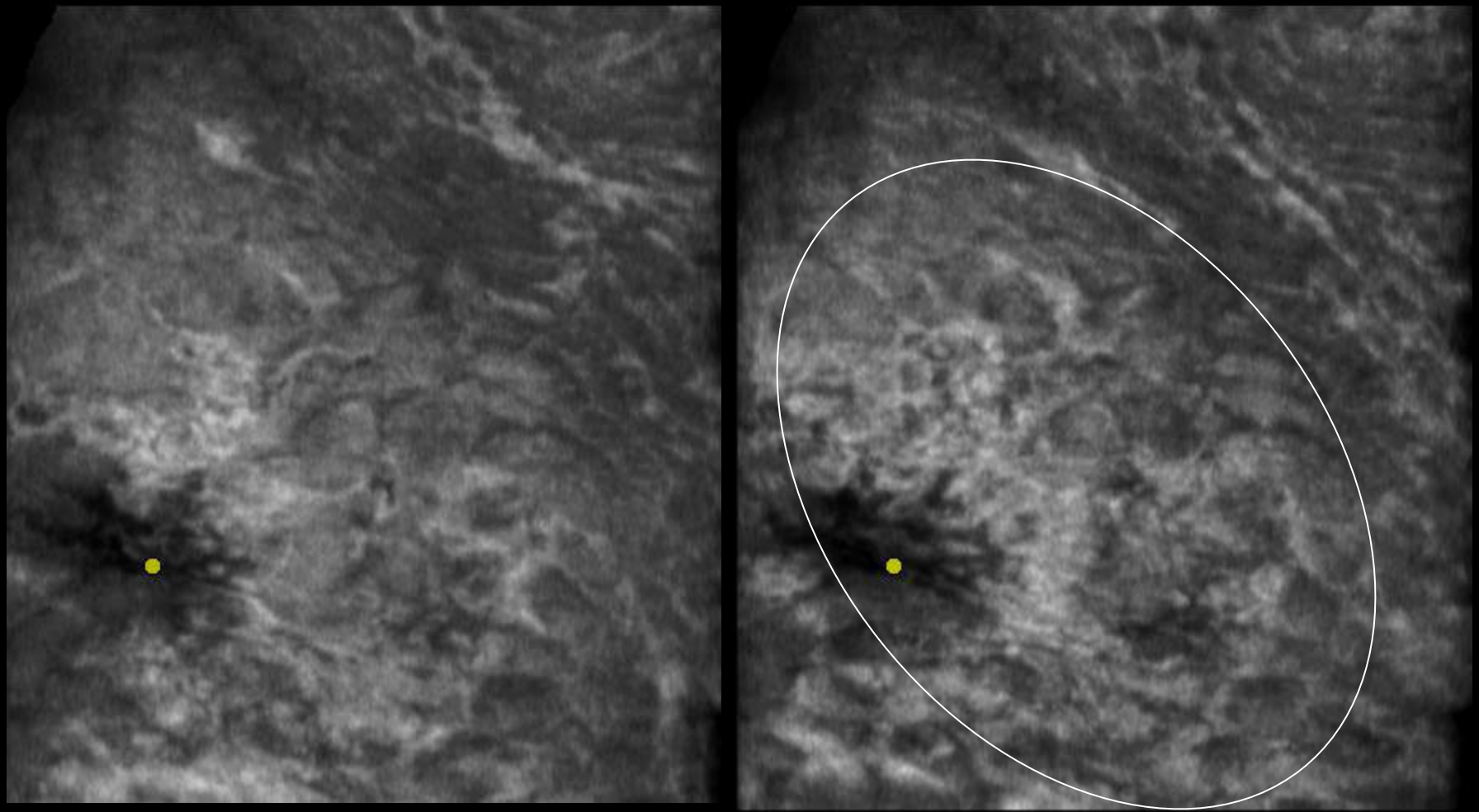


Left breast, skin level



Slice 6 (12 mm deep to the skin)

3D automated, reconstructed coronal images

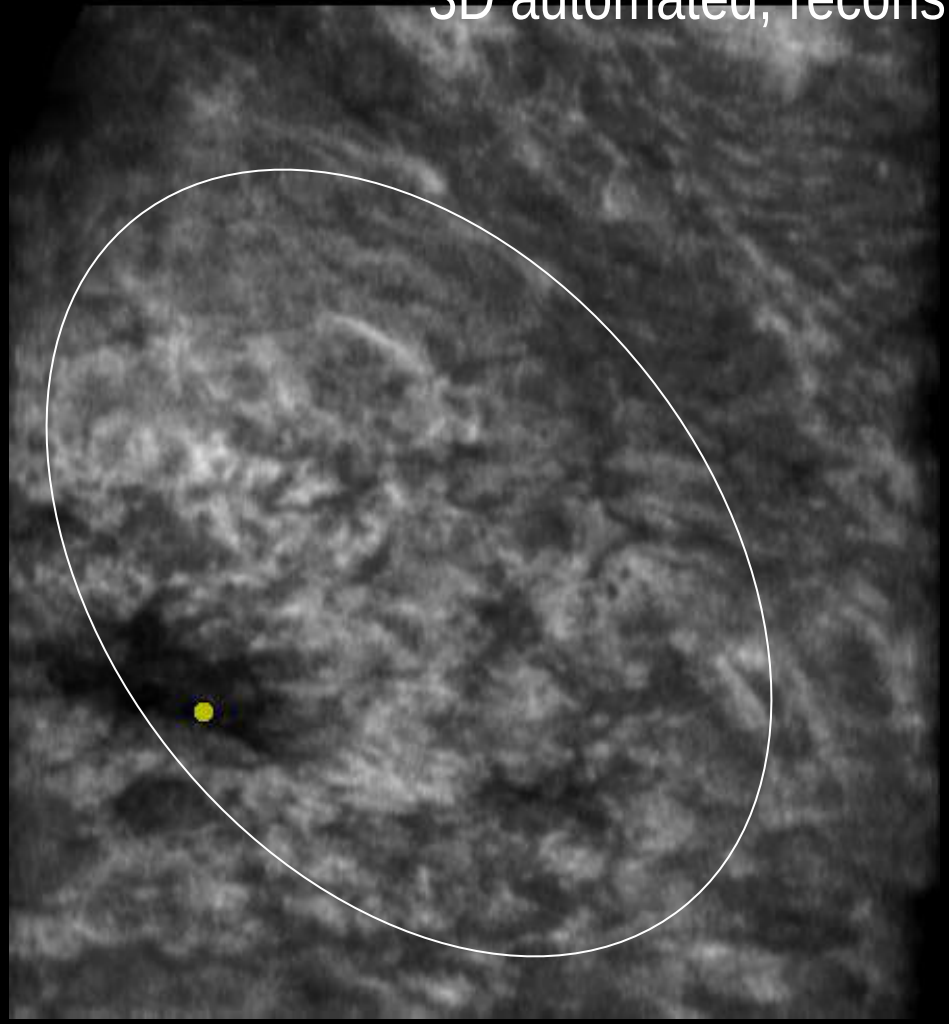


Slice 7

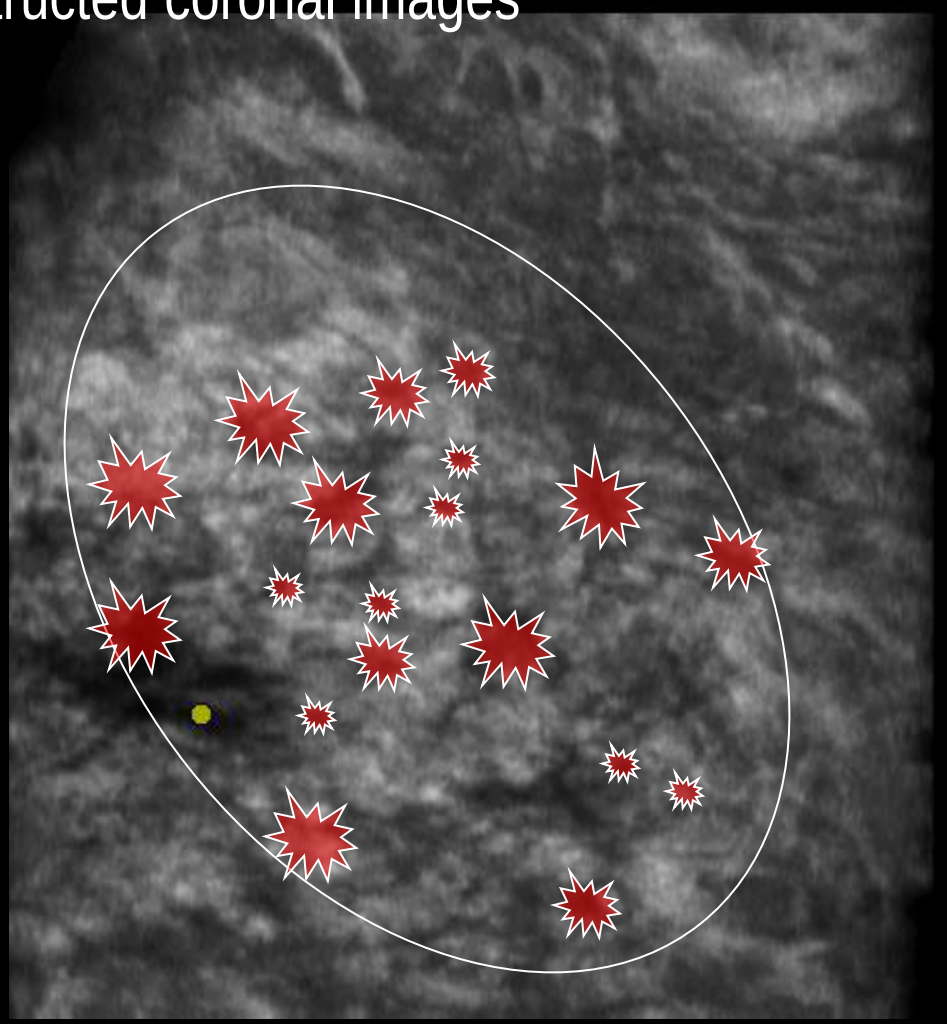
Slice 8

Numerous “black holes” and architectural distortion suggest the presence of multiple cancer foci

3D automated, reconstructed coronal images



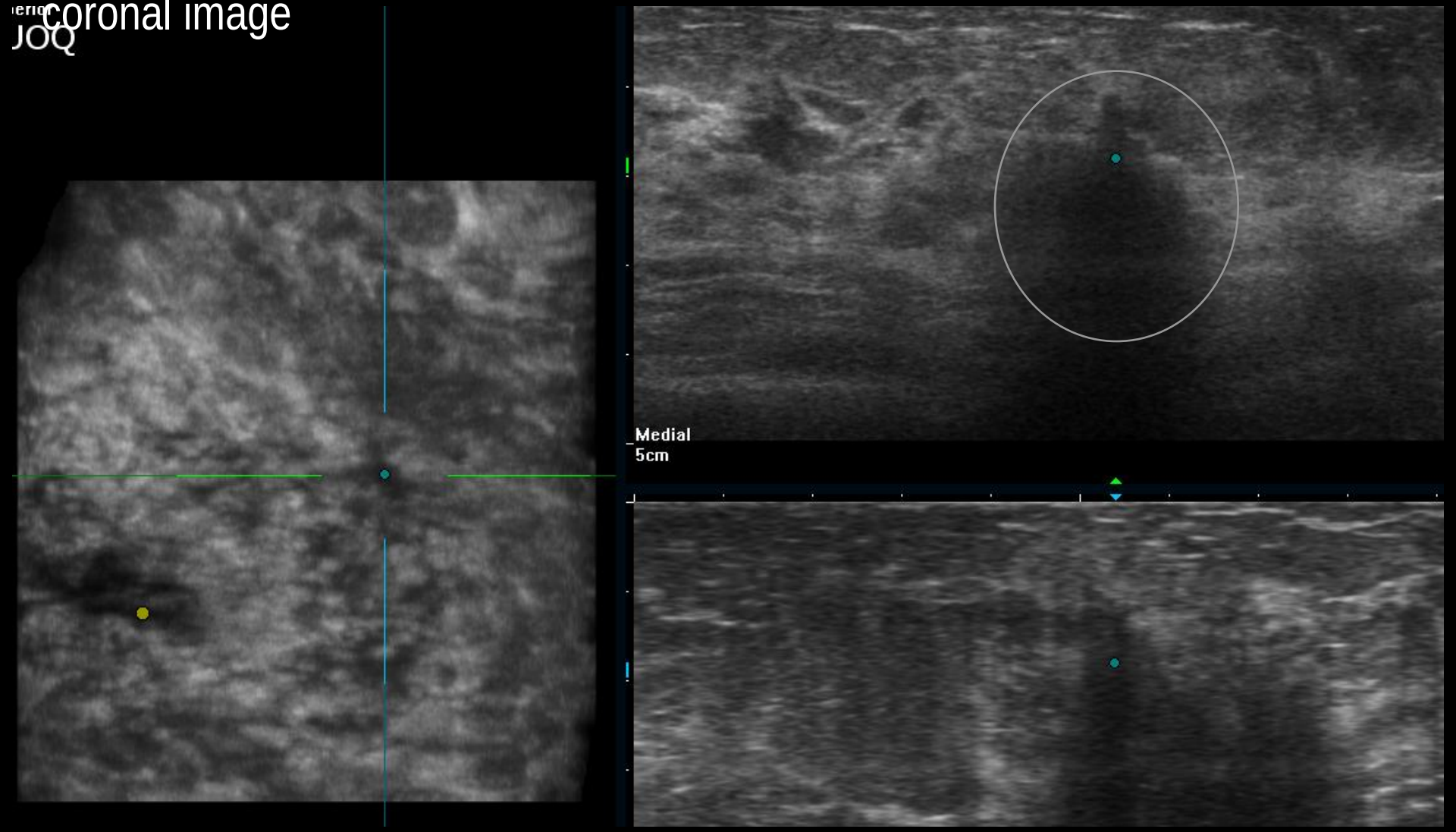
Slice 9



Slice 10

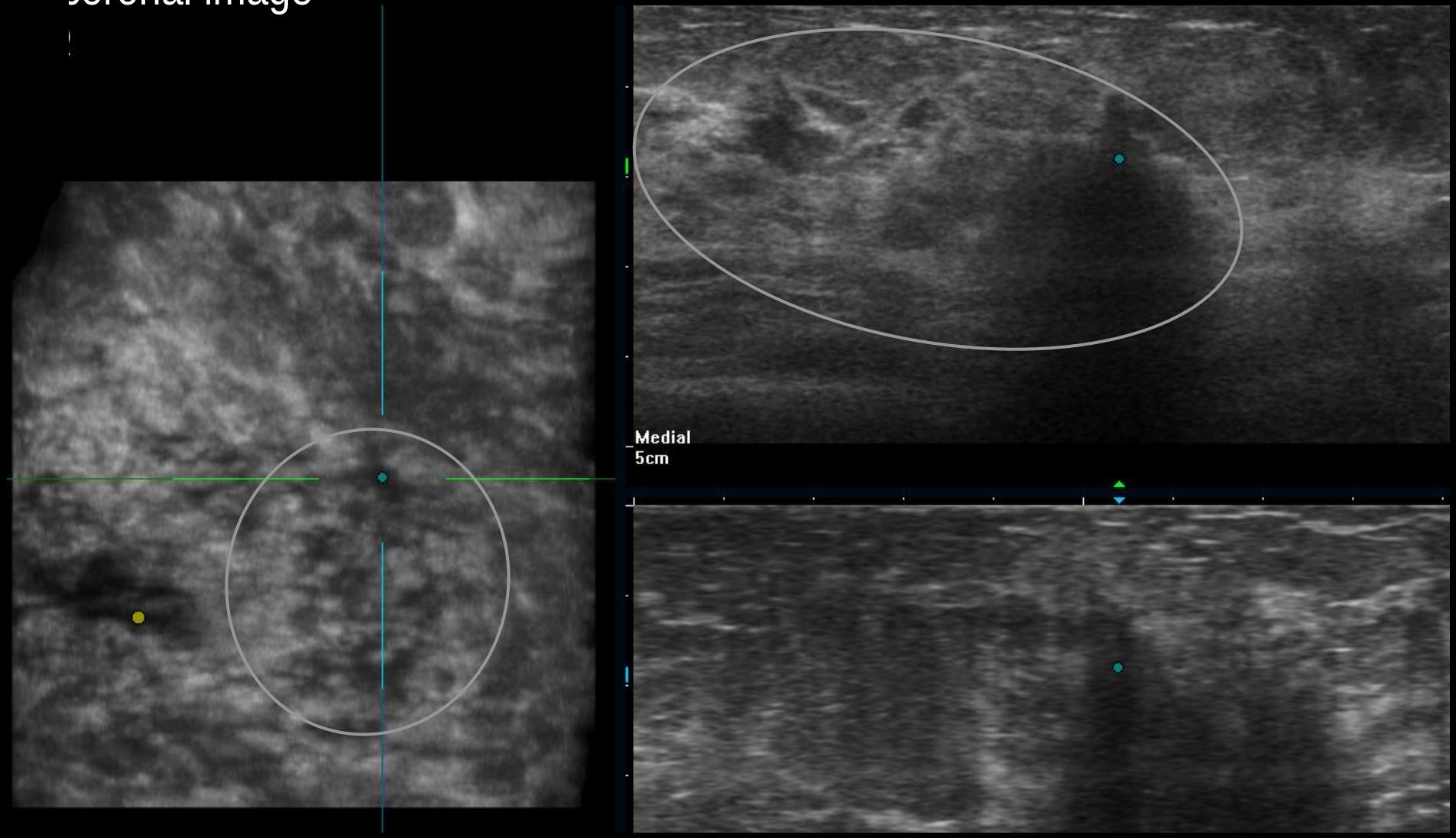
The numerous “black holes” and the architectural distortion are persistent in the consecutive 2 mm coronal reconstructed slices

3D automated, reconstructed coronal image

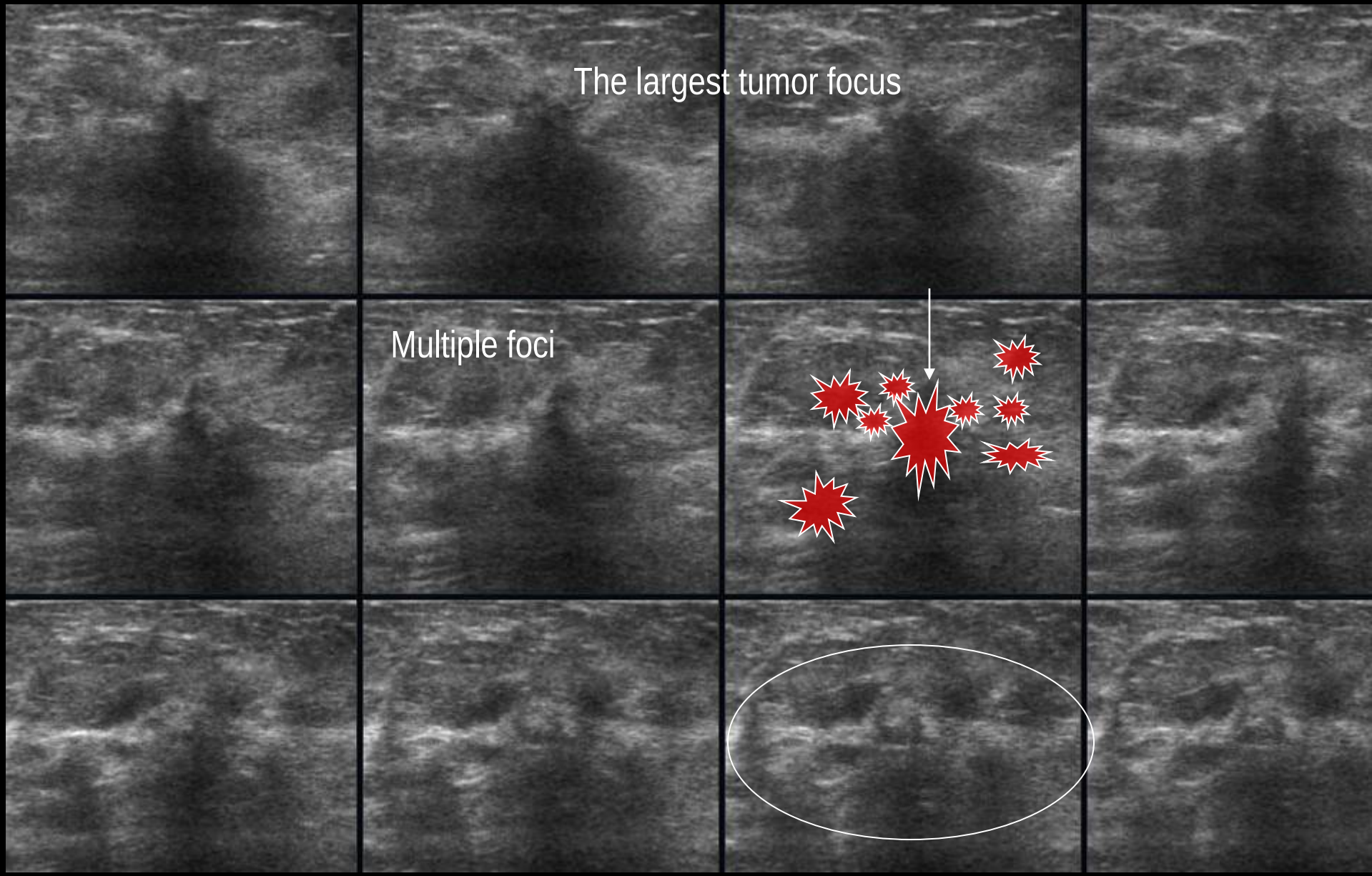


Confirmation of the finding: the “black hole” represents one of the malignant foci

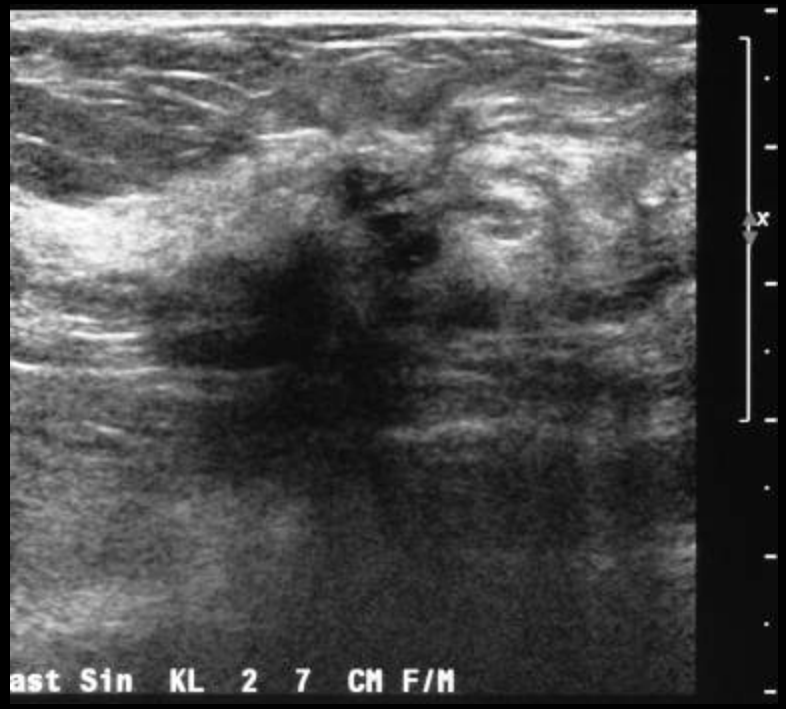
3D automated, reconstructed coronal image



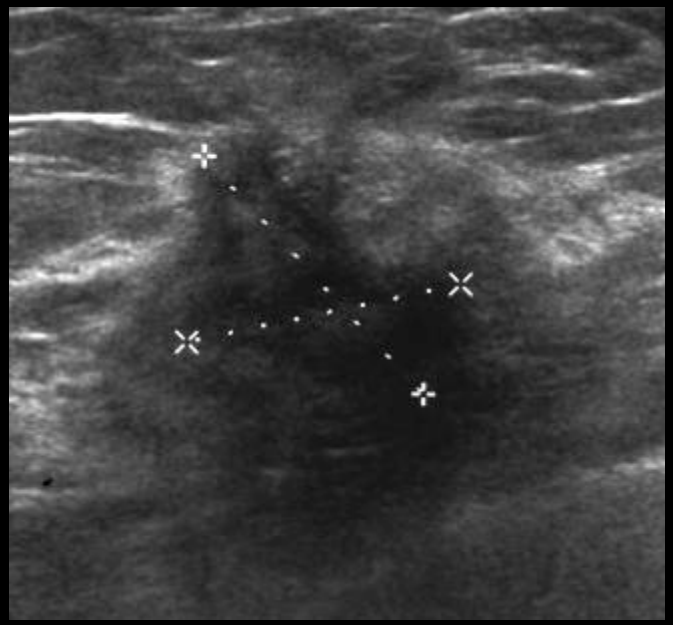
Demonstration of an additional malignant focus

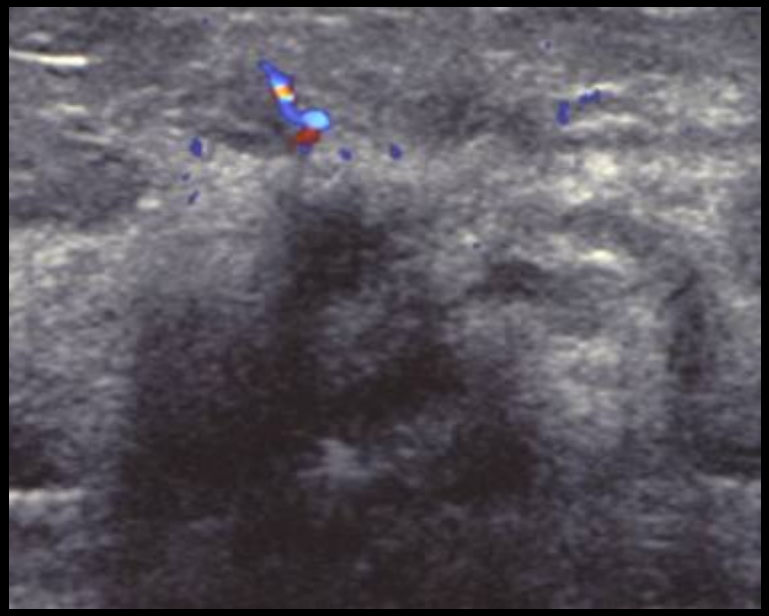


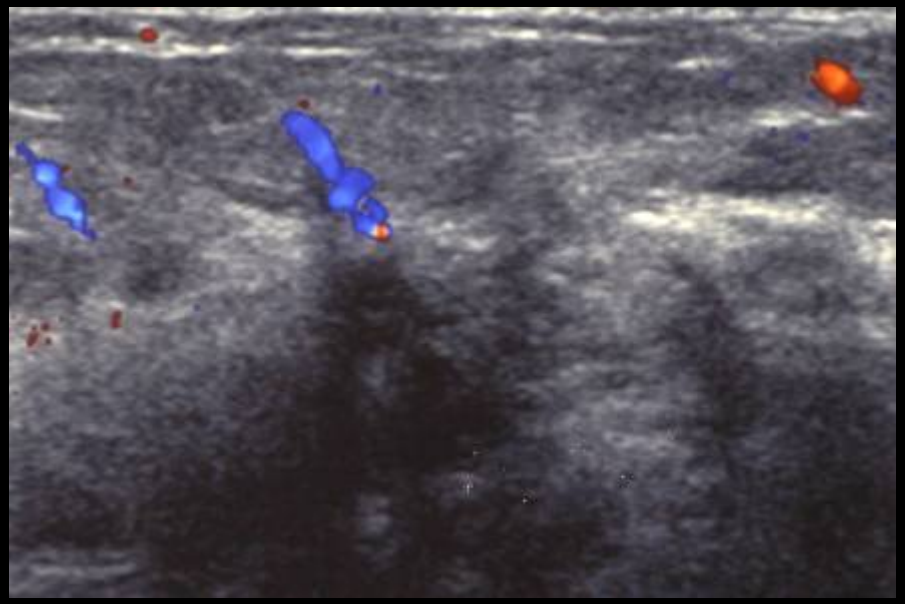
Multislice demonstrates the multiple foci

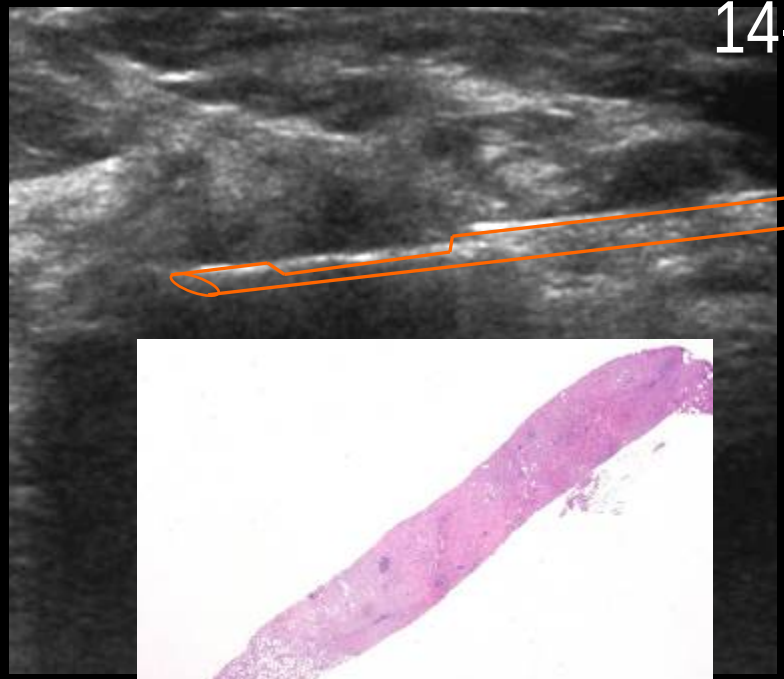


Hand held ultrasound: malignant breast tumor



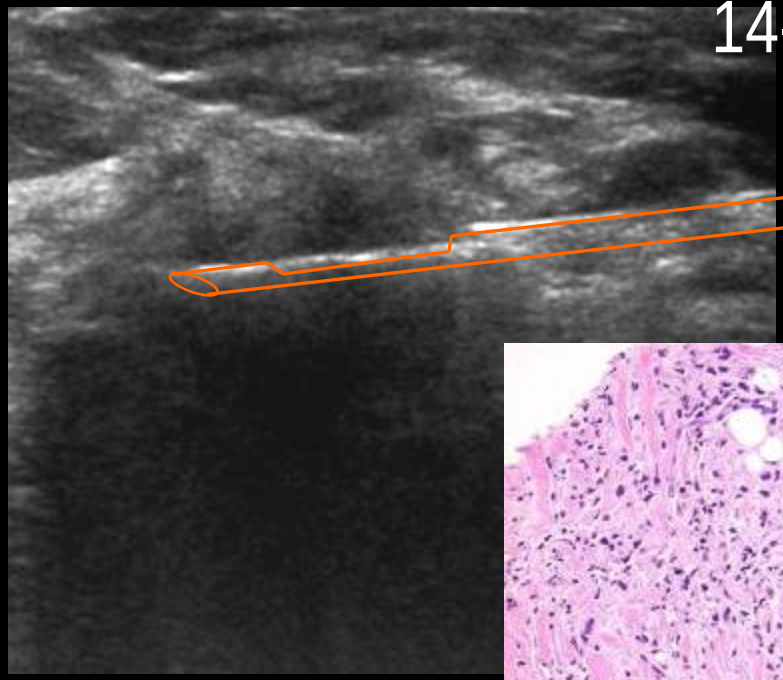


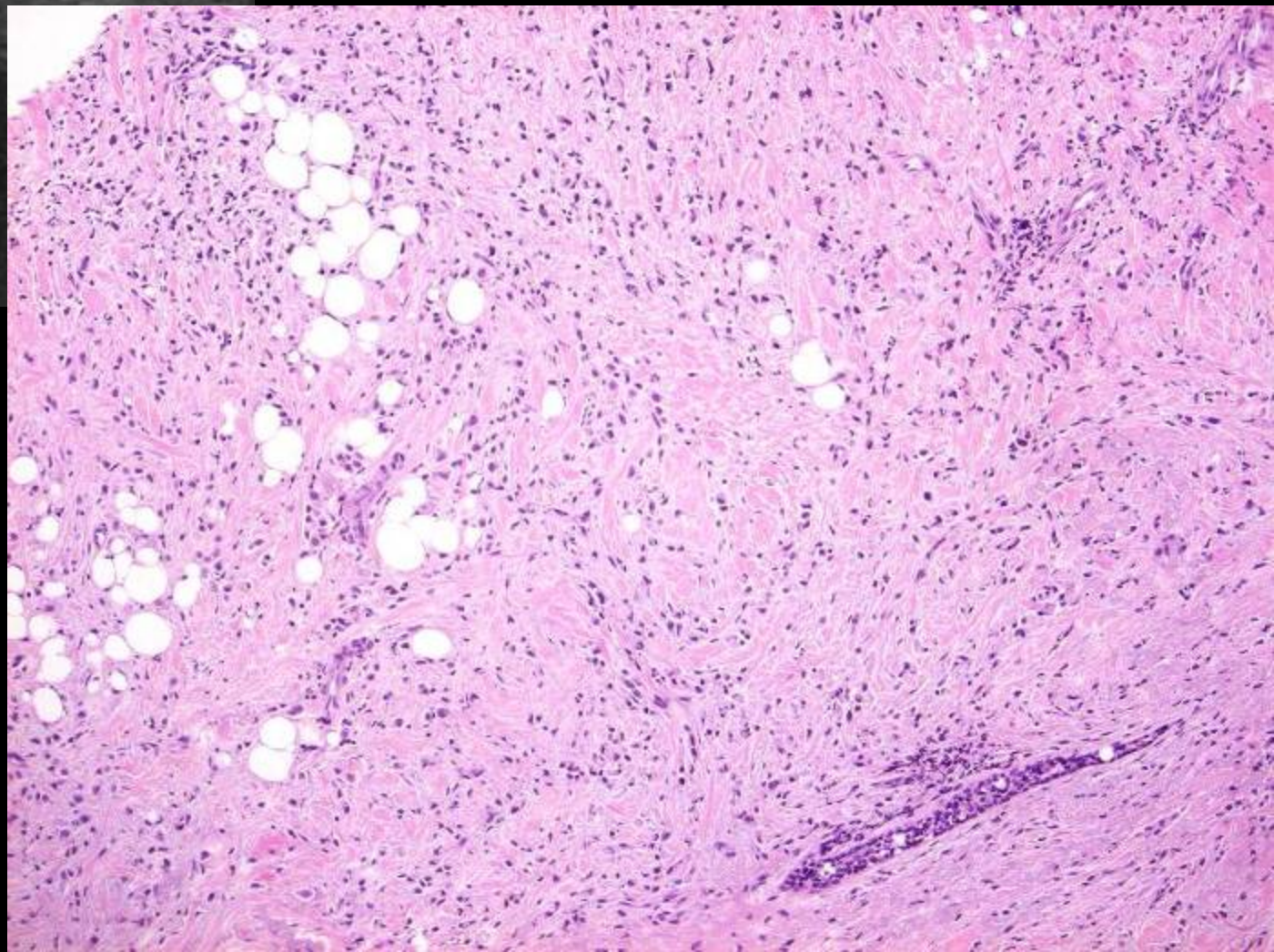




14-gauge core biopsy:

14-gauge core biopsy:

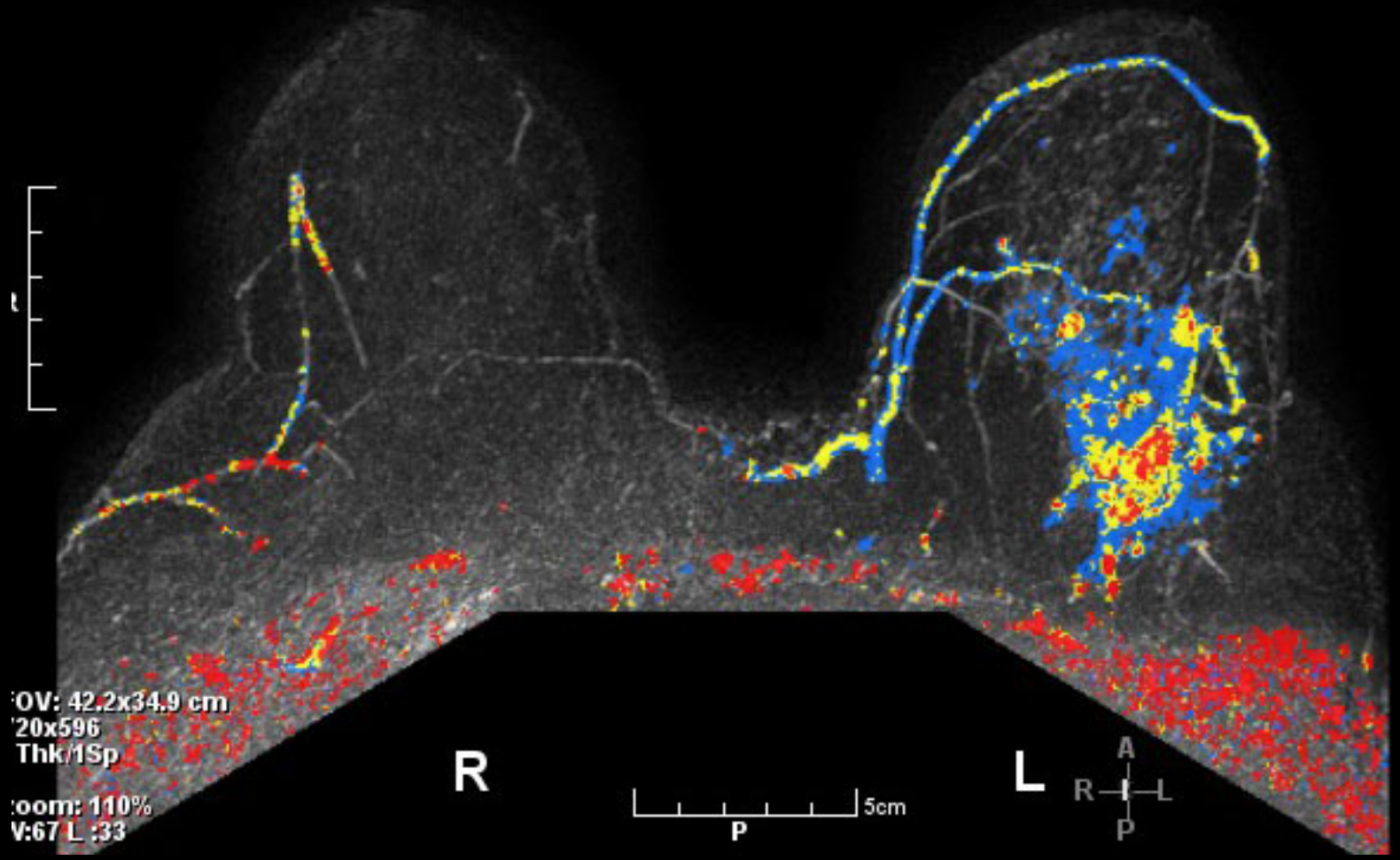




Histology: invasive lobular carcinoma

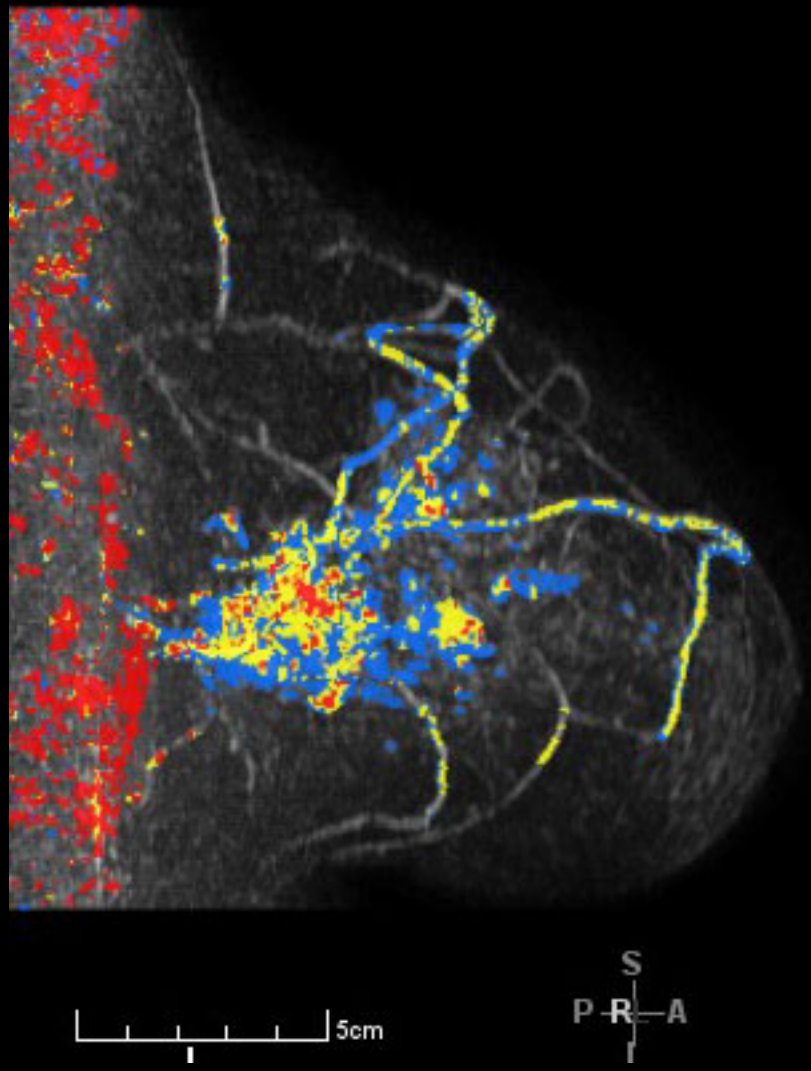
Breast MRI diagnosis

- Lt breast with multifocal malignancy. Extent of disease: 90X60X45 mm.
- Pathologic axillary lymph nodes. Findings suspicious for metastases in the skeleton

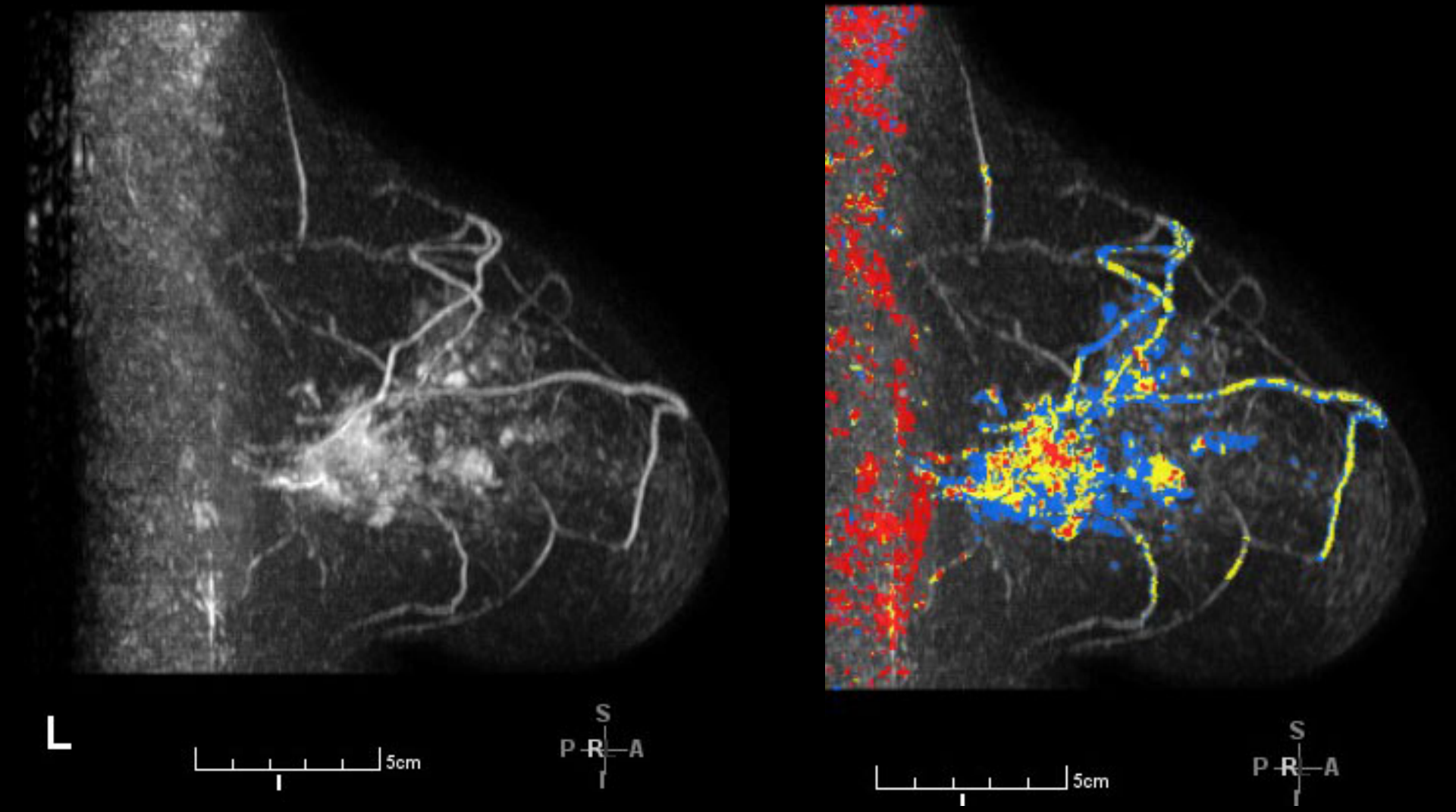


Mammography - MRI correlation

Lt MLO

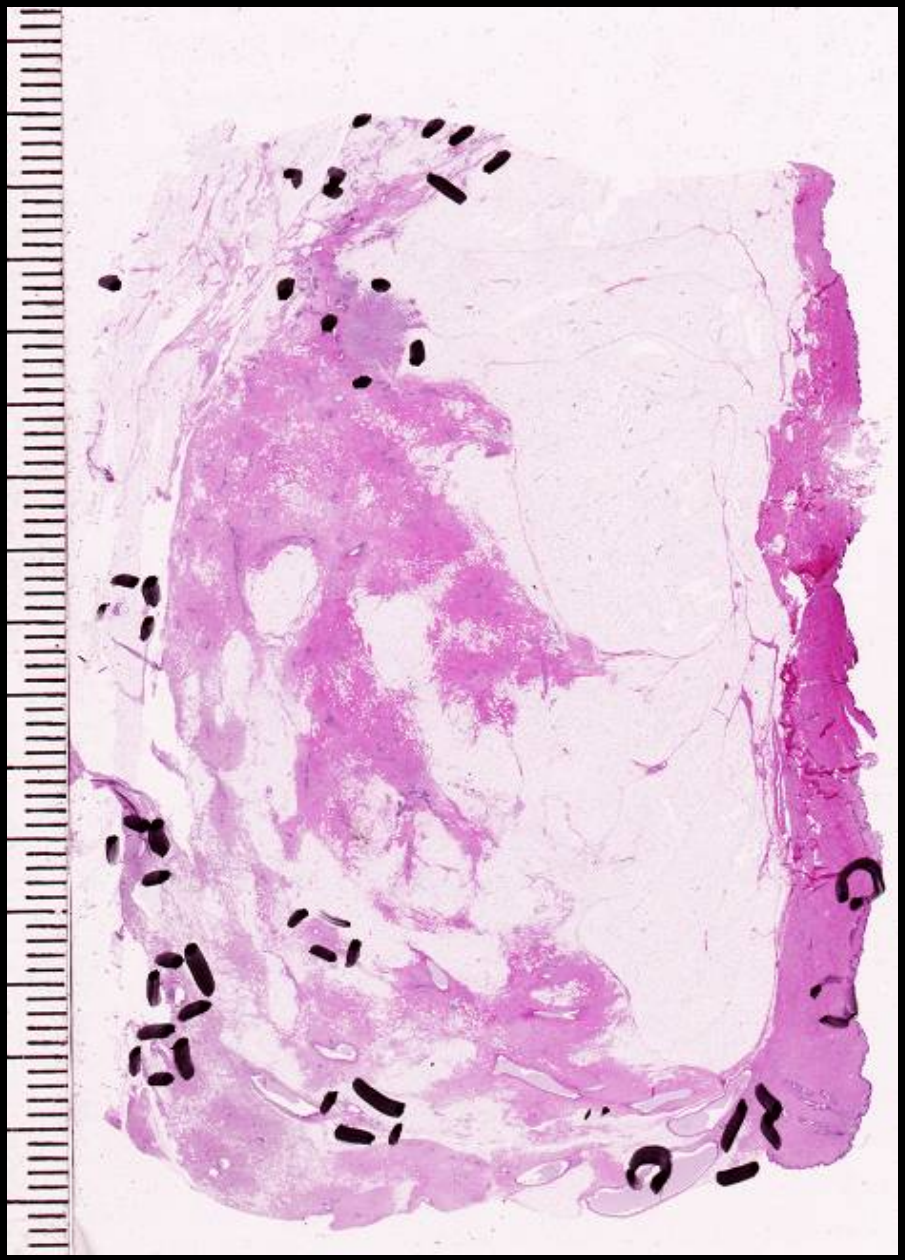


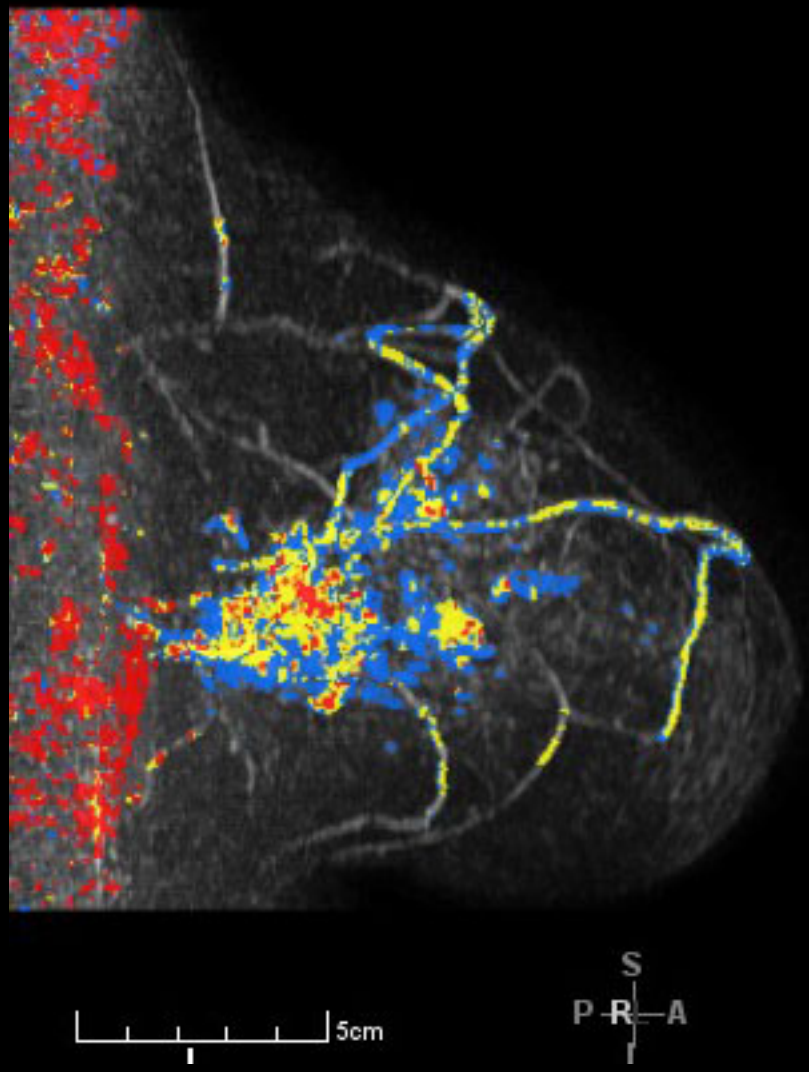
Left breast sagittal view



Left breast sagittal view

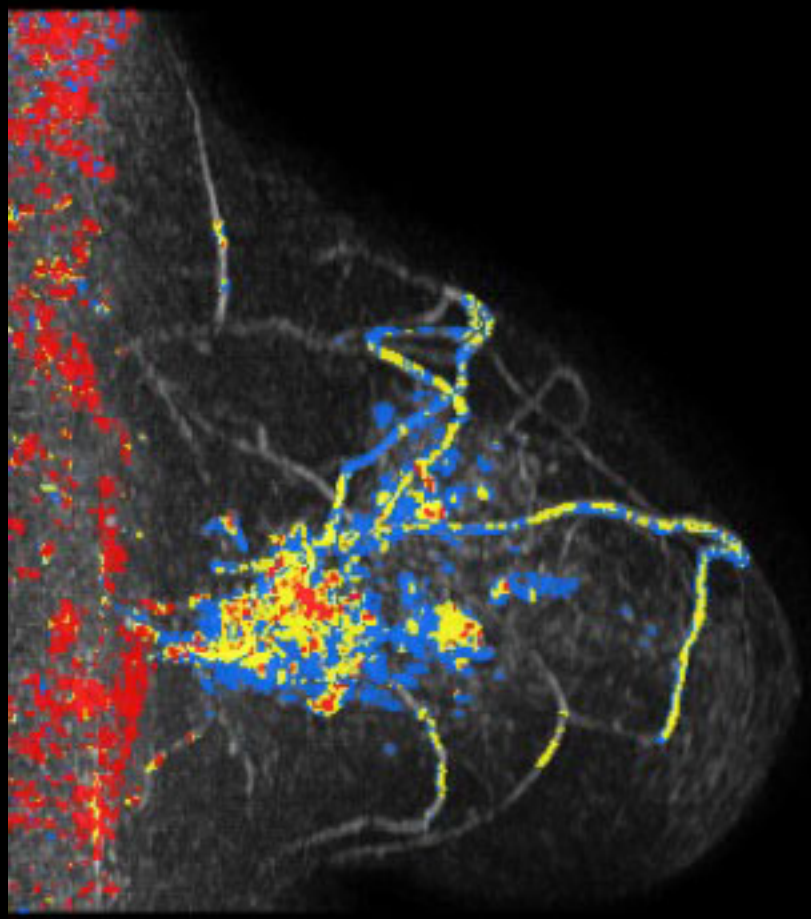
Large thin section - MRI correlation

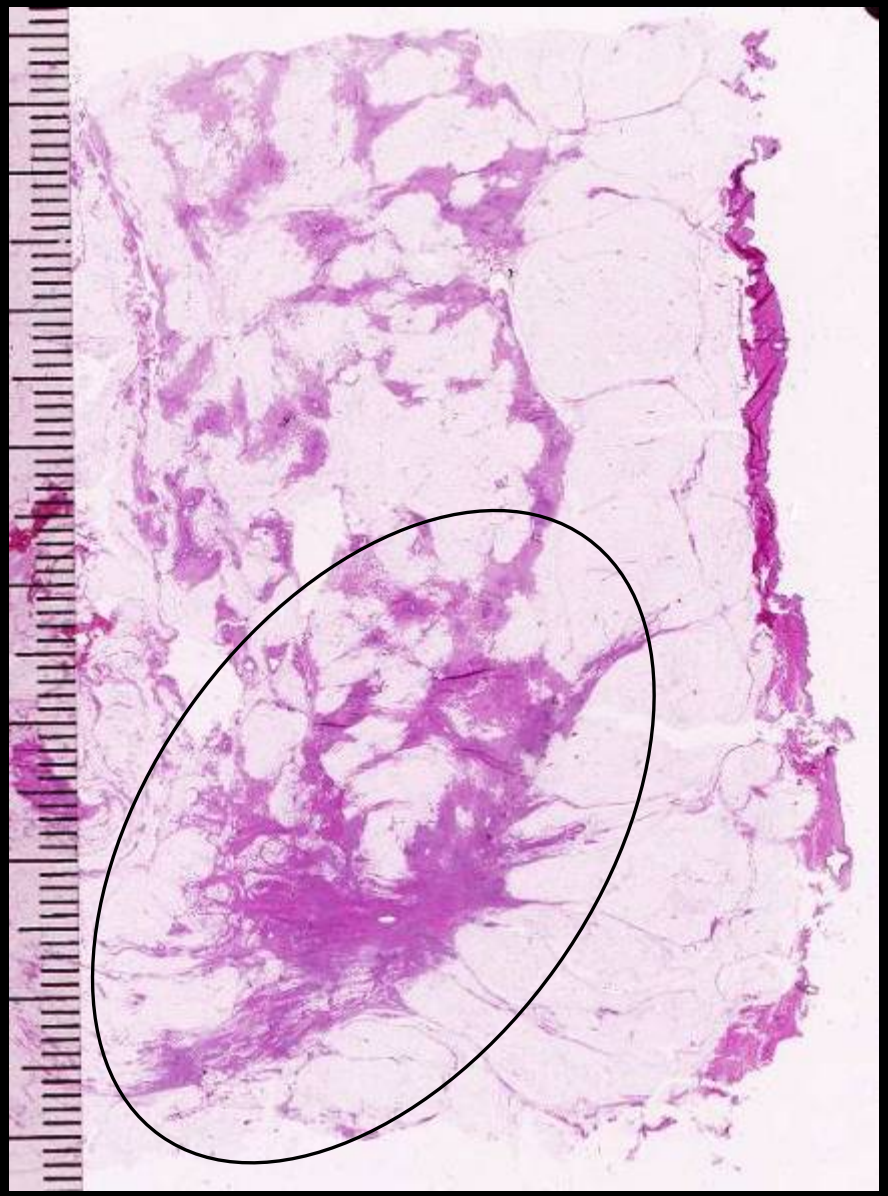




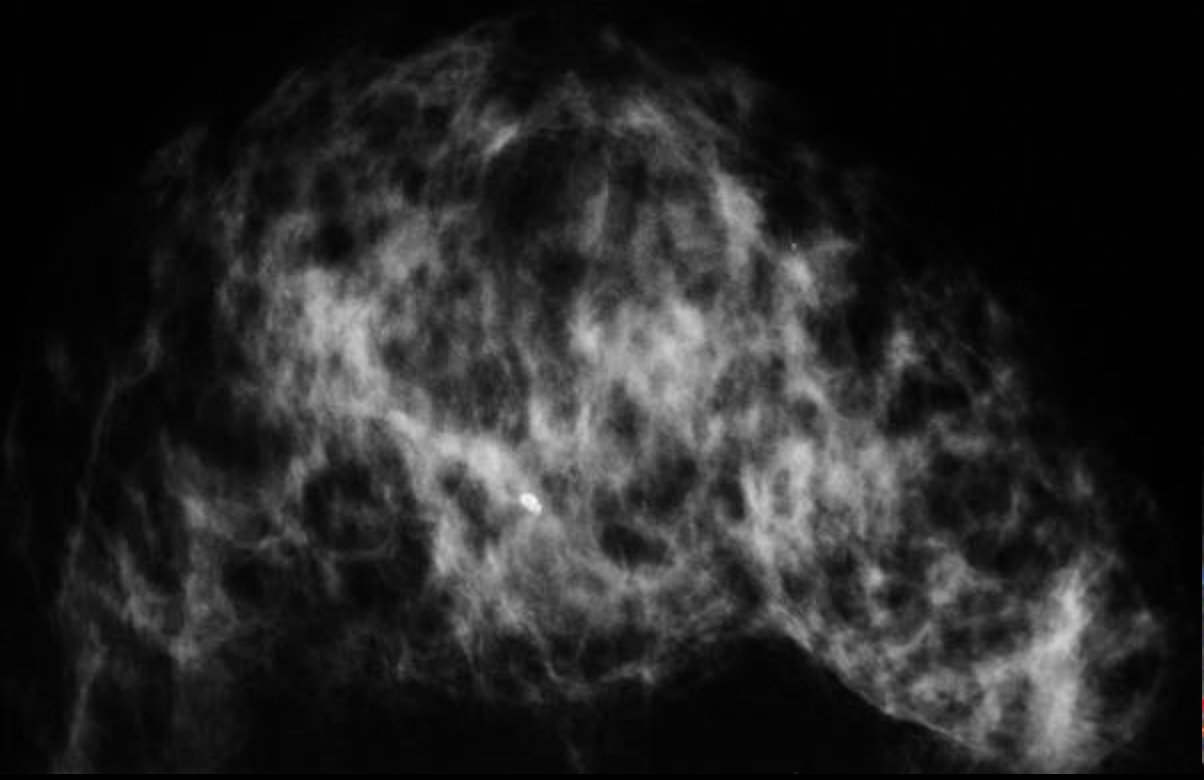
Numerous cancer foci, also within the skin

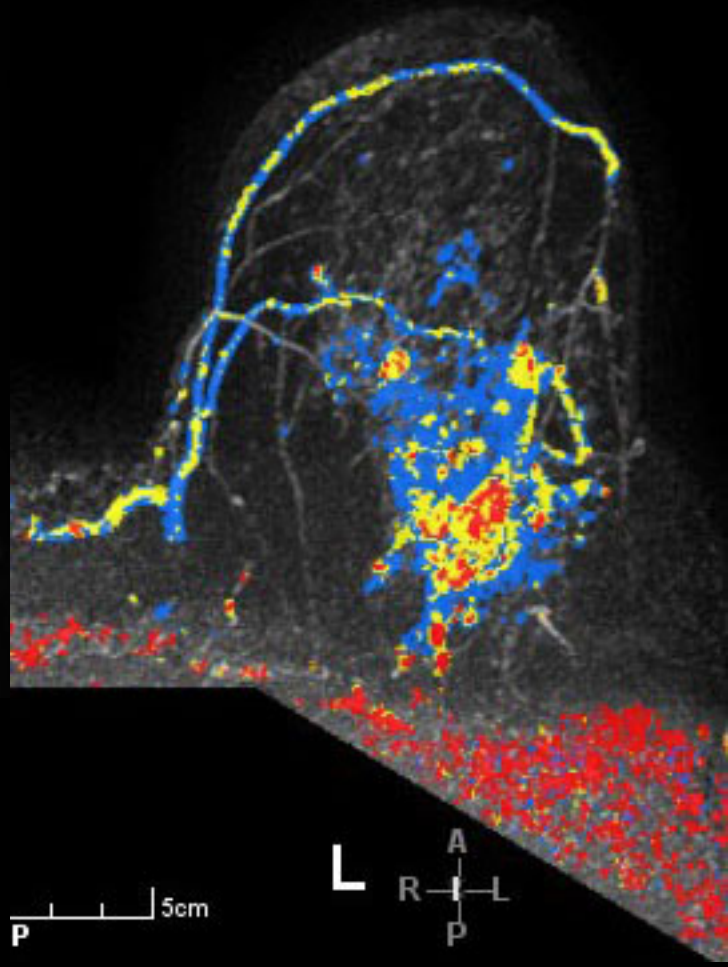
Breast MRI - large thin section histology correlation

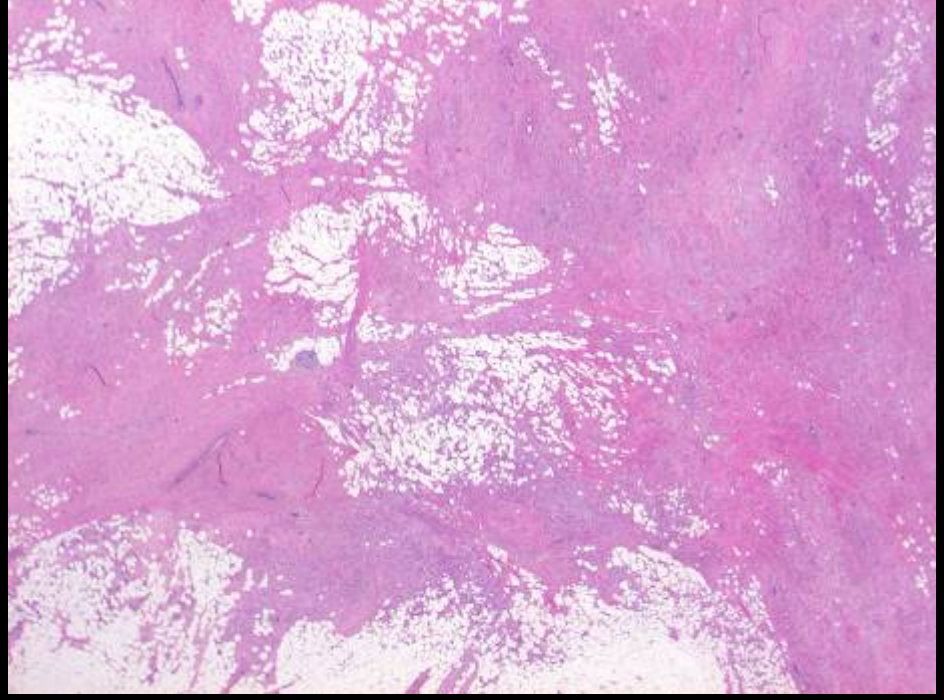


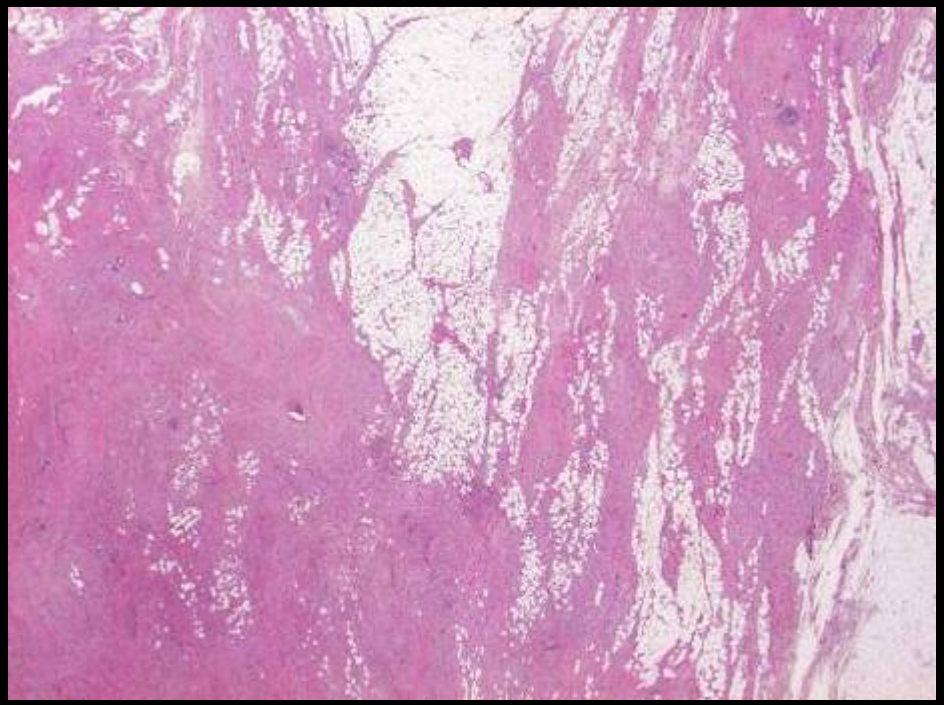


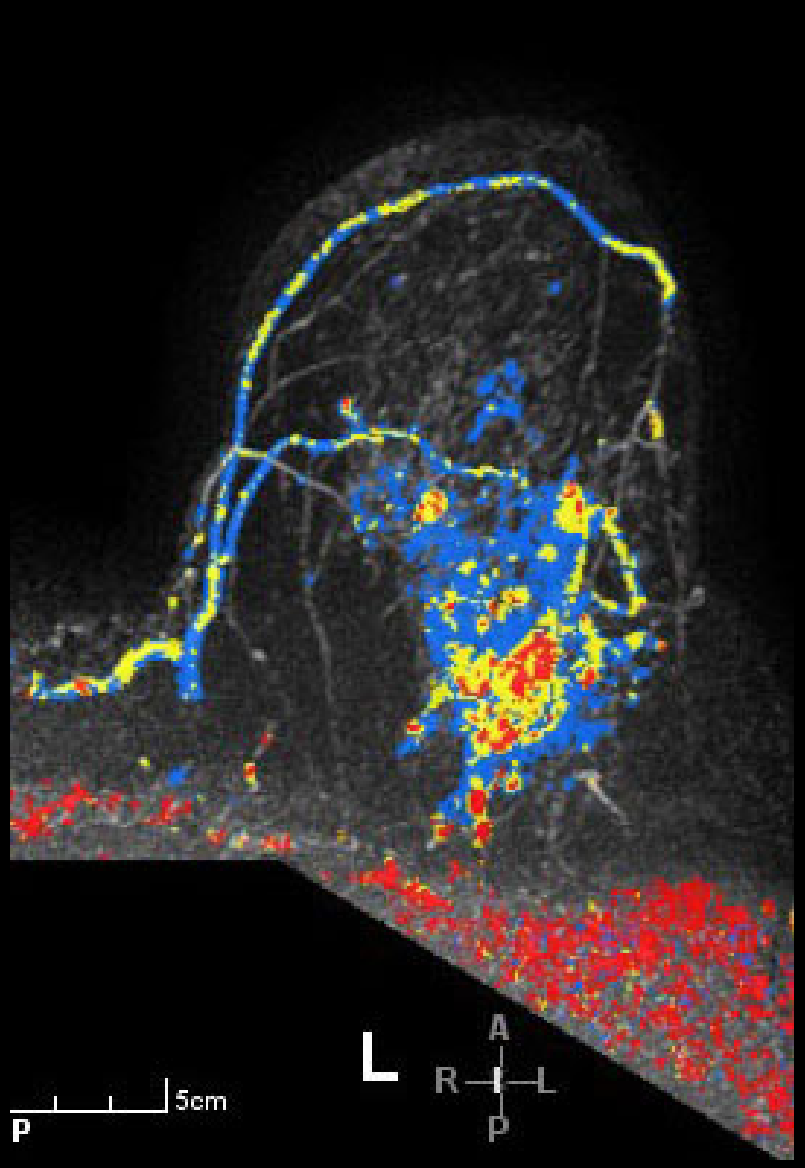
Mammography (CC projection) – breast MRI correlation





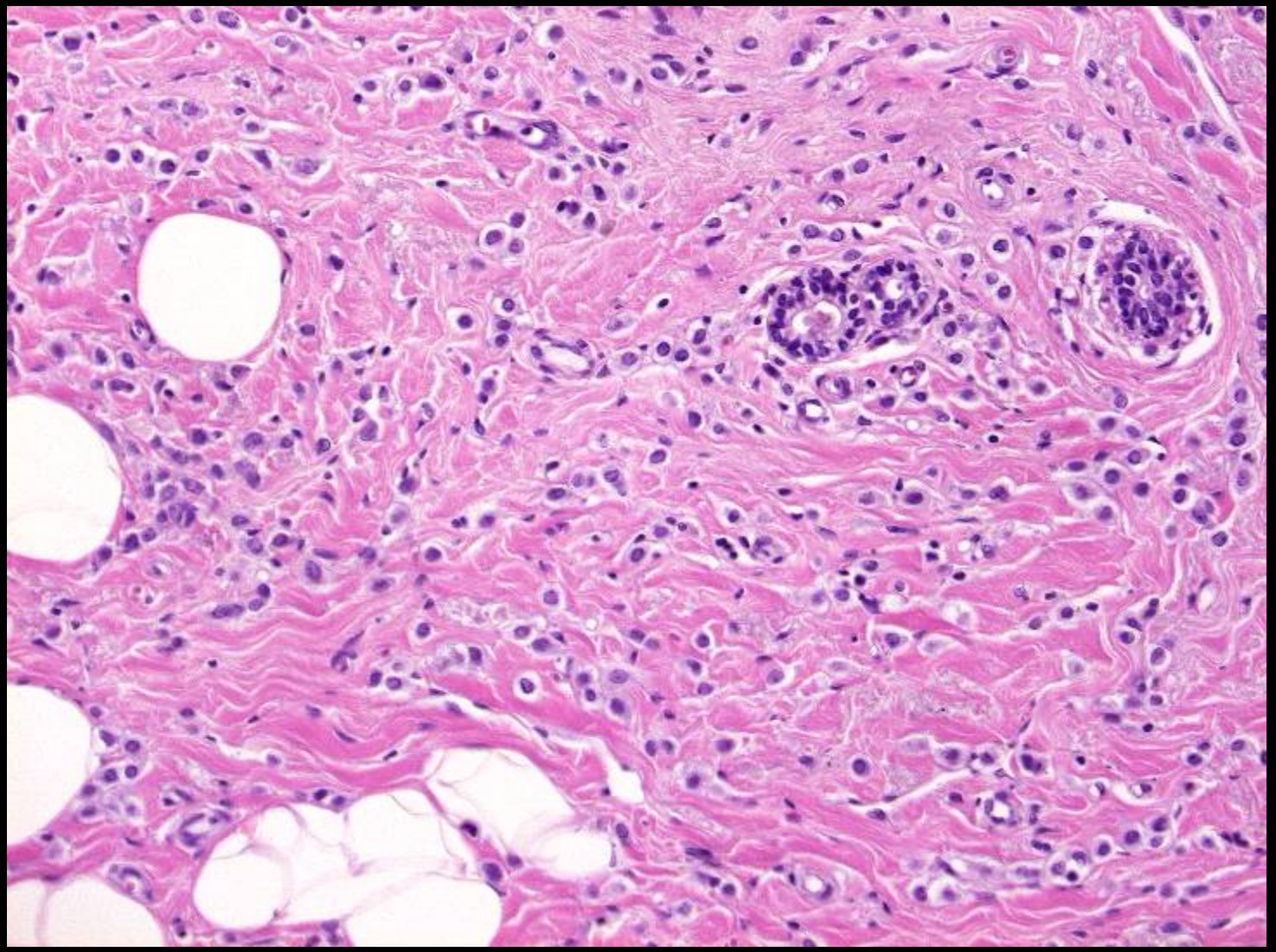




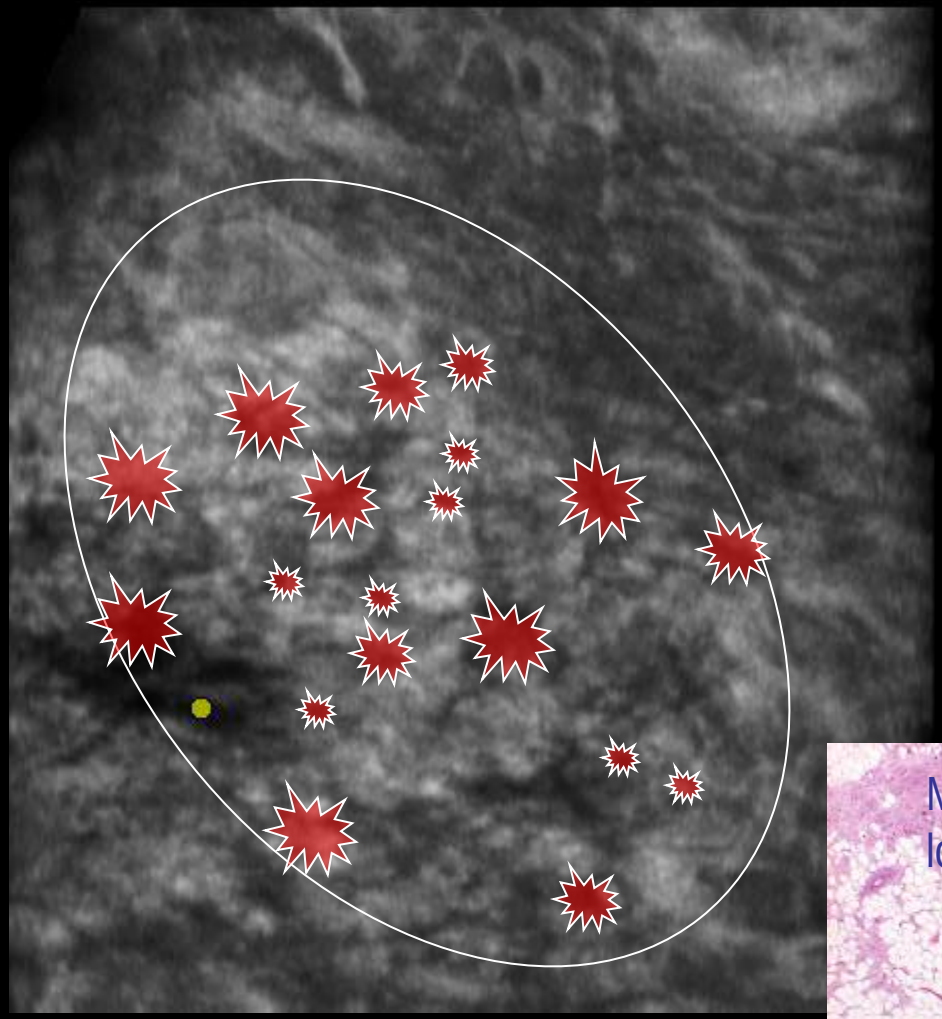


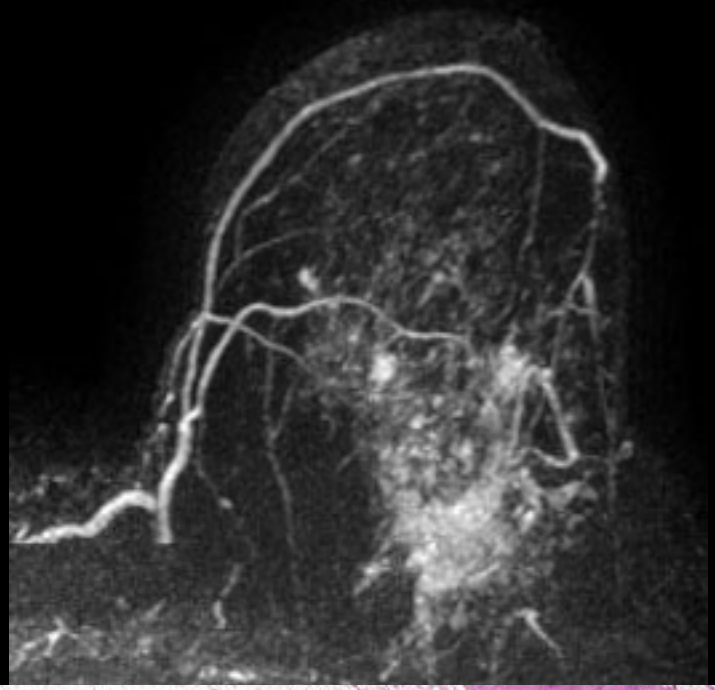
Numerous invasive lobular carcinoma foci. Histology – breast MRI correlation

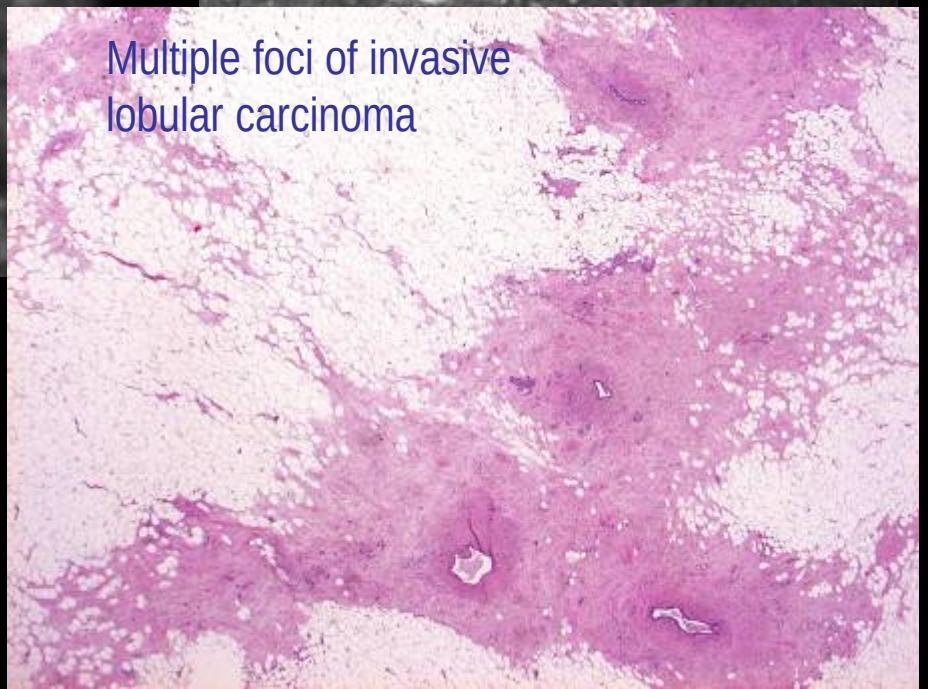
Histology:



Invasive lobular carcinoma, intermediate power image

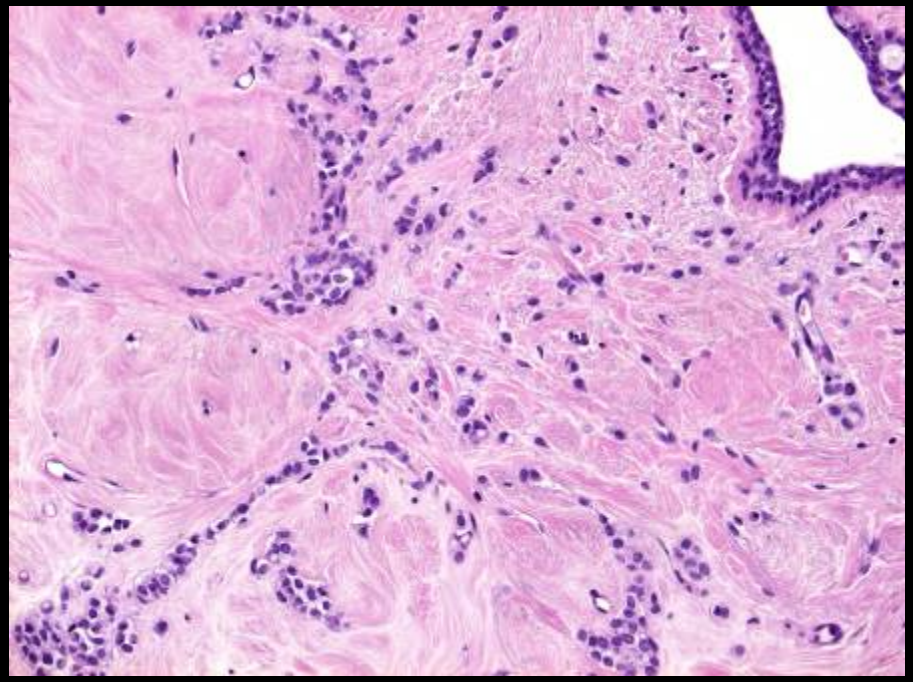


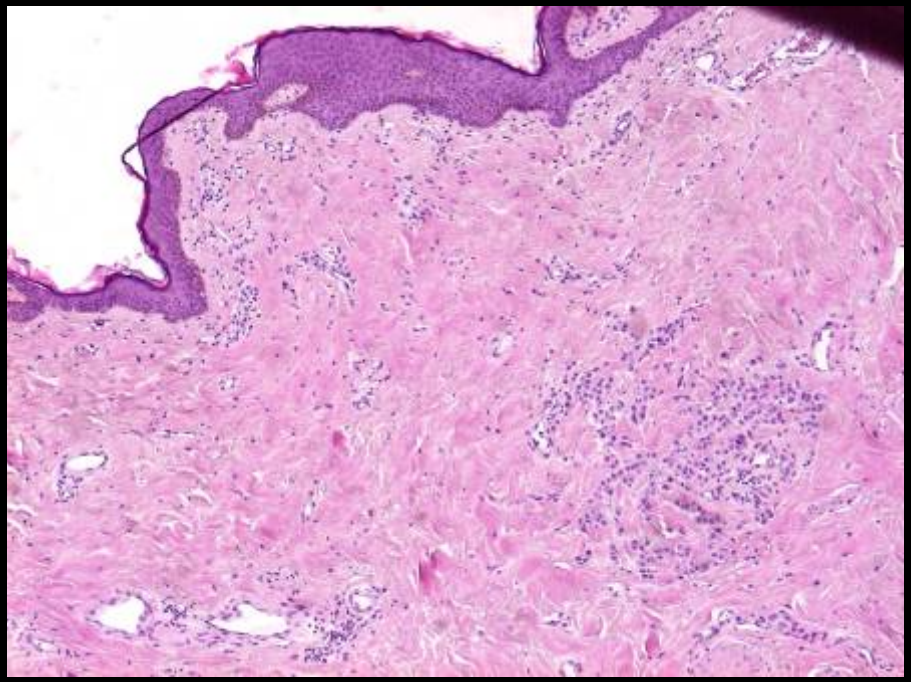


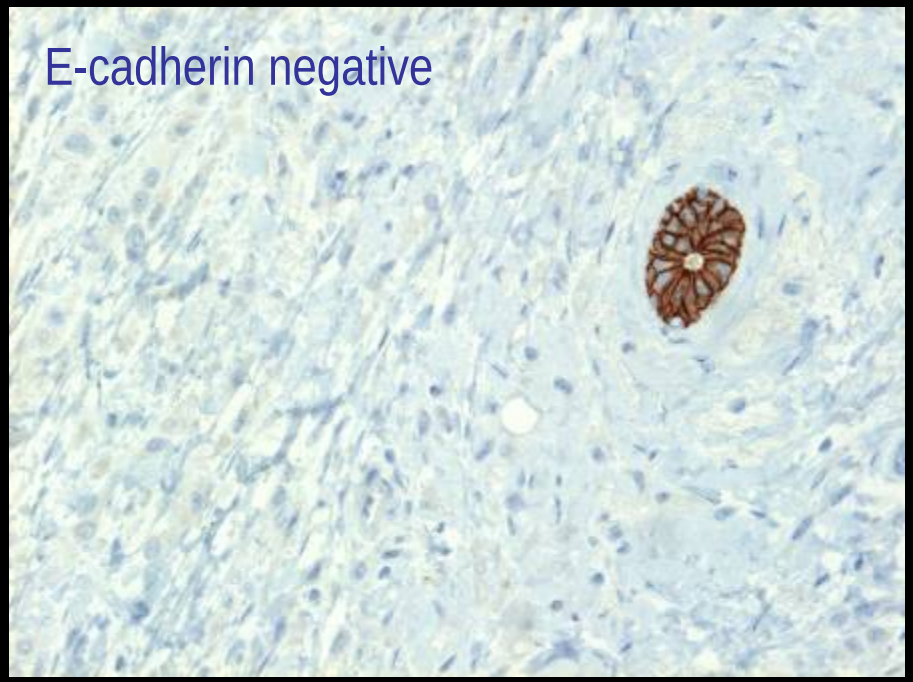


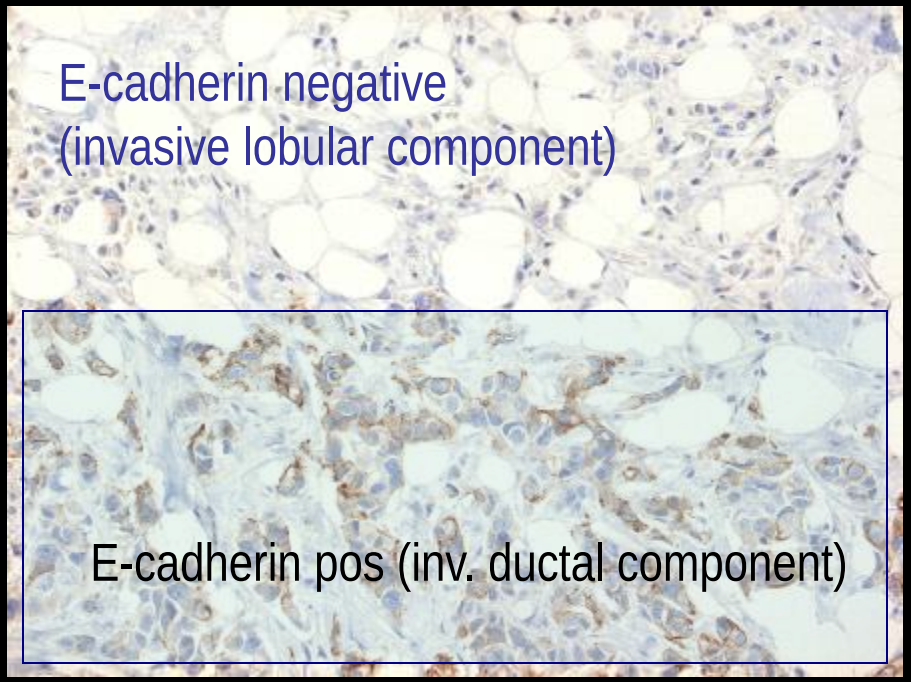
Slice 10

3D coronal ultrasound /MRI /large section histology correlation



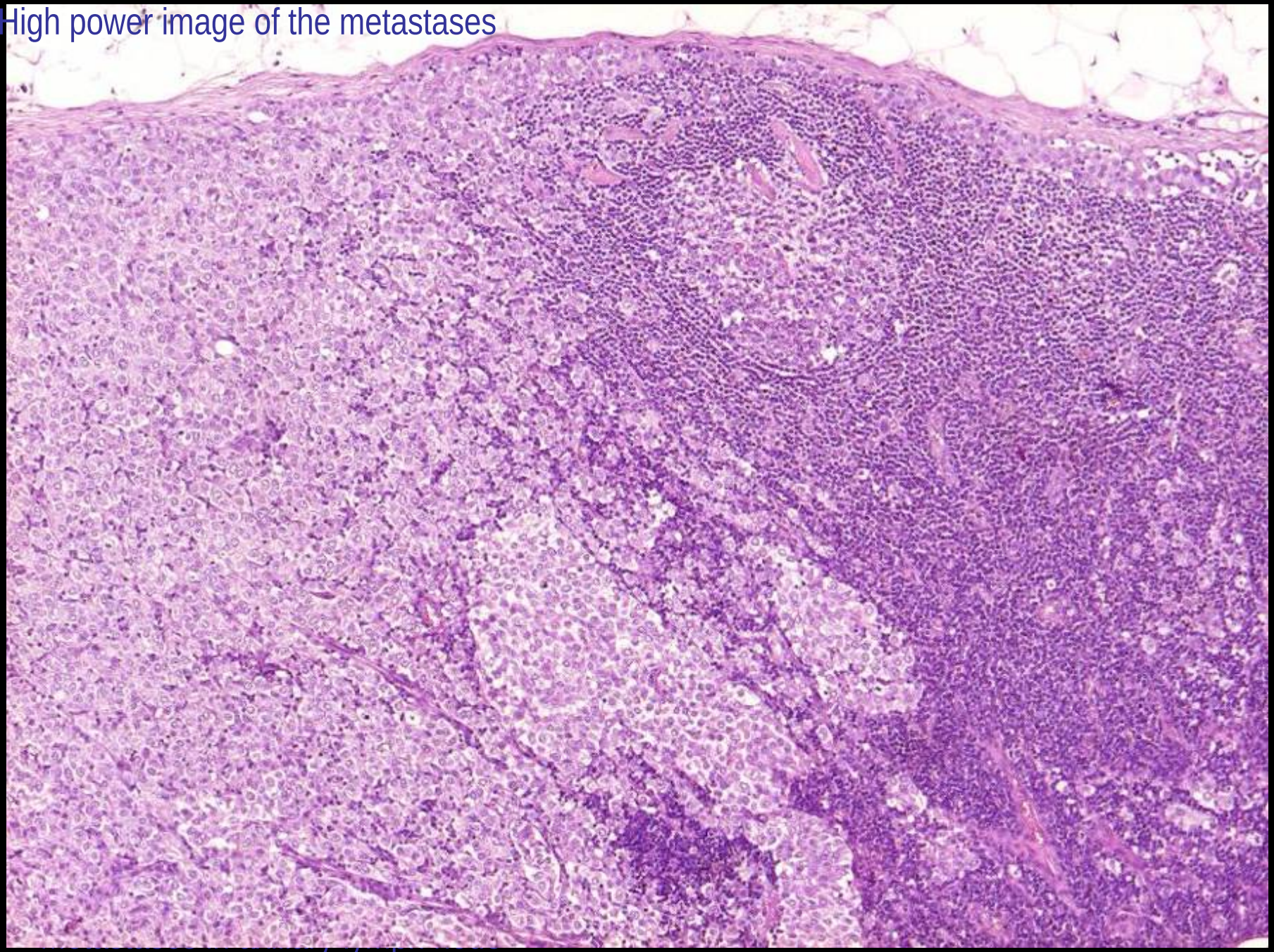



E-cadherin negative


E-cadherin negative
(invasive lobular component)
E-cadherin pos (inv. ductal component)

Metastases in axillary lymph node

High power image of the metastases



Histology

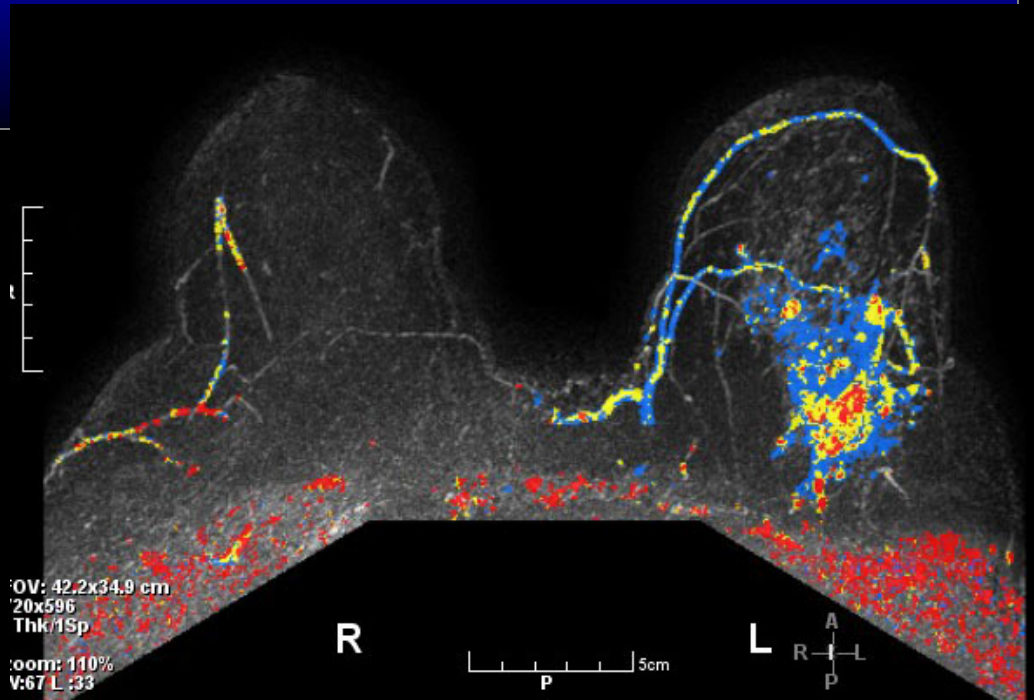
Multifocal invasive lobular carcinoma with ductal components, associated with LCIS and Grade 2 *in situ* carcinoma.

Disease extent: 85x55mm.

pN 8/8

Outcome

Brest cancer death six months after treatment



Sydney Botanical Garden

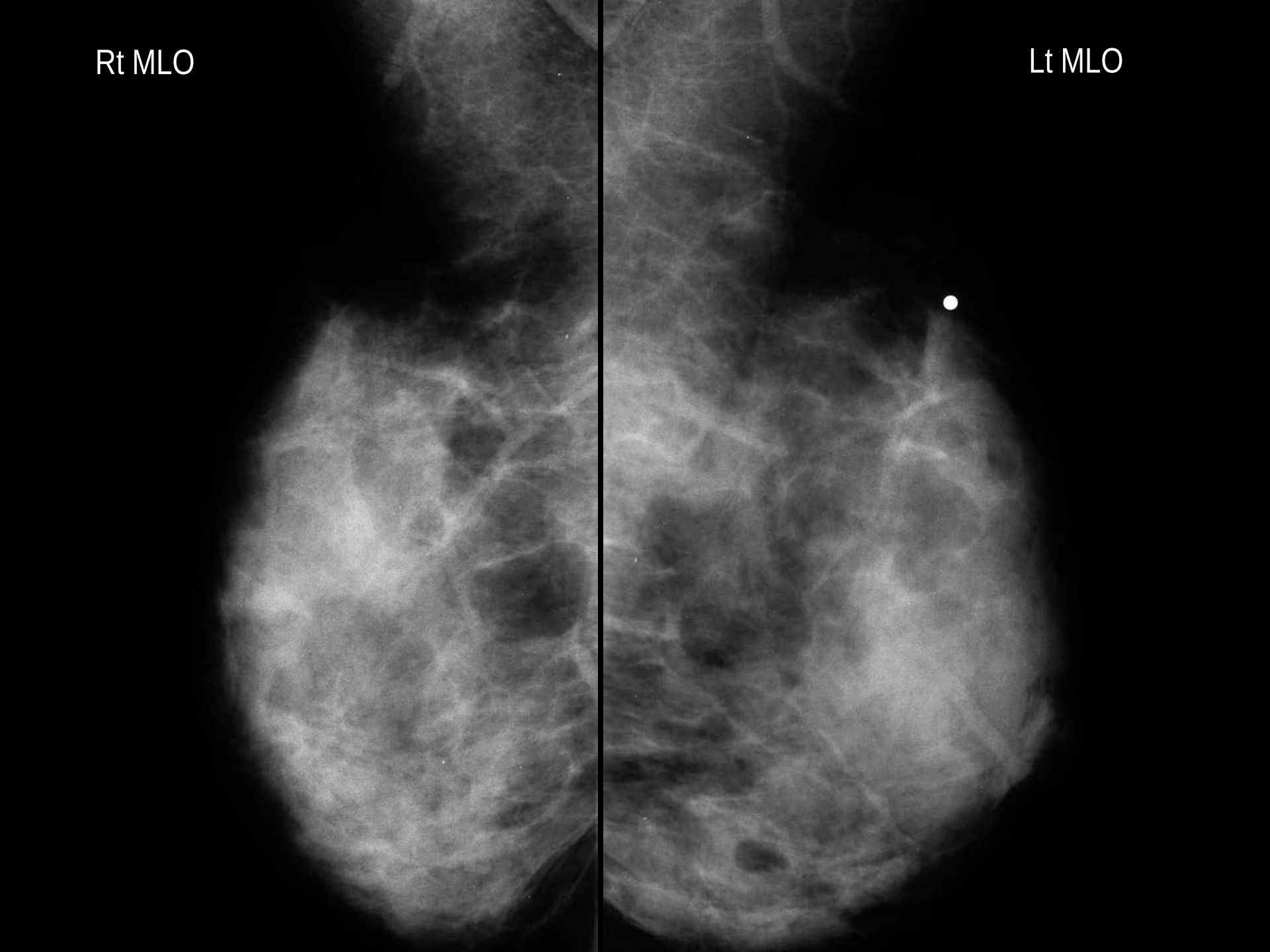
An approach to solve the perception problem in Pattern V, using 3D automated ultrasound technique (2 mm coronal sections)

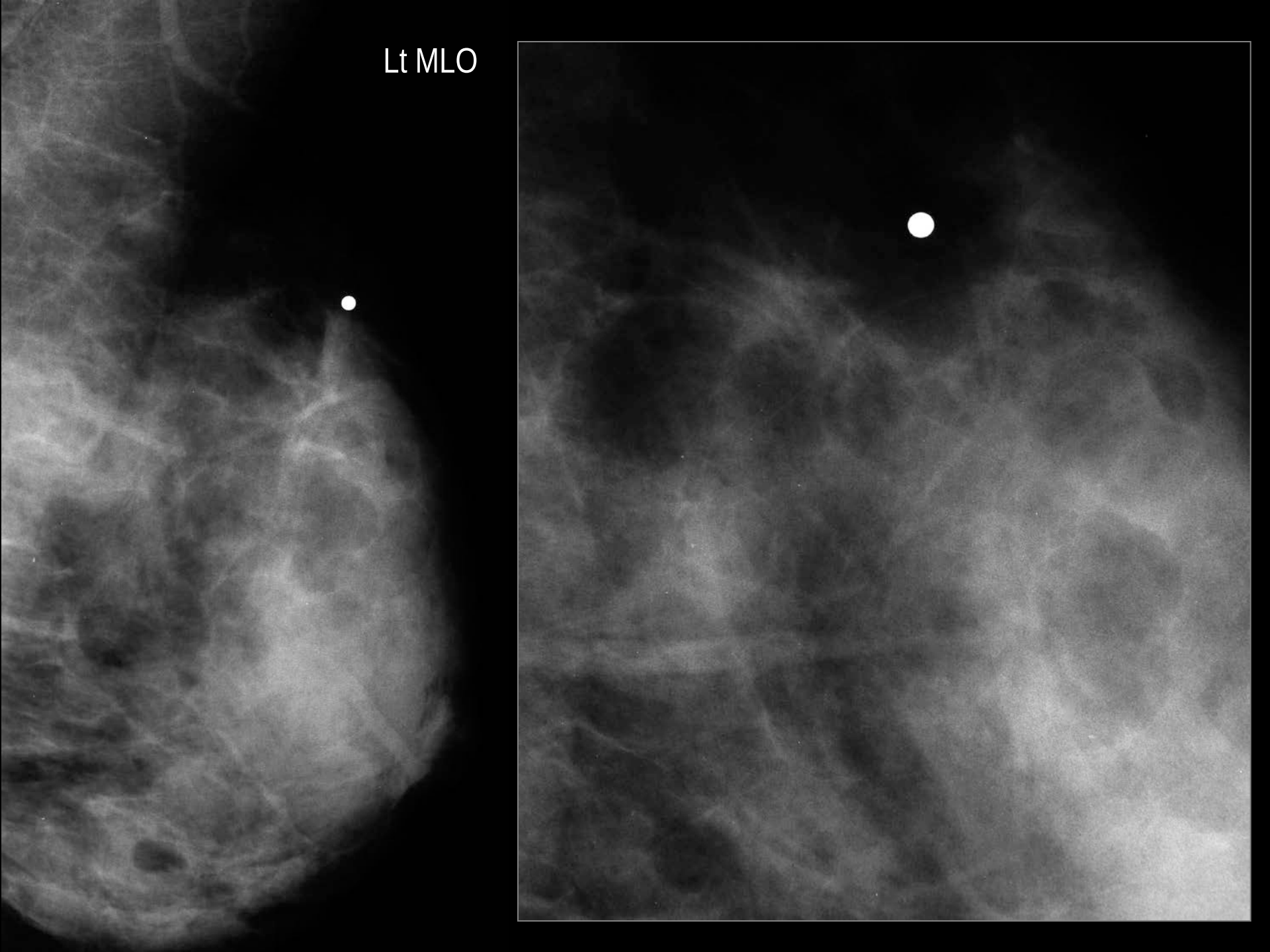
37 year old woman, who felt a lump in the upper-outer quadrant of her left breast

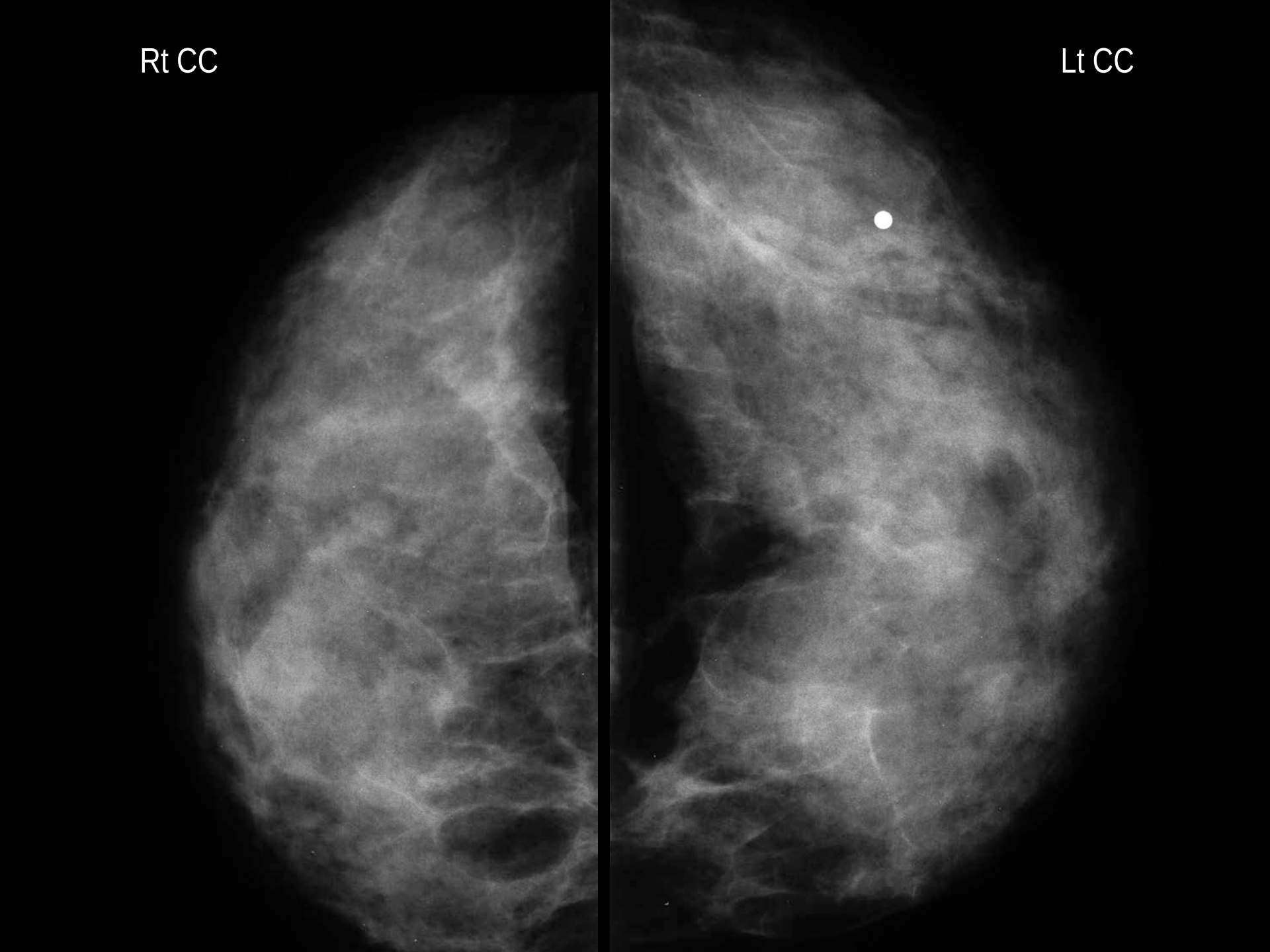
From the Departments of Mammography *and* Clinical Pathology

Falun Central Hospital, Sweden

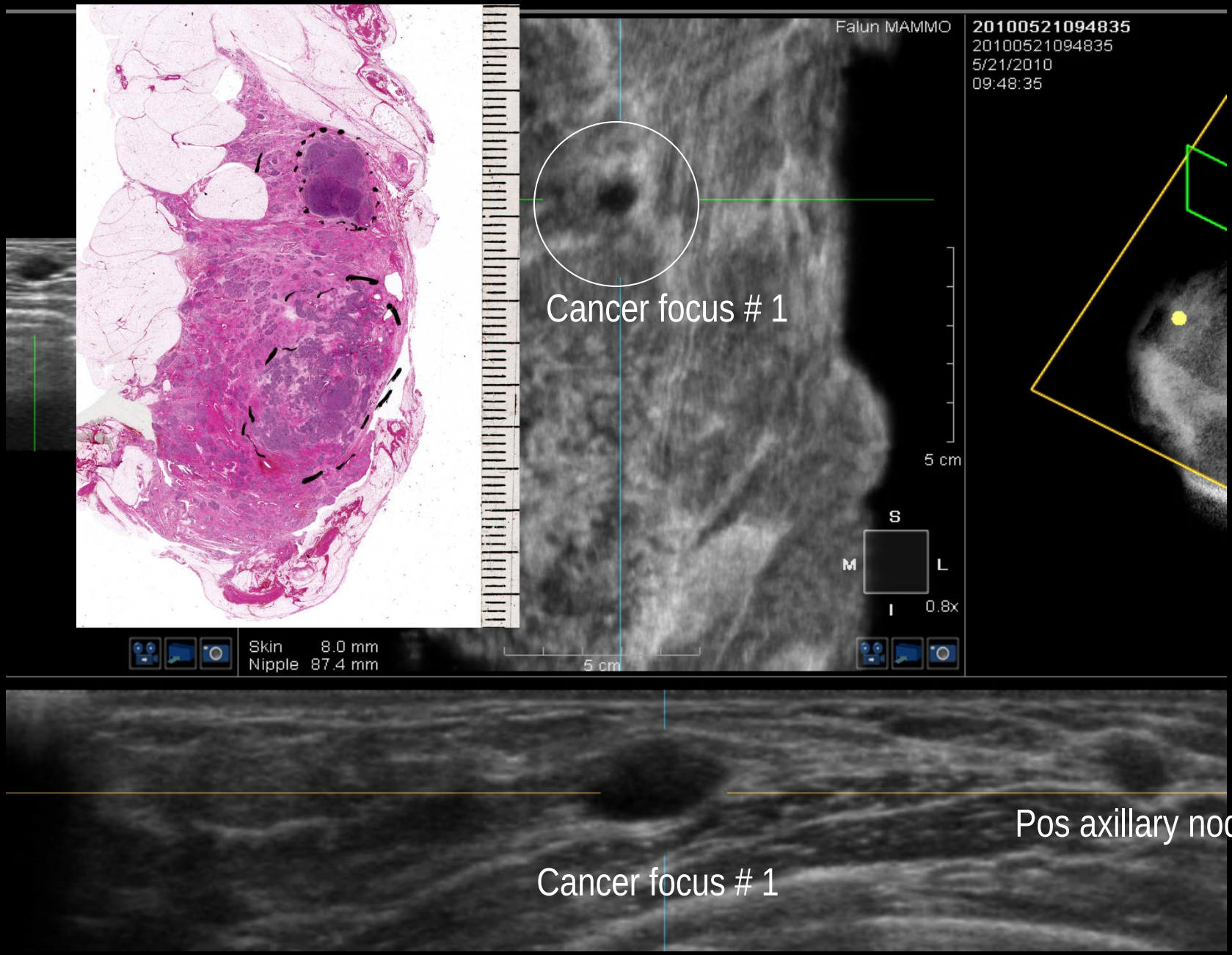
Example 1


Rt MLO
Lt MLO

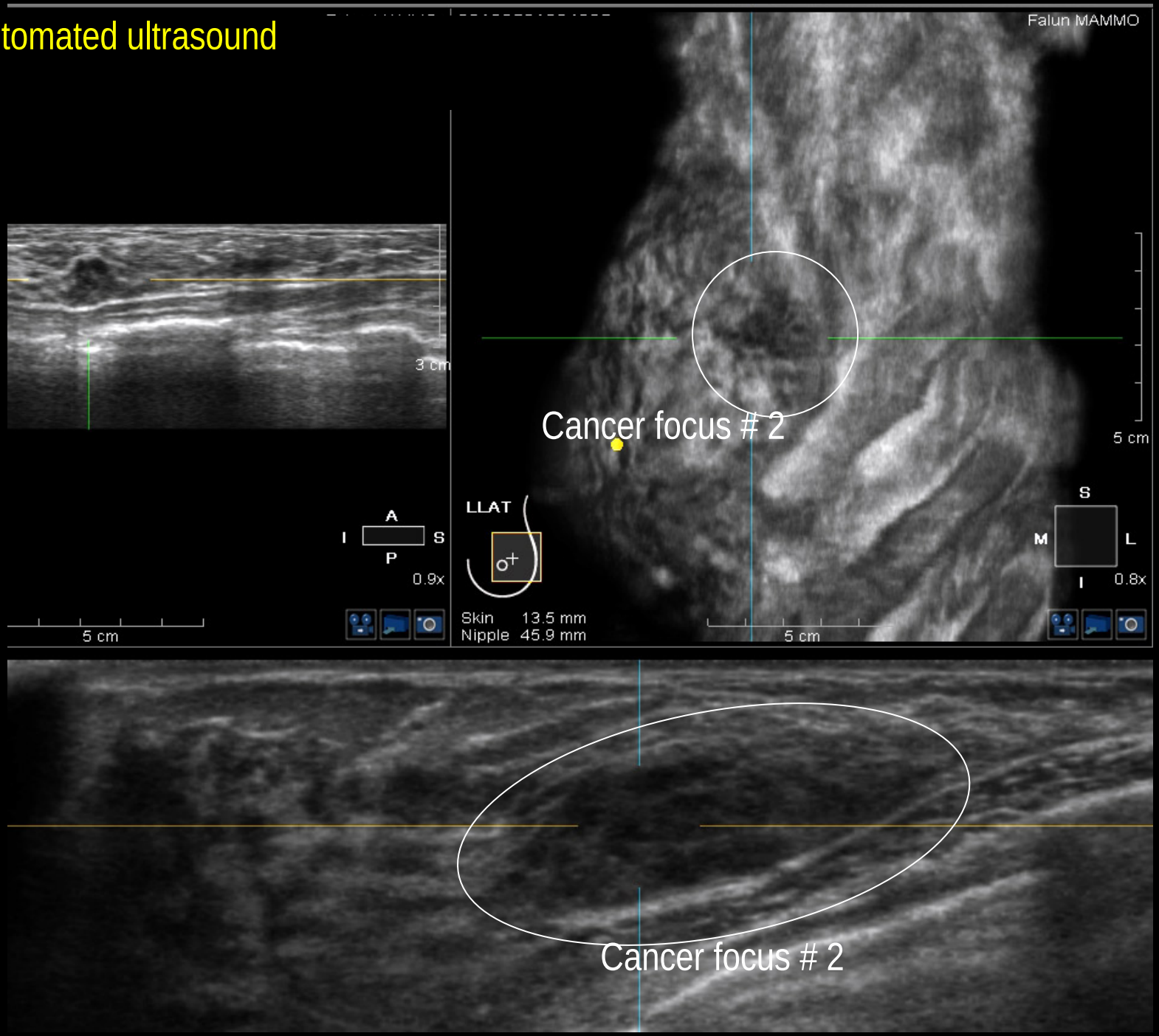

Lt MLO

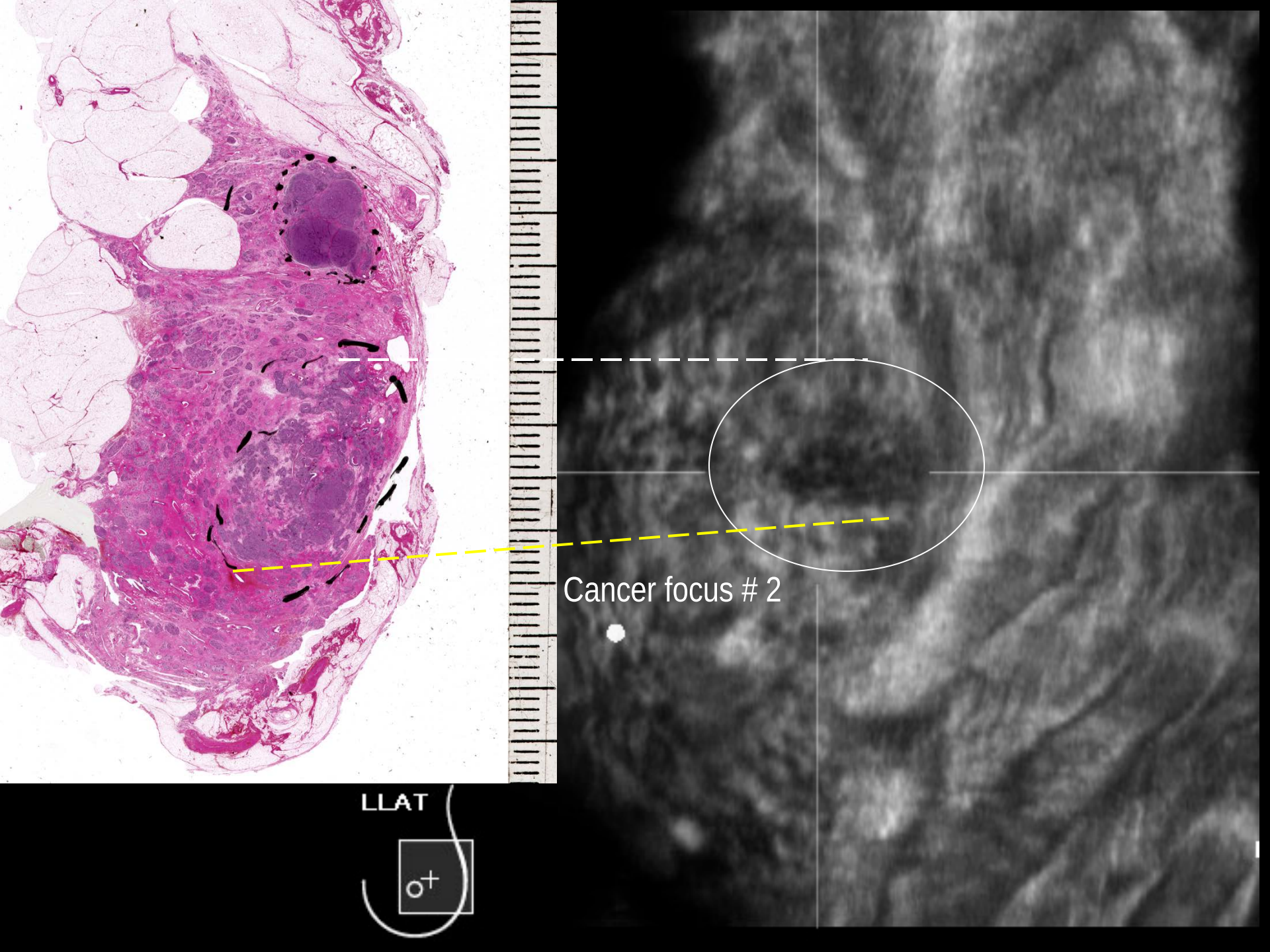

Rt CC
Lt CC

3D automated ultrasound

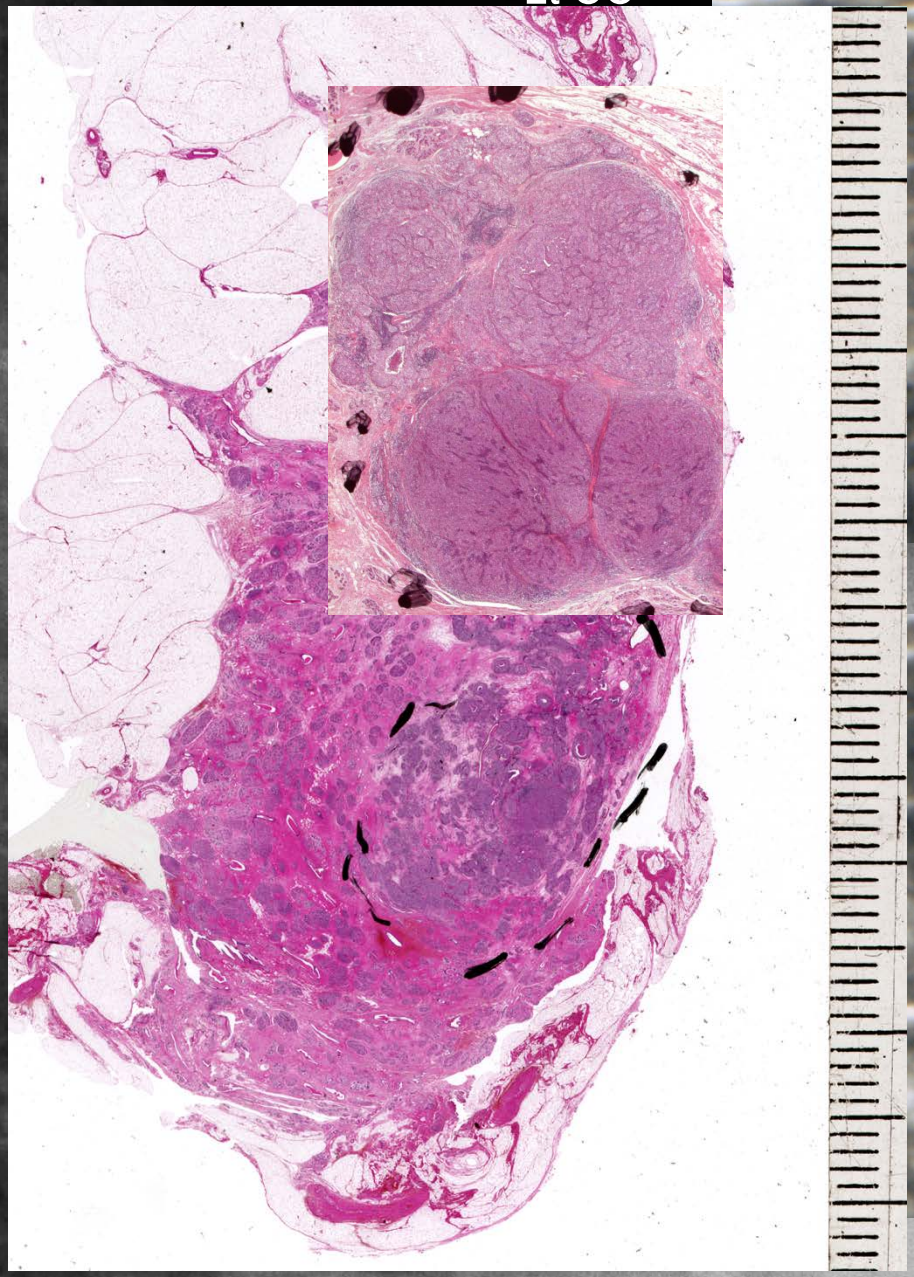


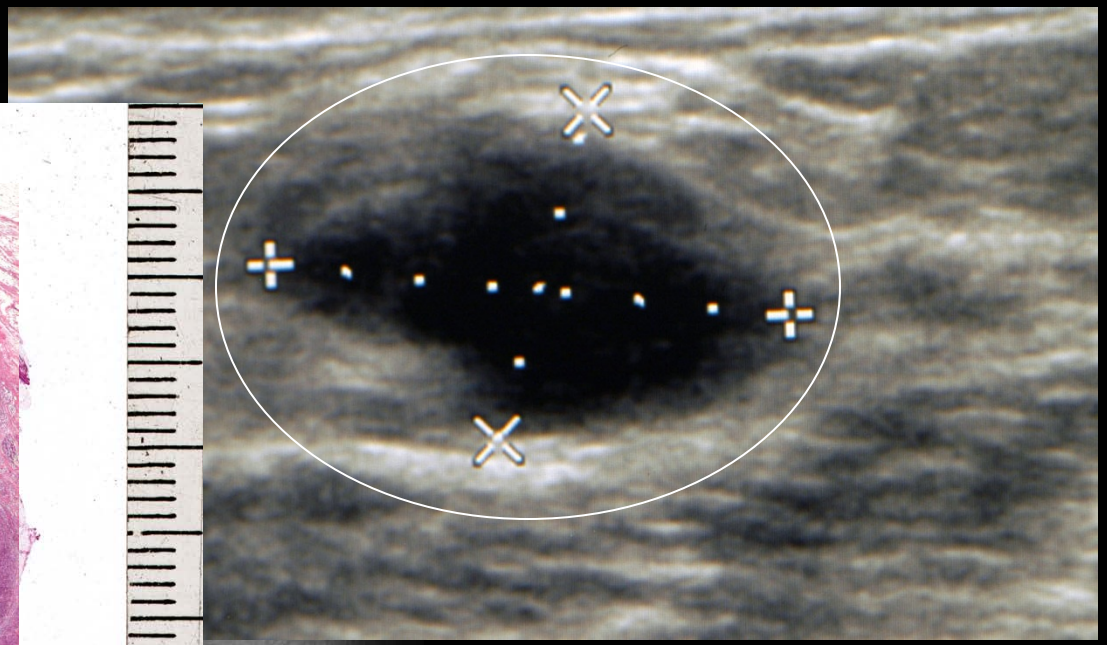
3D automated ultrasound



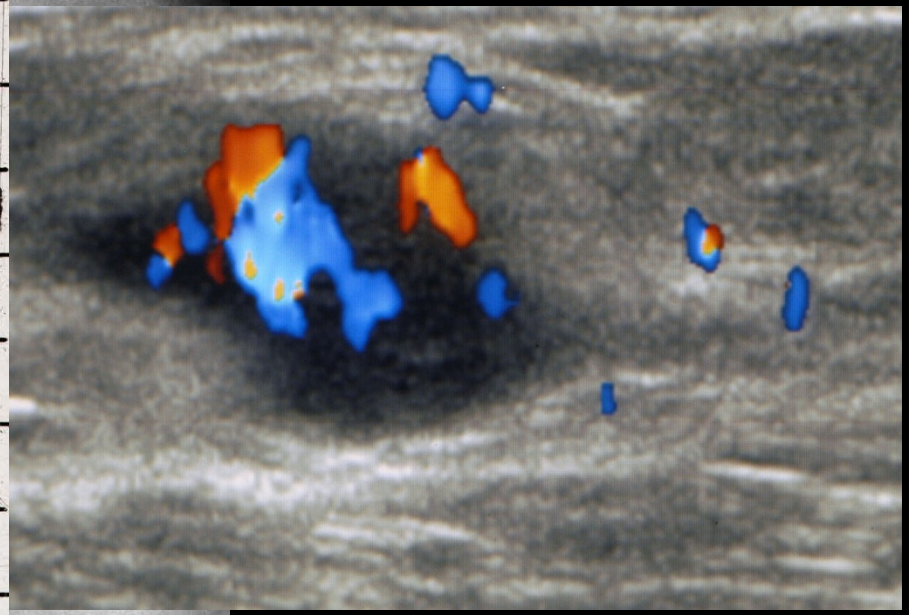

Cancer focus # 2
LLAT

Lt CC

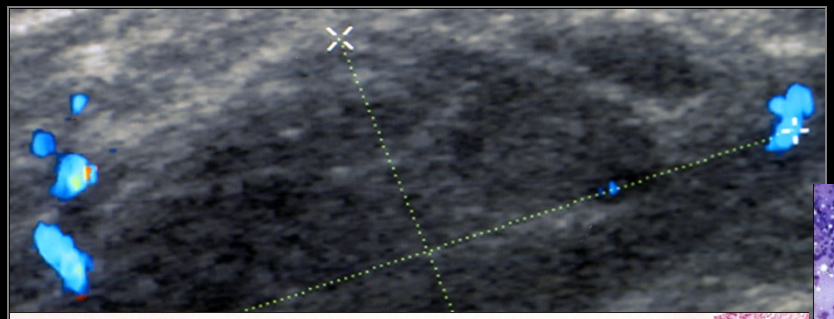


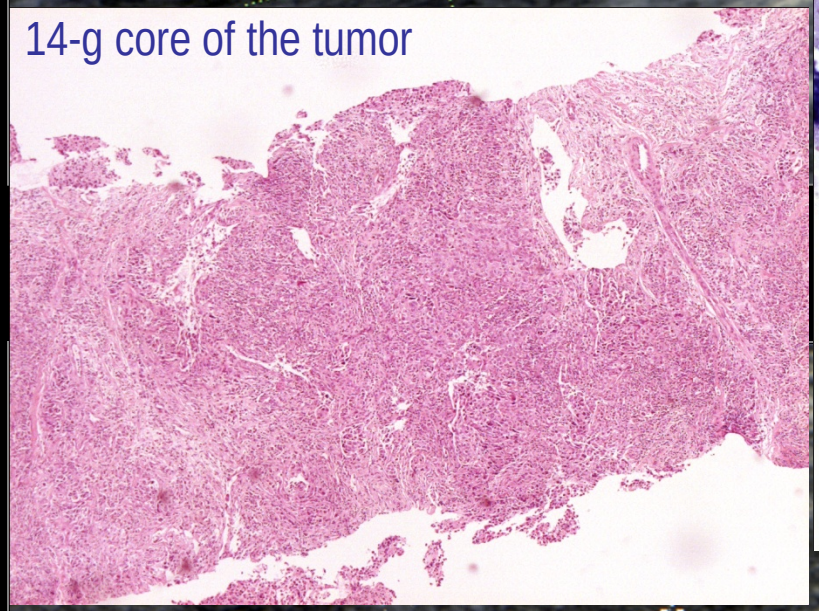


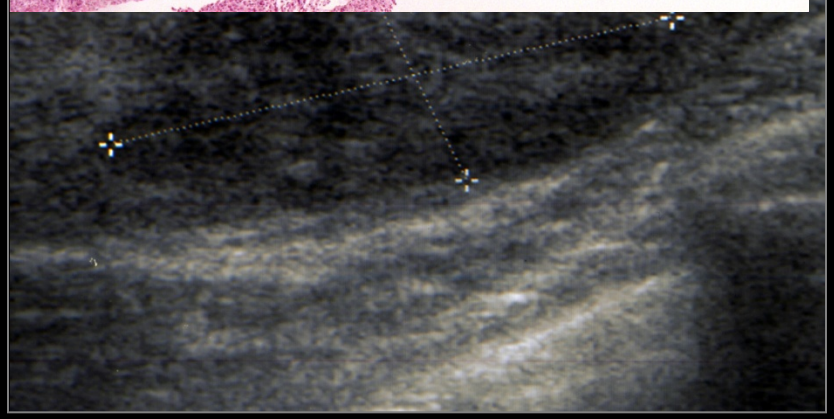
Breast ultrasound



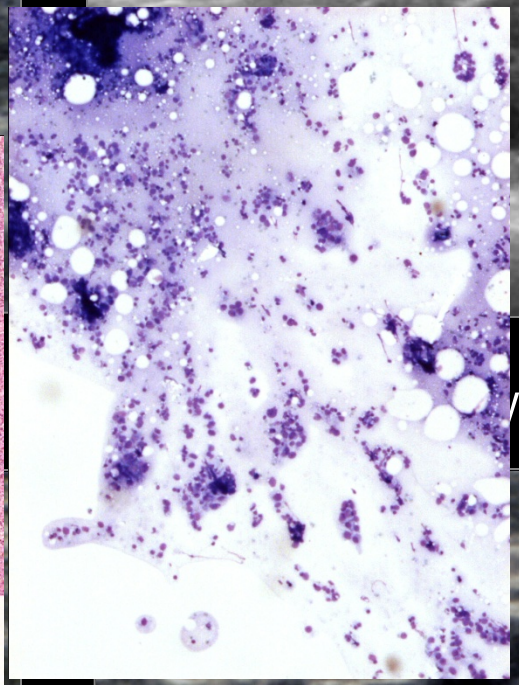
Tumor focus # 1 (12x8 mm)

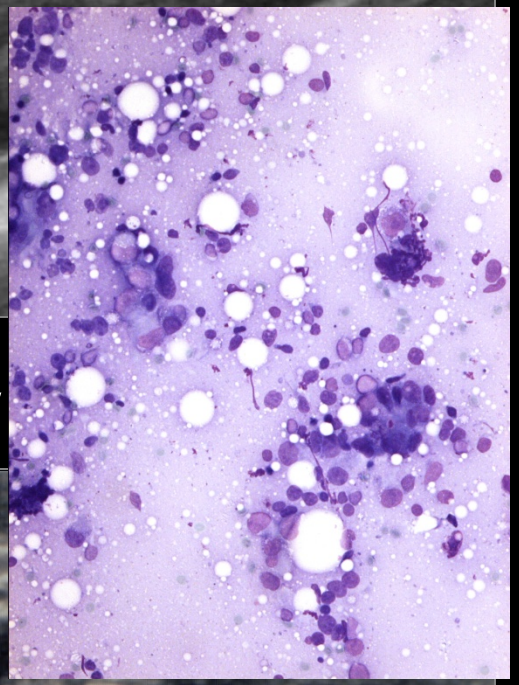


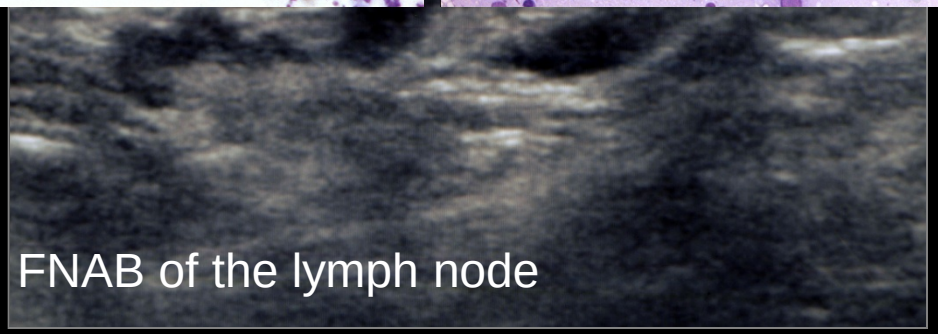




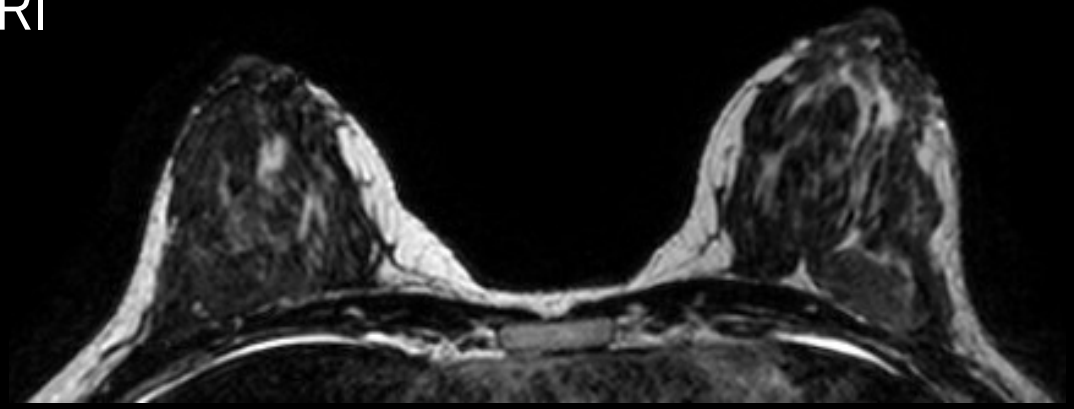
Tumor focus # 2

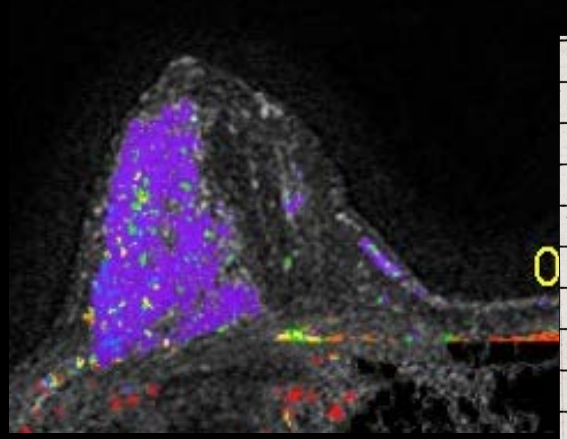


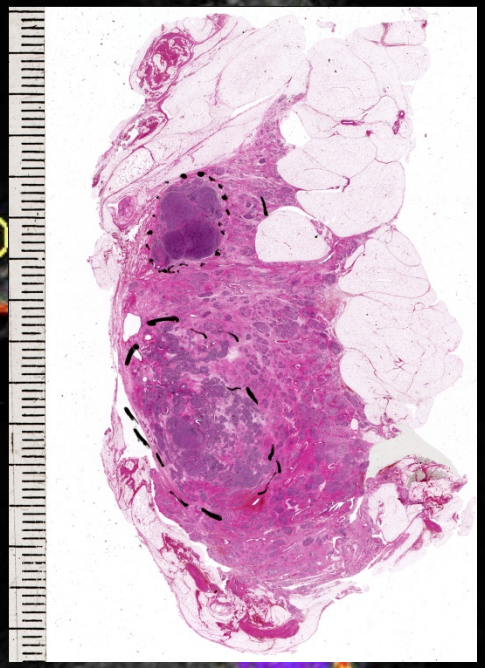


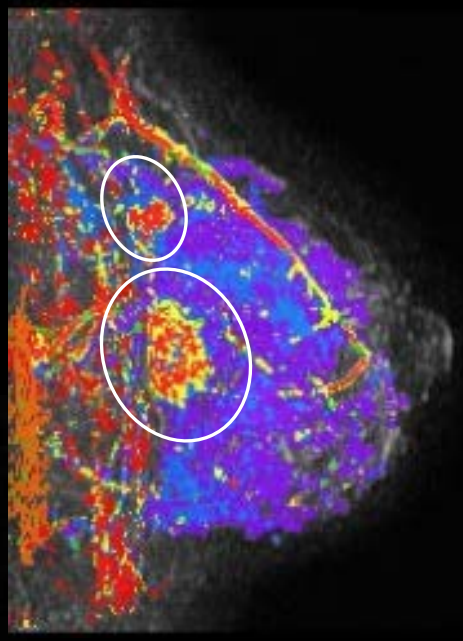


Breast MRI









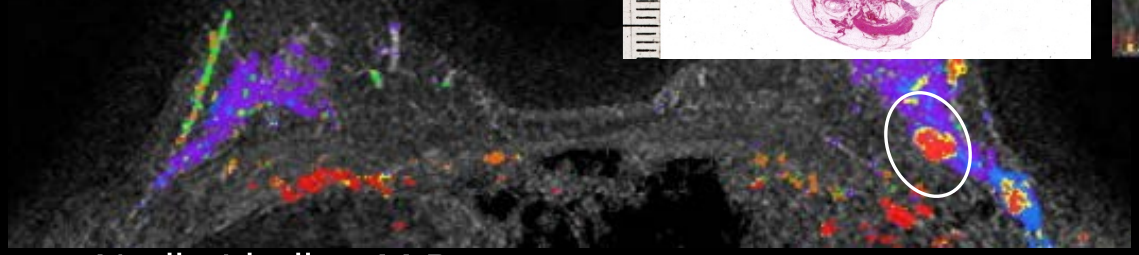
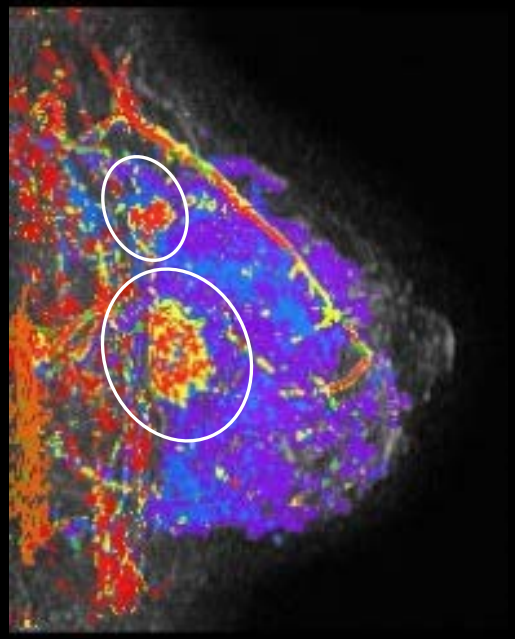
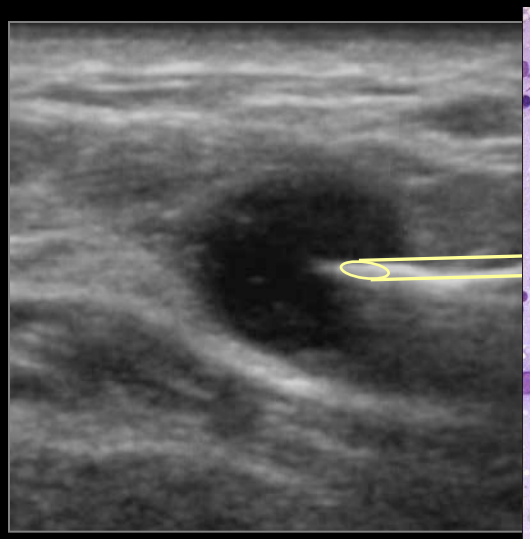
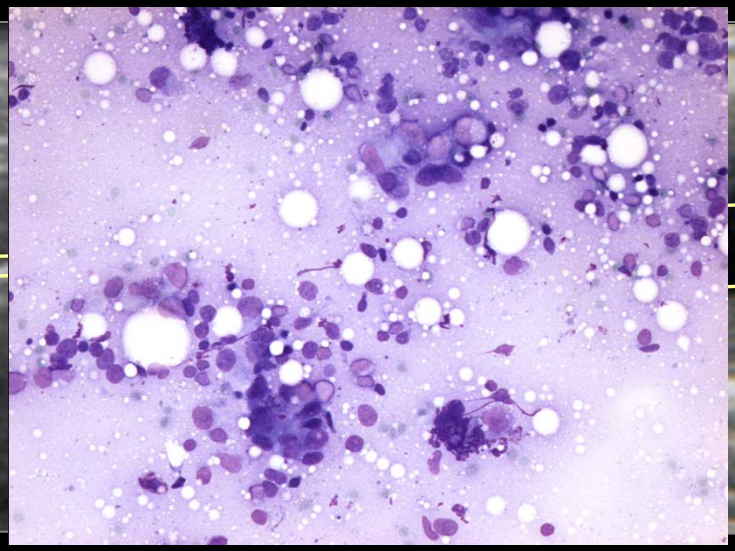


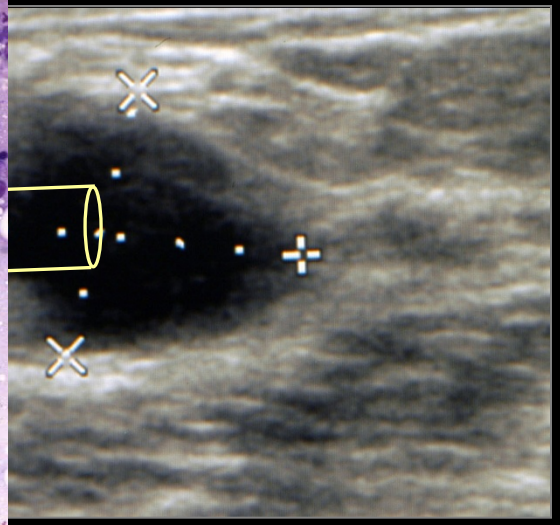
Image courtesy: Nadja Lindhe, M.D.

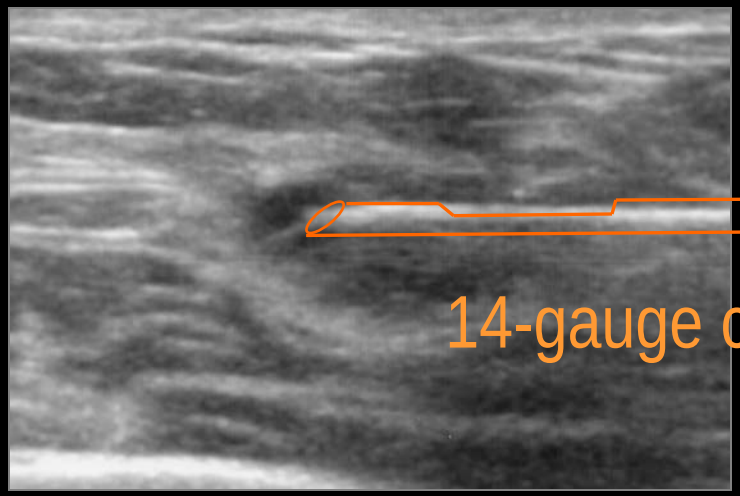
Left
latero-medial
horizontal

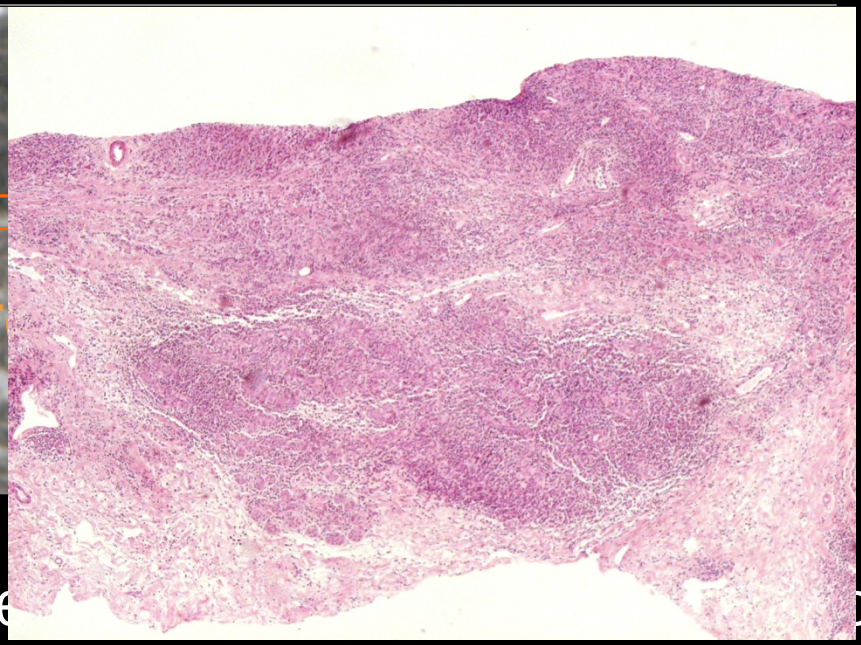












Preoperative FNAB of the axillary node ors
in the breast: Poorly differentiated cancers with axillary lymph node metastases

Histology

29x13 mm and 12x7 mm
poorly differentiated
invasive ductal carcinoma foci
with LVI.
Total extent: 41x20 mm
pN 2/4


Tabar, L.

Evaluation of ABUS as an adjunct to screening with mammography of asymptomatic women with dense breast tissue is a logical next step in developing screening strategies *to reduce the false-negative rate of mammography*

A large-scale clinical trial was needed to study the sensitivity of cancer detection when screening average-risk asymptomatic women with dense breast tissue with digital mammography and ABUS

Design of a trial

This situation is similar to the introduction of low-dose film-screen mammography in the mid 1970's

Design of a trial

It is for this purpose that a multicenter prospective scientific trial was designed by Stephen W. Duffy, Professor of cancer screening in London, UK

Study designer

W. Duffy

Professor of Cancer Screening and Director,
Cancer Screening and Aetiology Group,
Wolfson Institute of Preventive Medicine,
Queen Mary, University of London,
Charterhouse Square, London EC1M 6BQ
United Kingdom

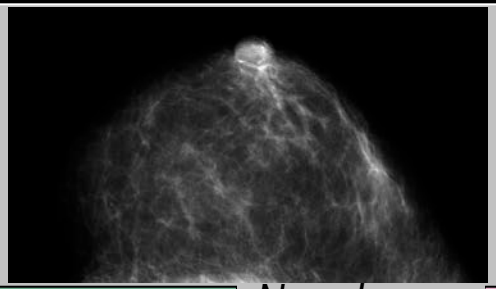
Hypothesis

Screening asymptomatic women with dense breast tissue using digital mammography (FFDM) *and* automated ultrasound (AU) will result in significantly higher sensitivity in the detection of breast cancer compared to screening with digital mammography alone with acceptable call-back rates.

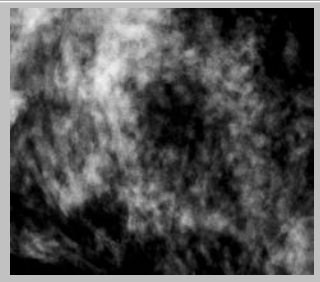
Objective

To determine the sensitivity of breast cancer detection *in asymptomatic women with a dense breast pattern* screened with

- Mammography *and* automated ultrasound
- Compared to mammography alone



Screenee



Non-dense

Dense

No further Imaging

Mammography

Automated ultrasound

Images to interpretation

Images to interpretation

Team 1

Team 2

Alternative study design

Design of a trial

The study had a matched pair design in which the examination of each woman with dense breast tissue has received a separate interpretation of the digital mammogram only,

as well as a combined interpretation of the digital mammogram and the automated 3-D ultrasound



Design of a trial

This clinical study of asymptomatic women with >50% parenchymal density has assessed the sensitivity and specificity of automated breast ultrasound combined with digital mammography

as a multimodality breast cancer screening method compared to digital mammography alone

Ongoing trial

The evaluation of this study has provided information about the value of digital mammography combined with automated 3D ultrasound as a new, multimodality screening tool in the fight against breast cancer




Playing with water and light