BREAST MRI

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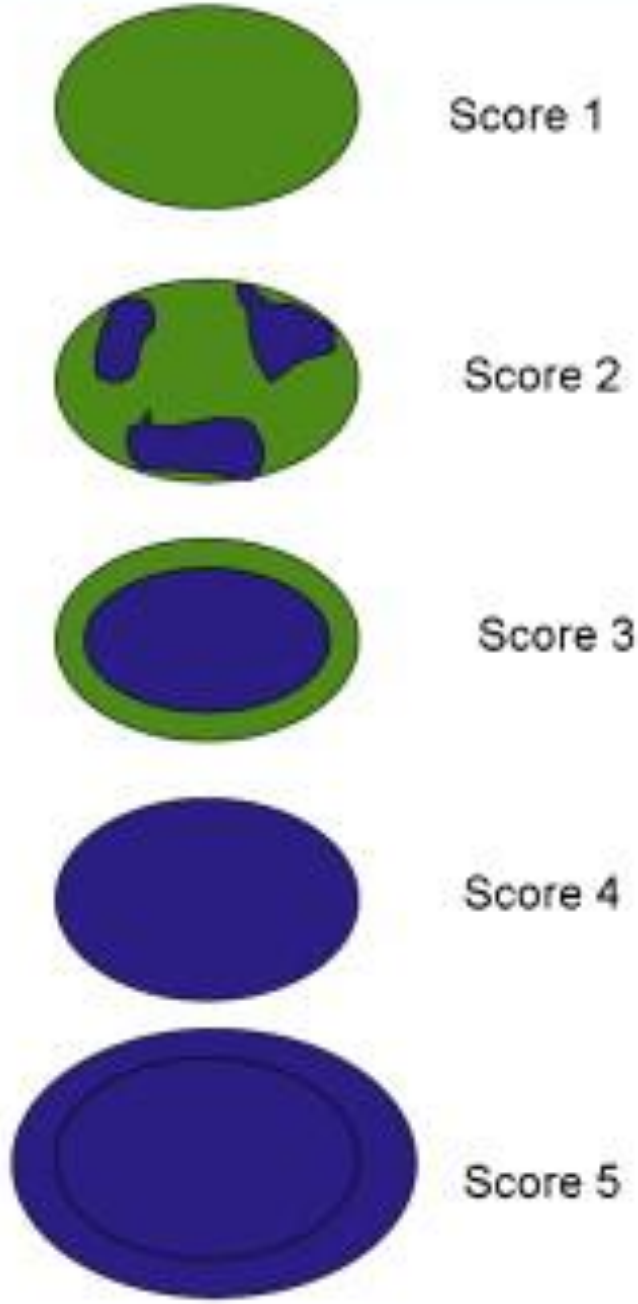
2025
a

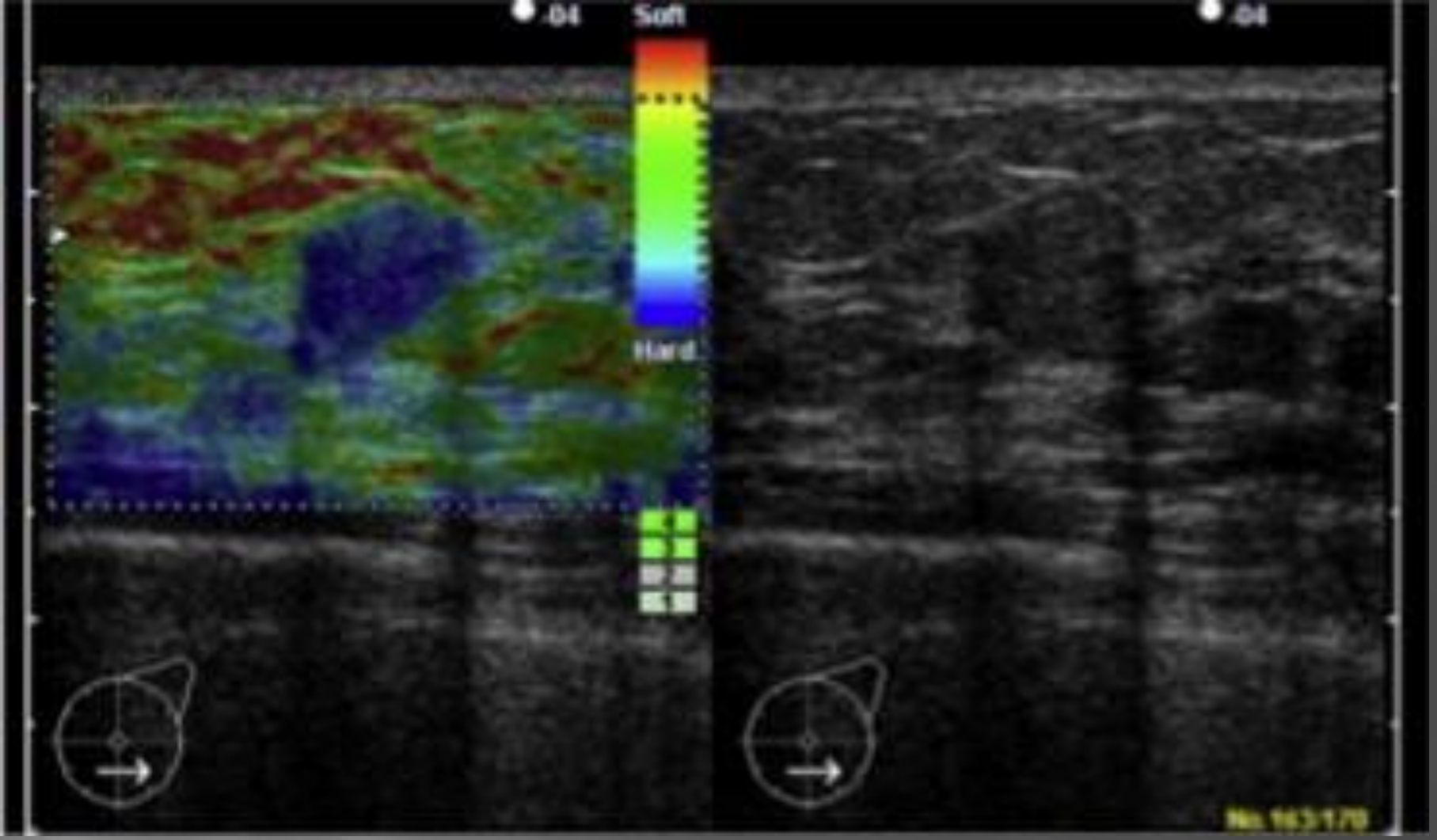
strain elastography,'

- The quasistatic elastography technique, also known as 'strain elastography,' measures deformation of tissue induced by a quasistatic mechanical source. In a clinical context, the mechanical movement is manually supplied by the operator who exerts a pressure on tissue with the ultrasound transducer. The resulting deformation is measured by calculation of local tissue relative displacement along the axial direction

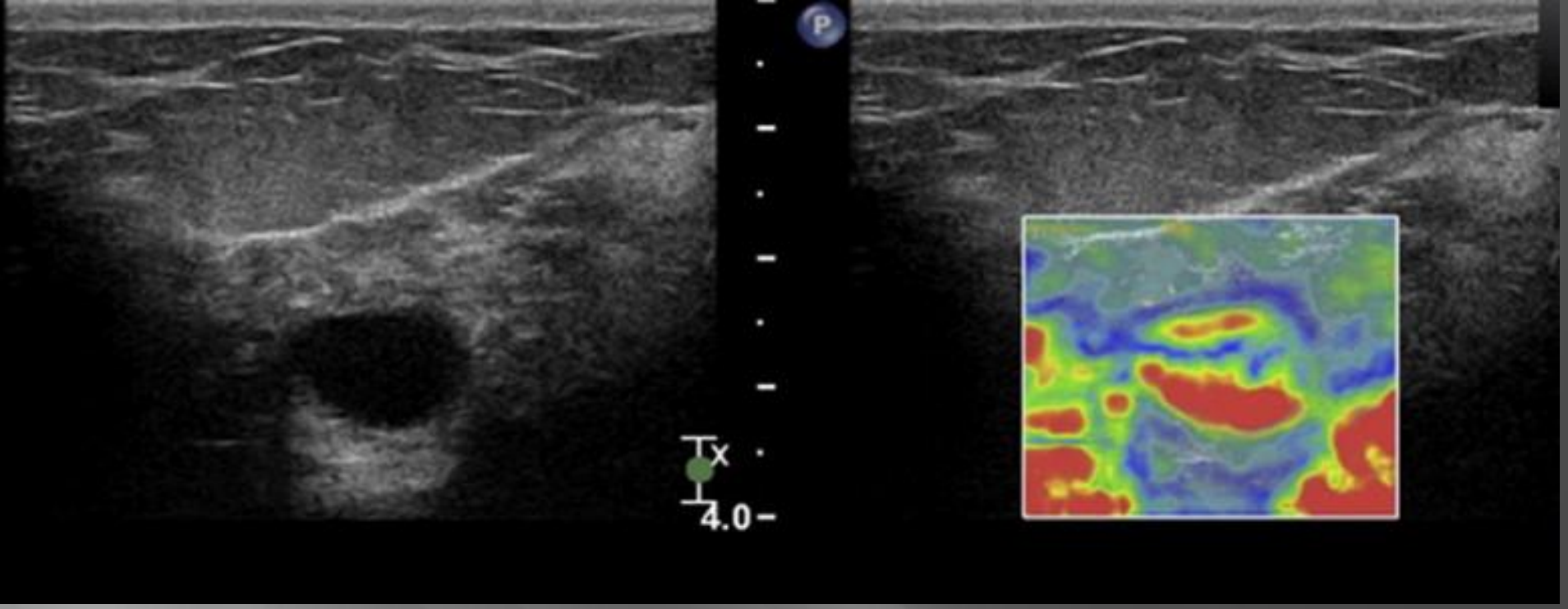
- shear wave elastography , uses focused beams of US energy from conventional transducers to produce movement in the order of several microns at depths of up to 6 cm beneath the US transducer. This technique results in low-frequency shear waves in a plane perpendicular to tissue displacement and the speed of shear wave propagation is directly proportional to tissue elasticity, with faster speeds in stiffer tissues. Detection is accomplished by ultrafast real-time US imaging, and the data are displayed in kilopascals (kPa) on color-coded elasticity maps .This method has the advantage of being quantitative, reproducible, and operator independent and is therefore suitable for monitoring changes over time. Shear wave elasticity imaging has been used for assessing the stiffness of the liver, prostate, and heart.


Score 1
Score 2
Score 3
Score 4
Score 5

- A score 1 represents an entirely green lesion with the same elasticity throughout the lesion, a score 2 represents a lesion of which the greater part can be deformed although it may also contain non-deformable areas (green and blue mosaic), a score 3 corresponds to high elasticity level in the periphery of the lesion (green) whereas the centre of the lesion is blue, a score 4 indicates no deformability throughout the lesion (entire lesion is blue although the adjacent tissue is not affected) and a score 5 indicates no deformation throughout the hypoechoic lesion or the adjacent tissue (lesion and adjacent tissue are blue). The risk of malignancy increases from 1 (benign lesion) to 5 (malignant lesion).
- Score 1: lesion entirely green (same elasticity throughout the lesion). Score 2: blue and green mosaic (most of the lesion is deformable although there are areas which are not deformable). Score 3: deformability in the periphery of the lesion although the centre is blue. Score 4: blue lesion, surrounding tissue not affected (no deformability throughout the entire lesion only). Score 5: the lesion and adjacent tissues are blue (no deformation throughout the entire lesion or in adjacent tissue). The risk of malignancy increases from 1 to 5.

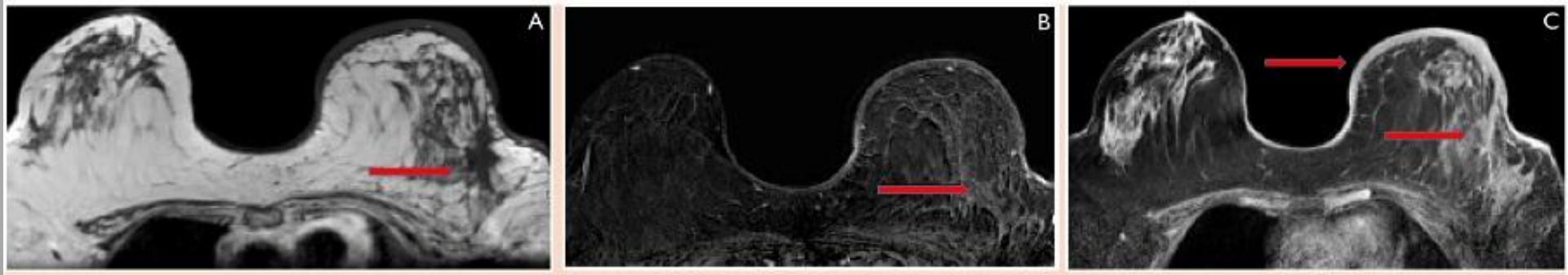


- 45-years-old, infiltrative ductal carcinoma. Free-hand (strian) elastography and B mode ultrasound (Hitachi®). The elastogram is homogeneously blue, indicating a poorly deformable lesion. However adjacent tissue is not blue and the Ueno score is 4, indicating a suspicious lesion requiring a biopsy, with irregular margins.



- Cyst. Free-hand elastography, colour mode (Philips®). This typical cyst shows a triple layout couloured lesion, which is a typical feature of a cystic lesion. It is therefore be used to differentiate cystic lesions from solid fine echoic lesions as seen on atypical cyst.

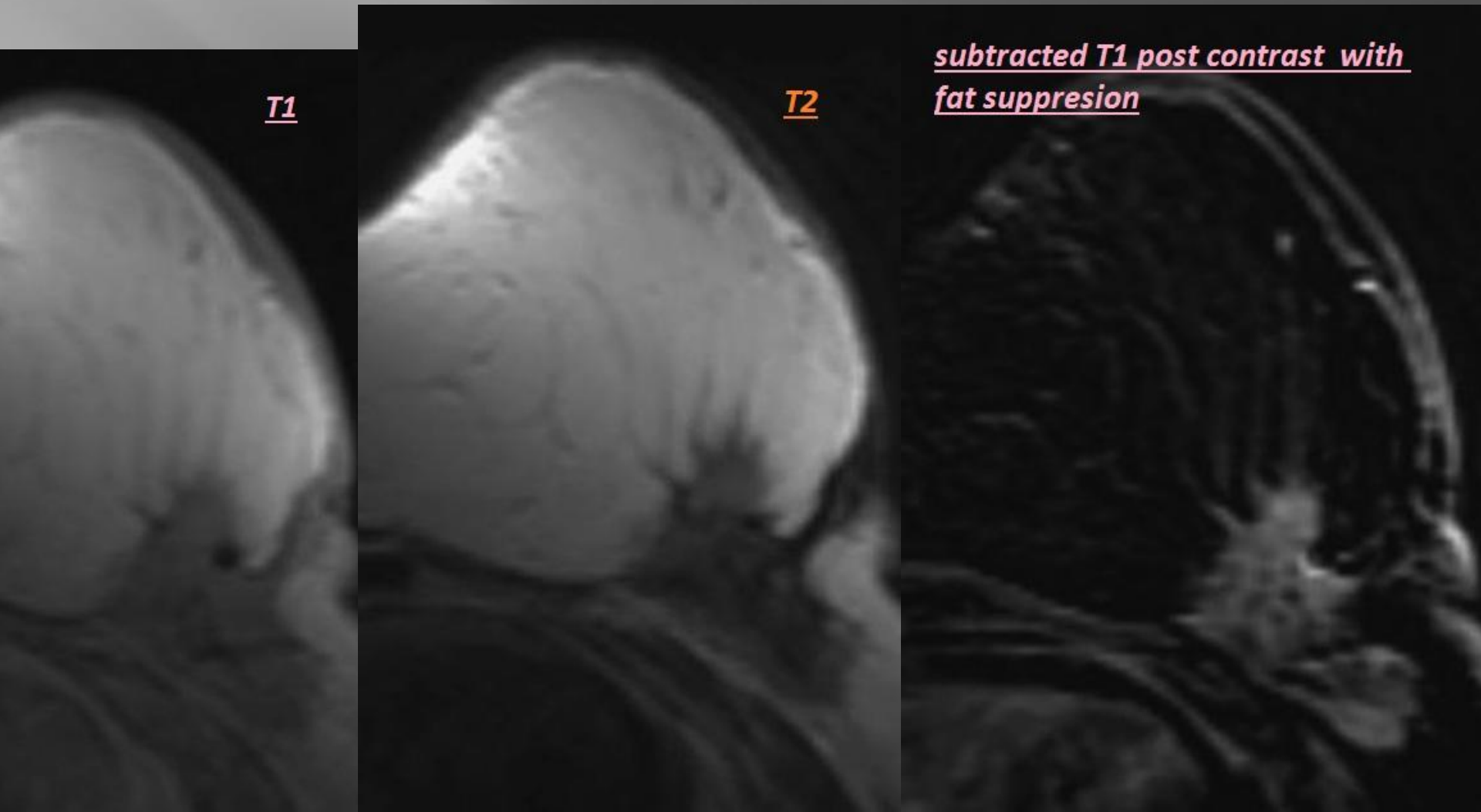
- **Clinical presentation:**50yr old lady with post BCT status left breast with heaviness in the left breast and at the operative site.



Follow Up MRI In Operated Case Of Left Breast Invasive Ductal Grade Ii Carcinoma. Tiw, T2 Fat Sat Images [Fig A, B] Show Hypointense Thick Scar Tissue Which Has Irregular Margins With Architectural Distortions. Post Radiation Changes And Oedematous Skin Is Noted. However Post Contrast [Fig C] Images Do Not Show Any Enhancement In The Scar Or In The Operative Bed, Suggesting No Recurrence.

- With Mammography and Sonography the assessment of residual disease has limitations, due to the postoperative changes, granulation tissue formation, distortions, hematoma, seroma, and fibrosis in and around the operative bed. All these can mimic residual disease. All these also affect the clinical examination findings, and it is difficult to assess the operative bed on follow ups. Residual disease that is untreated may eventually manifest itself as Recurrence, early or late. It may be argued that radiation may take care of this, but not all, and we don't know which will be and which will not, especially if there is no pre-operative assessment and there is a large bulky residual disease left behind.
- MRI can also assess complications like hematoma, seroma, infection in the operative bed accurately with higher sensitivity and specificity as compared to other modalities.

History of brest conservative therapy



Recurrent breast cancer

- **Risk factors**

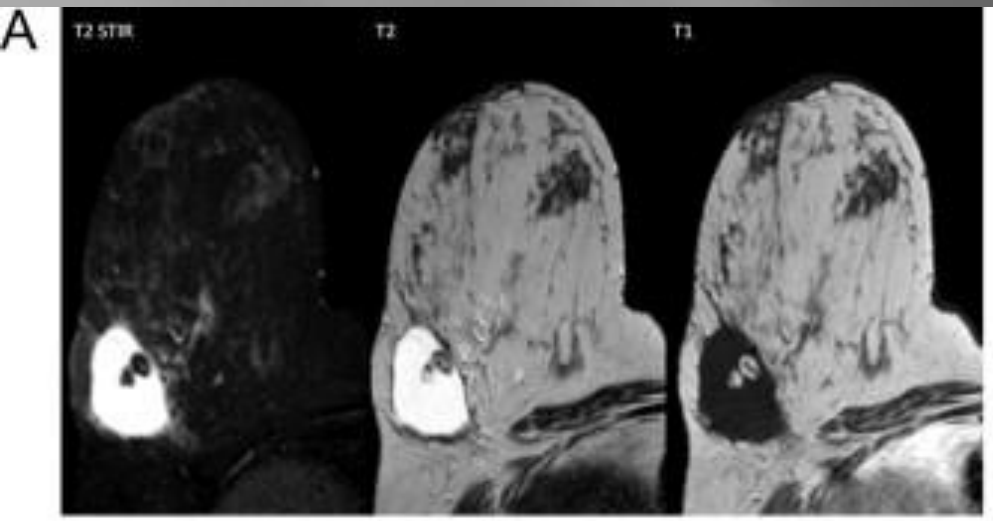
- Recognized risk factors include:
- close +/- positive margins at time of resection
- extensive intraductal components (EIC)
- inadequate adjuvant radiation therapy
- young age at initial presentation
- multicentric breast cancer
- multifocal breast cancer

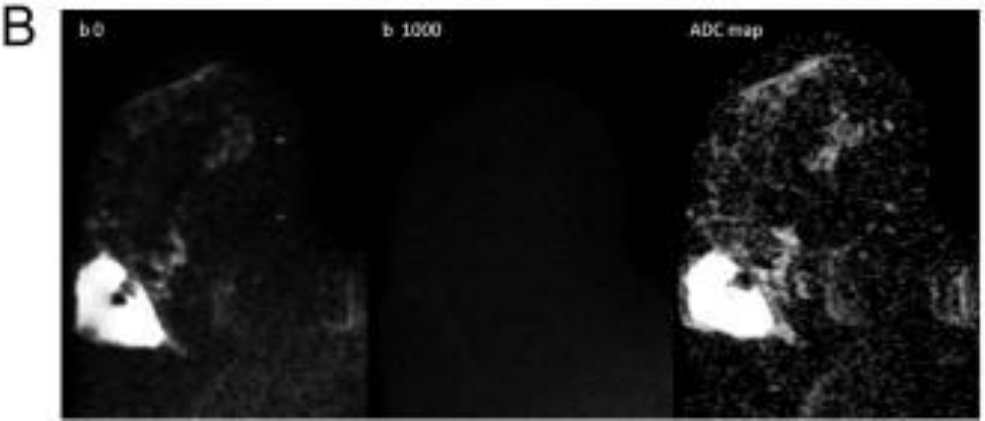
- **Radiographic features**
- **Mammography**
- On mammography, the appearance of recurrent breast cancers are generally thought to be mammographically similar to the original breast tumor [2].

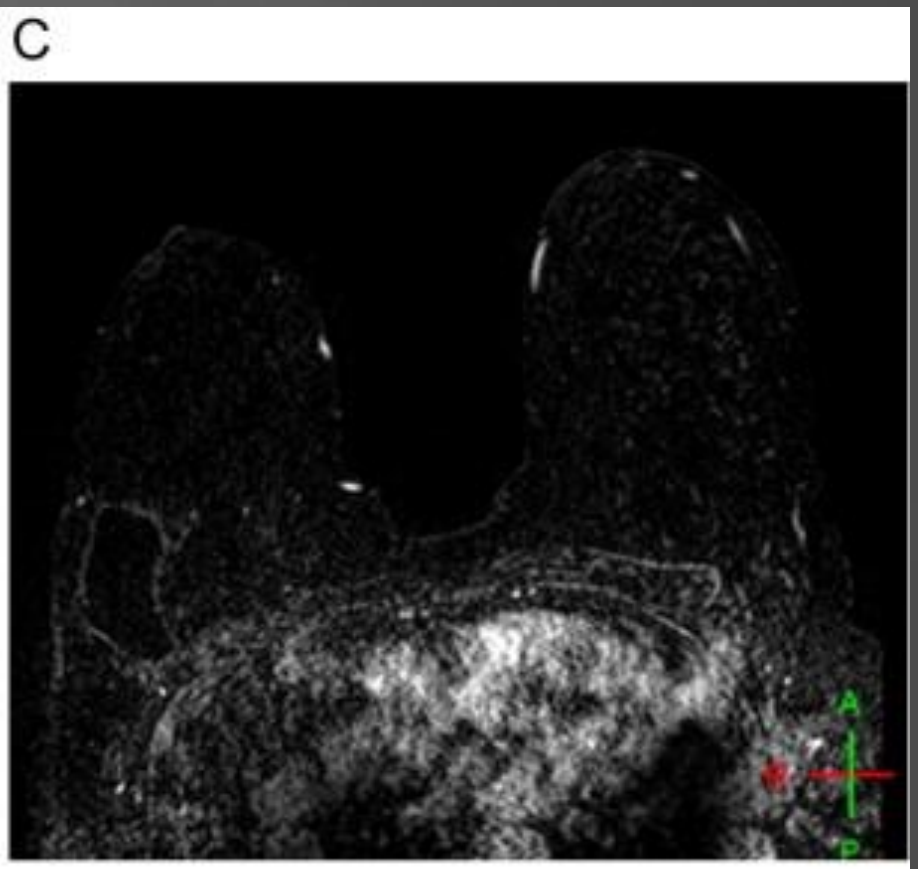
- **Breast MRI**
- MRI offers an advantage over conventional methods in assessing recurrence. This can be seen in evaluating of tumor recurrence versus scarring where enhancement in the post-surgical scar should decrease substantially over the first 2 years.

- The presence of enhancement at the lumpectomy site after ~18 months since surgery is considered a concerning feature for recurrent

Female patient 65-years-old with right BCS since 6 months

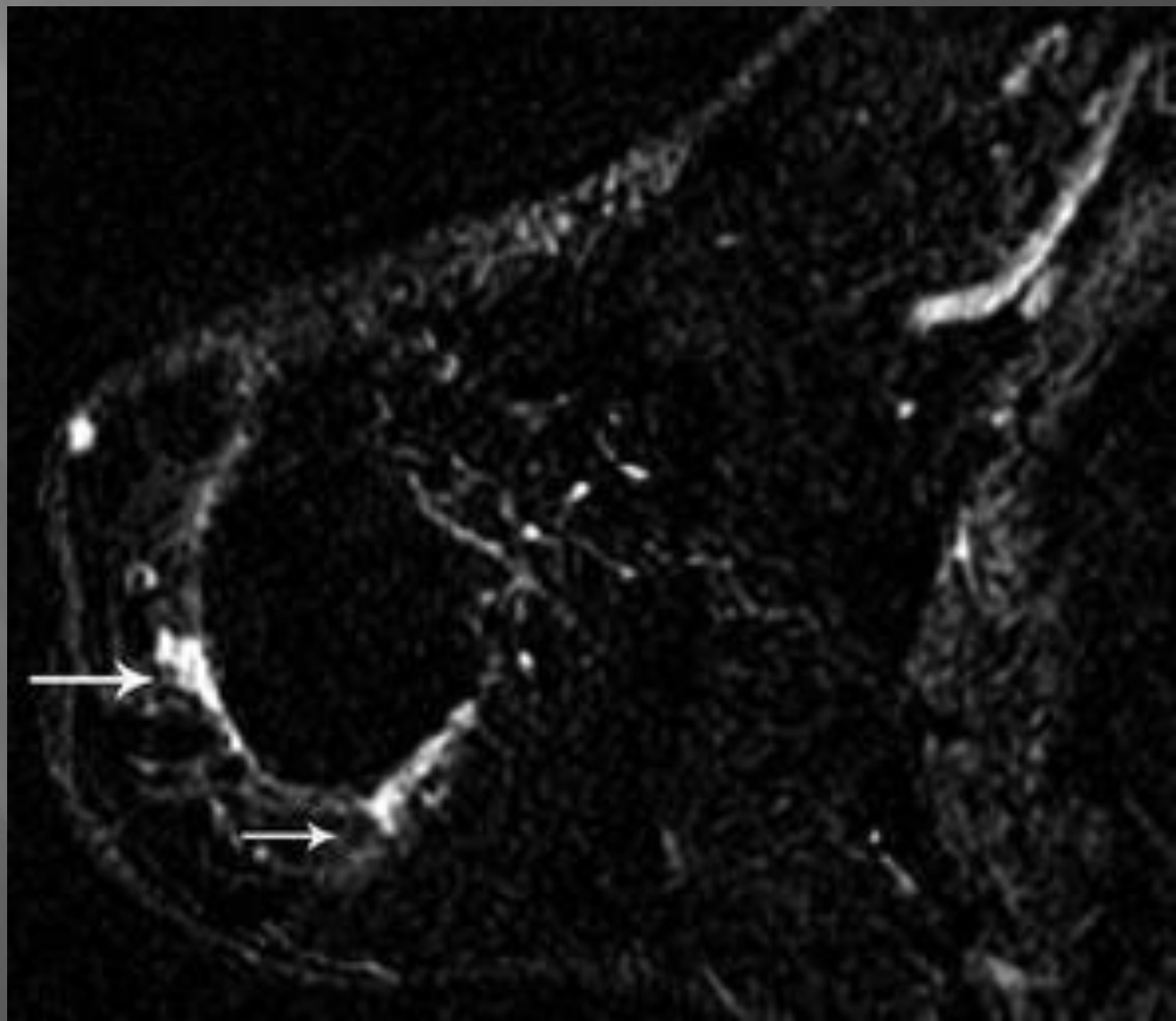




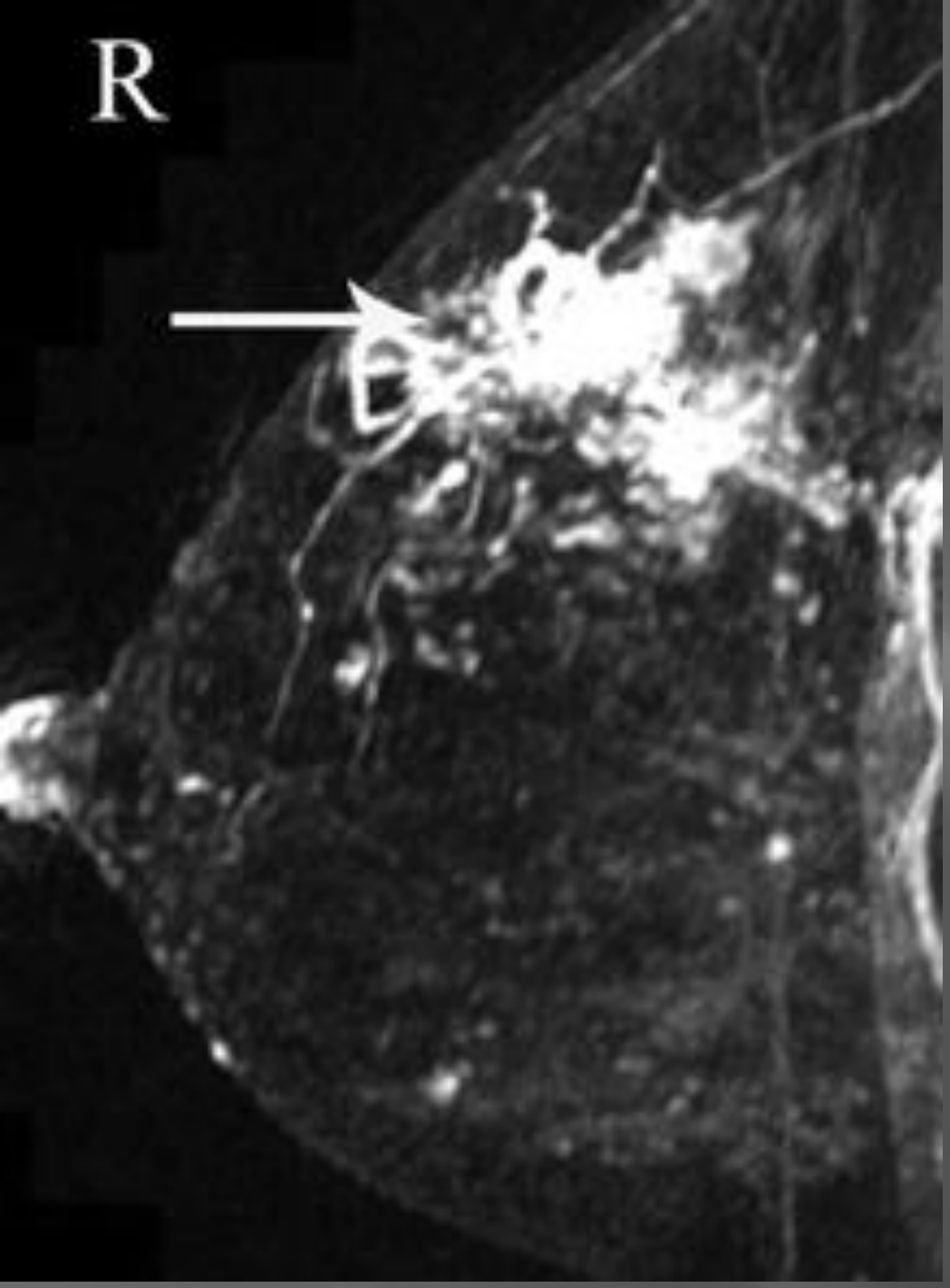


- (a) From right to left, axial T2 STIR, T2 FSE and T1 SE sequences showed right upper outer complicated fluid collection along the scar line with mural based loculi therein. Regarding the elicited SI, the mass could be hematoma versus seroma with enclosed fat loculi. (b) Axial DWI at *b* 0 and 1000 and ADC map: here the diagnosis is more likely to be seroma with enclosed fatty elements. (c) Axial 3D MIP showed faint marginal enhancement. Here DWI had excluded malignancy and discriminated seroma from hematoma. Such ability could guide management of the post operative sequel as Un-resolving postoperative hematomas cannot be aspirated (viscid blood), it should be evacuated under general anesthesia, while seroma could be easily aspirated followed by antibiotic coverage.

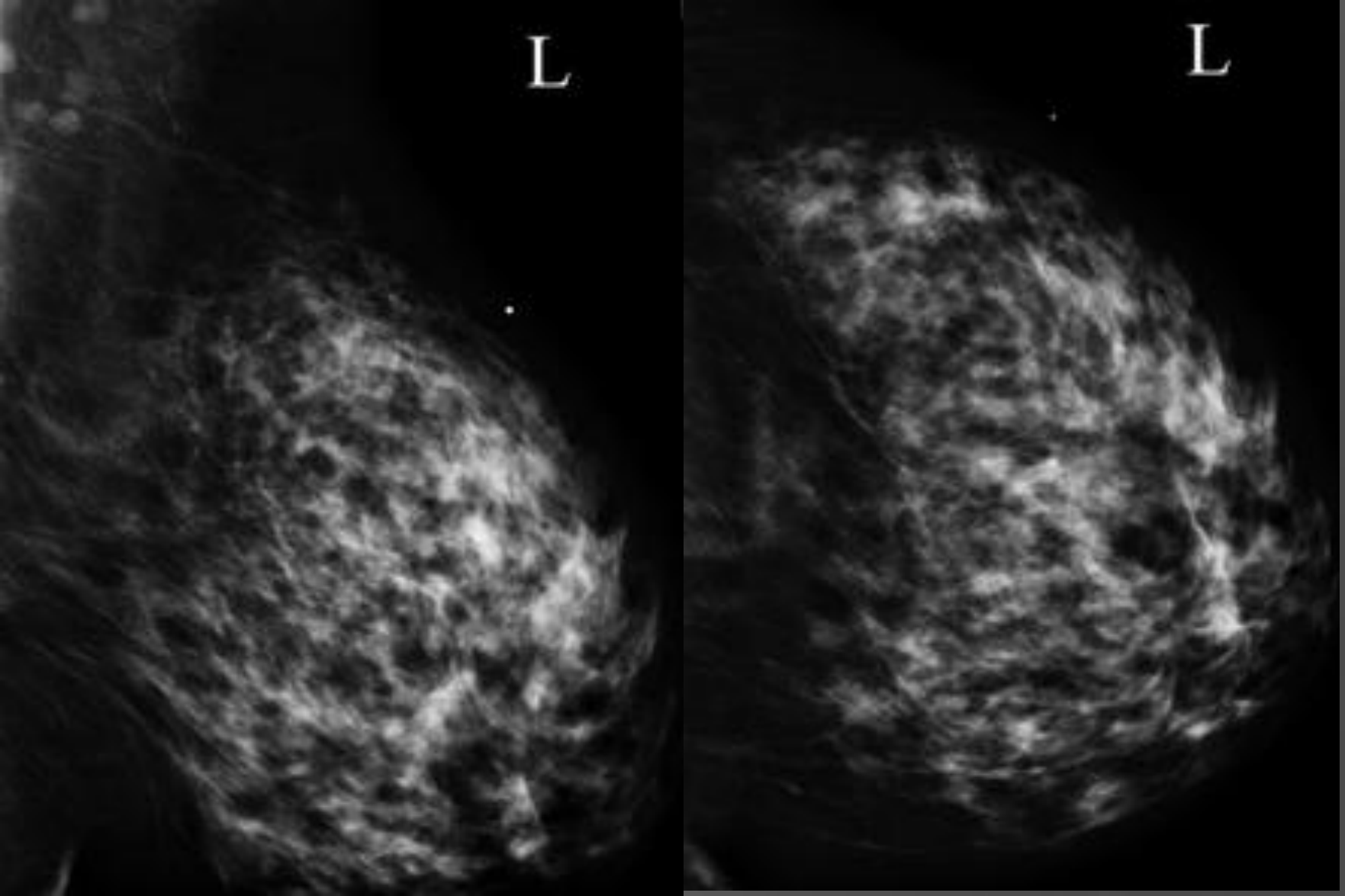
One month hx of breast surgery



- 52-year-old woman with positive surgical margins after lumpectomy for invasive lobular carcinoma. Breast MRI was performed 1 month after lumpectomy. Sagittal subtraction MR image created from first dynamic series obtained 90 seconds after contrast administration shows nodular enhancement (*arrows*) of anterior and inferior margins of postoperative seroma cavity corresponding to areas of residual malignancy found after reexcision.

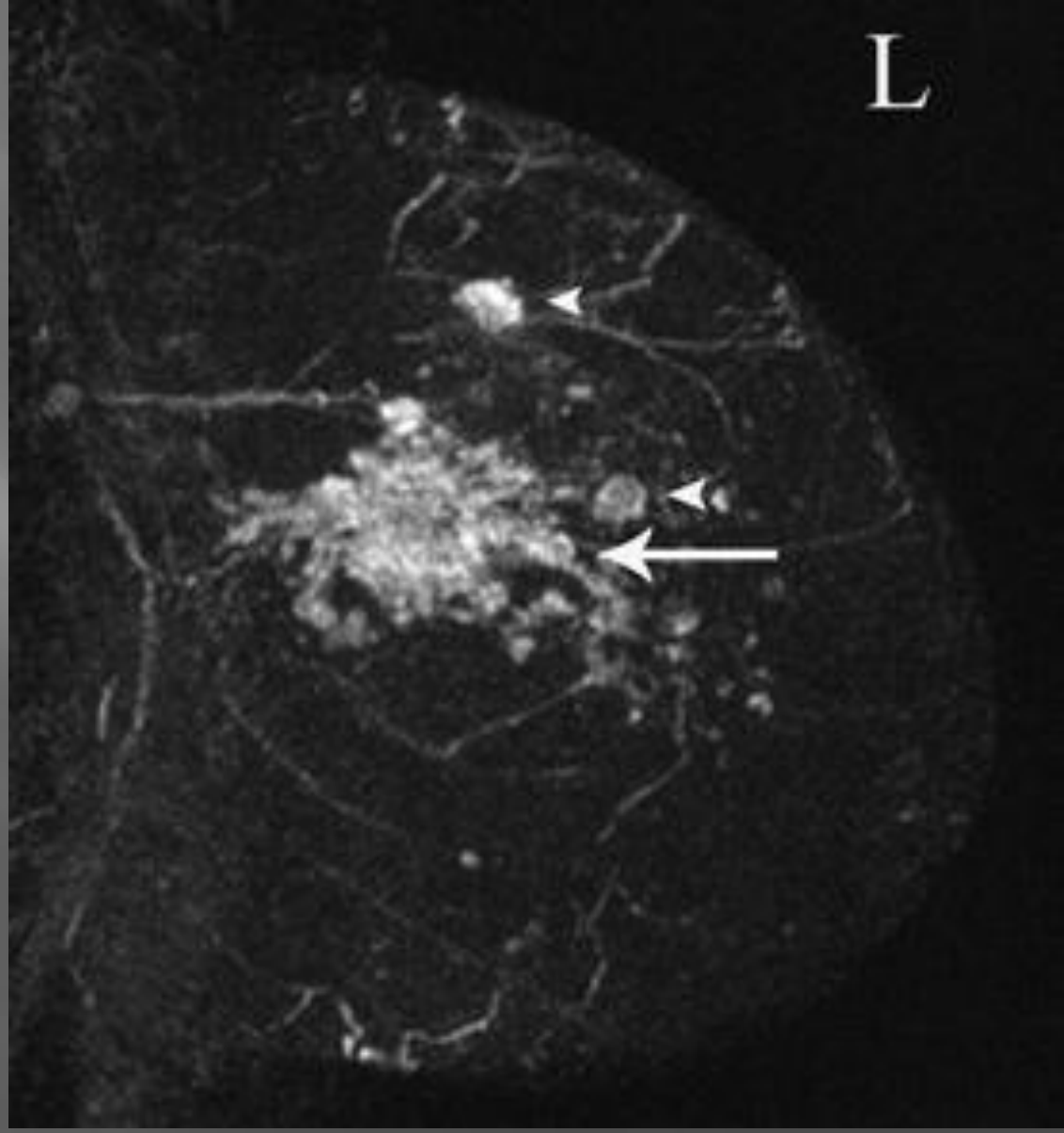

R

- 35-year-old woman with palpable lump in lower medial left breast. Sagittal subtraction MIP image of right breast created from first dynamic series obtained 90 seconds after contrast administration shows three irregularly shaped, rapidly enhancing masses and adjacent nonmasslike enhancement (*arrow*) at 12-o'clock position of right breast. These findings were unsuspected based on mammography. Diagnosis of invasive ductal carcinoma was made by ultrasound-guided biopsy. Patient was treated with bilateral mastectomies and was also found to carry *BRCA1* gene mutation.



- 61-year-old woman with palpable mass in upper outer left breast. Digital mammograms, mediolateral oblique (**A**) and craniocaudal (**B**) views, of left breast obtained with BB placed on skin over site where patient pointed out palpable mass show breast parenchyma is heterogeneously dense. No mammographic abnormality is evident.

Same case



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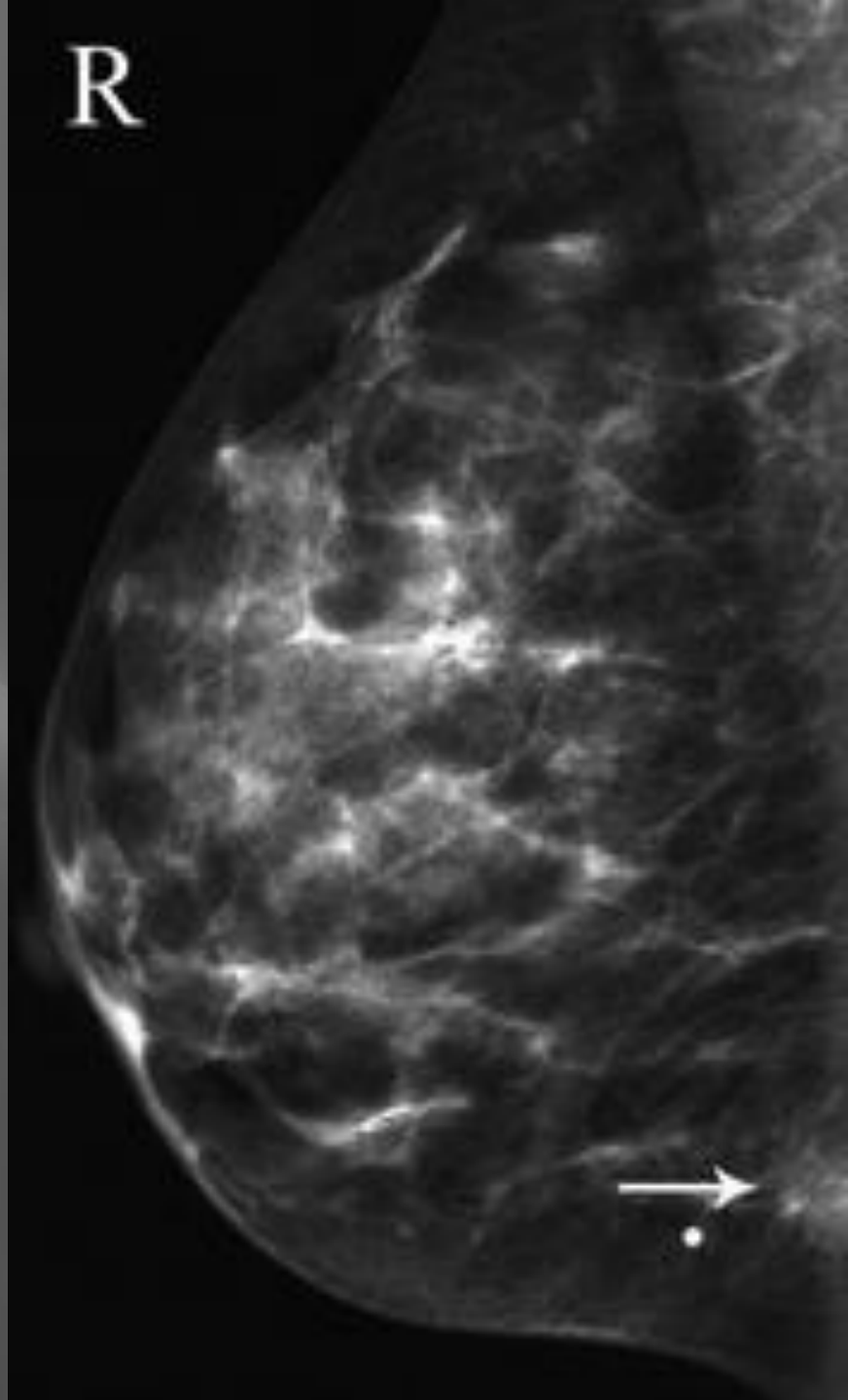
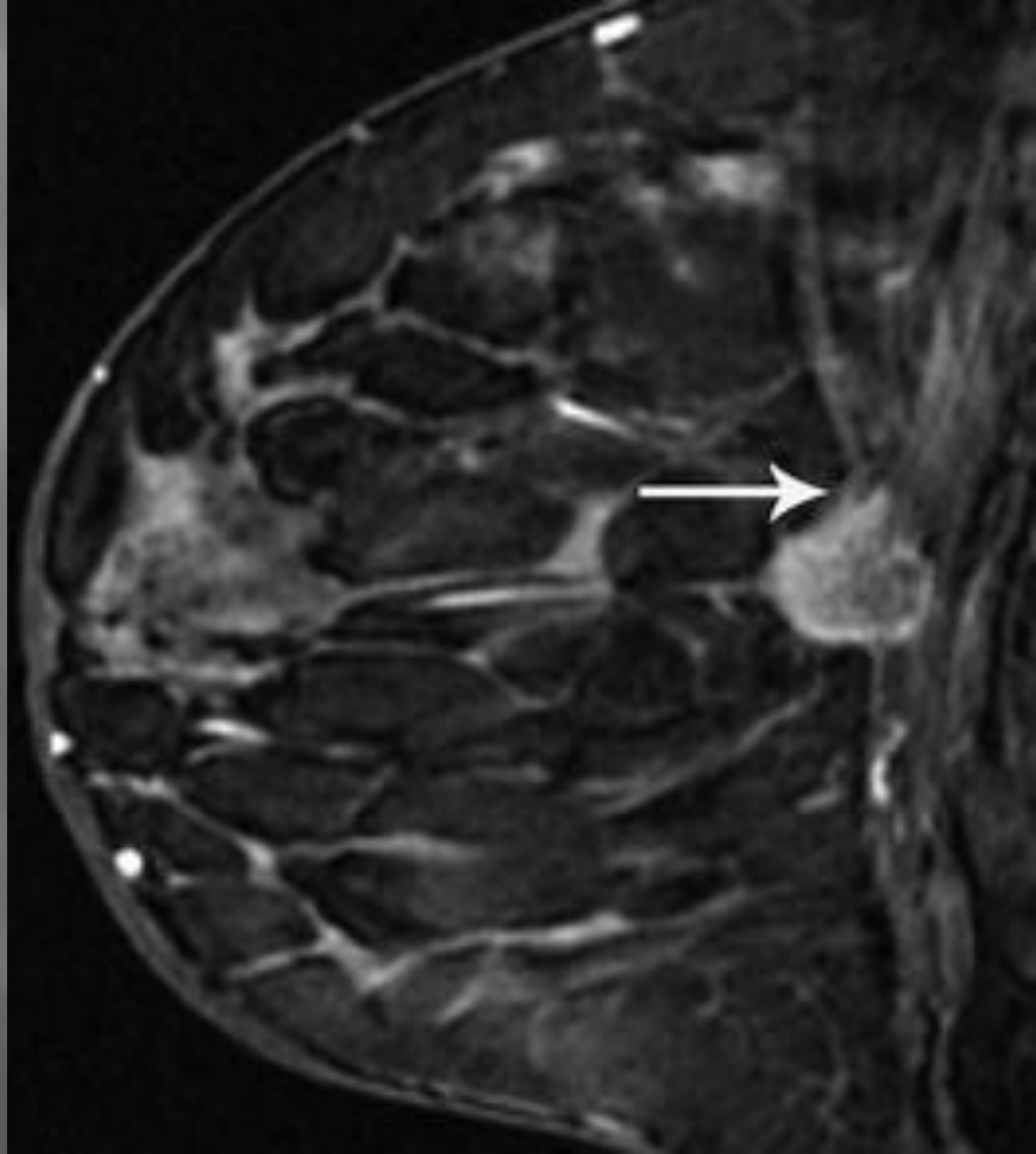
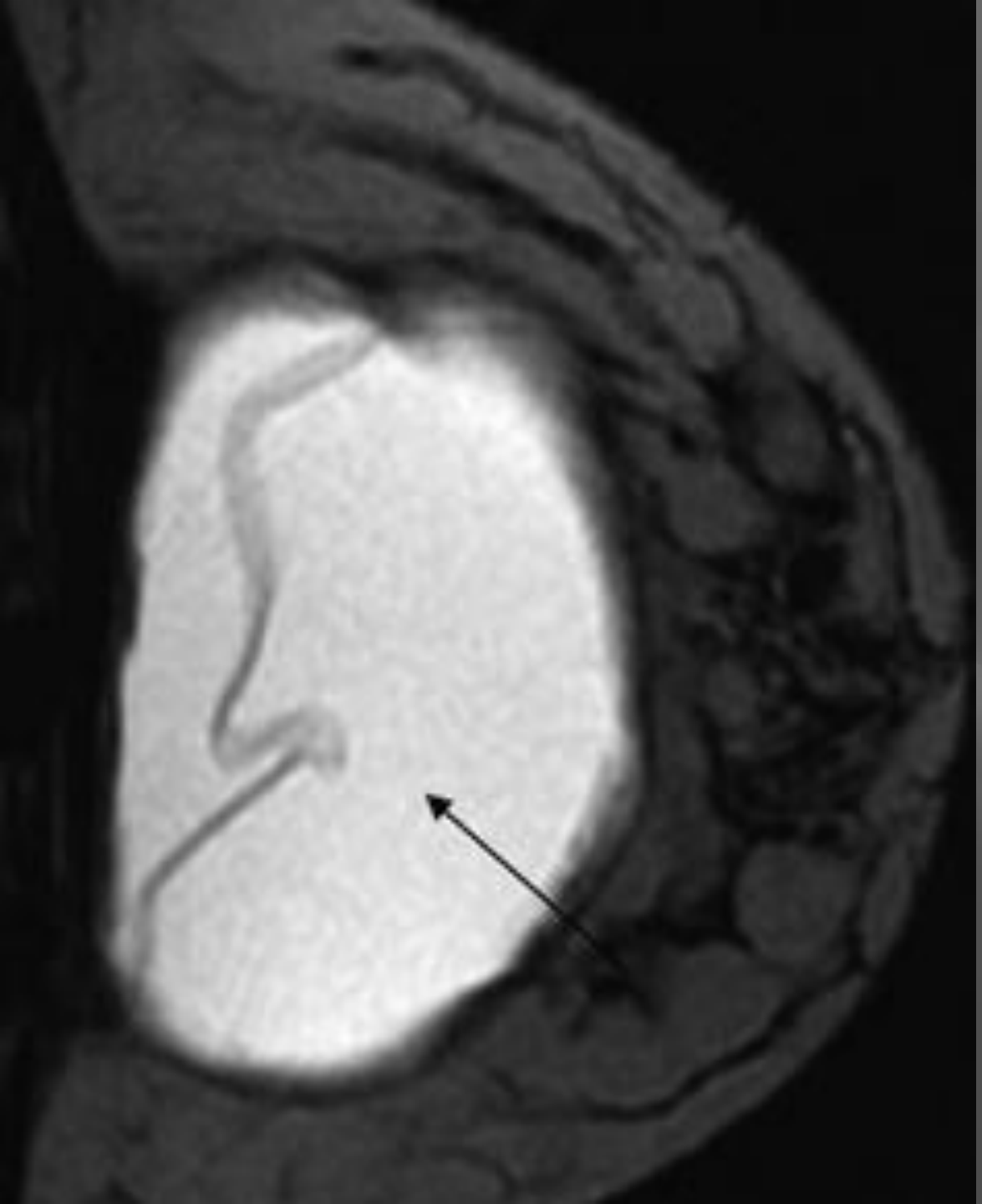


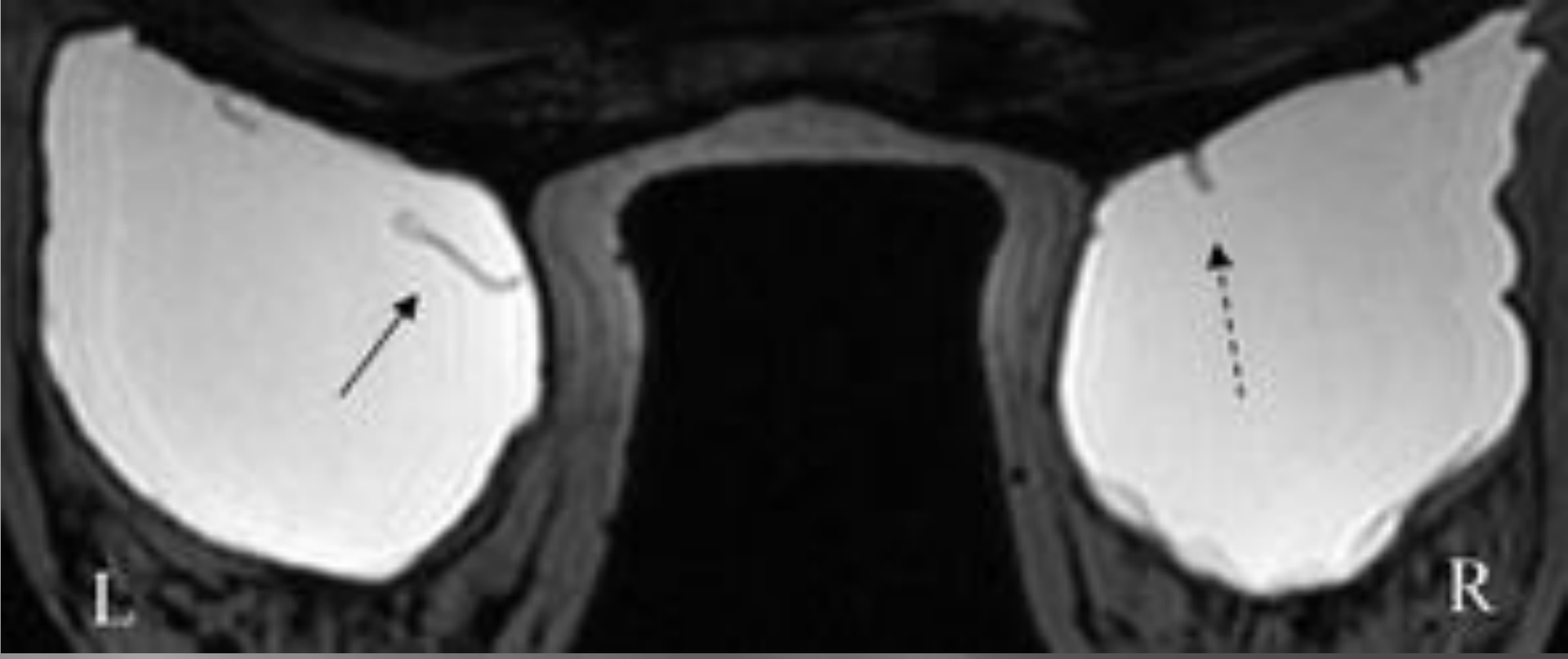
- —65-year-old woman with palpable mass in lower medial right breast. Digital mammogram, right mediolateral oblique view, obtained with BB marker on skin of inferior breast to indicate palpable abnormality pointed out by patient shows partially obscured mass (*arrow*) in posterior breast. Mass is not completely included on image because of its posterior location in breast.



65-year-old woman with palpable mass in lower medial right breast. Contrast-enhanced fat-suppressed T1 sagittal image of right breast from MRI performed for preoperative staging shows irregular mass with rim enhancement in posterior breast corresponding to biopsy-proven malignancy. Mass extends into pectoral muscle, and ill-defined enhancement (*arrow*) extends from superior margin of mass into pectoral muscle. Mass was invasive ductal carcinoma by ultrasound-guided biops



- Linguine sign (*arrow*) is seen as dark curvilinear line within silicone, indicating intracapsular implant rupture. There is no silicone outside implant to indicate extracapsular implant rupture.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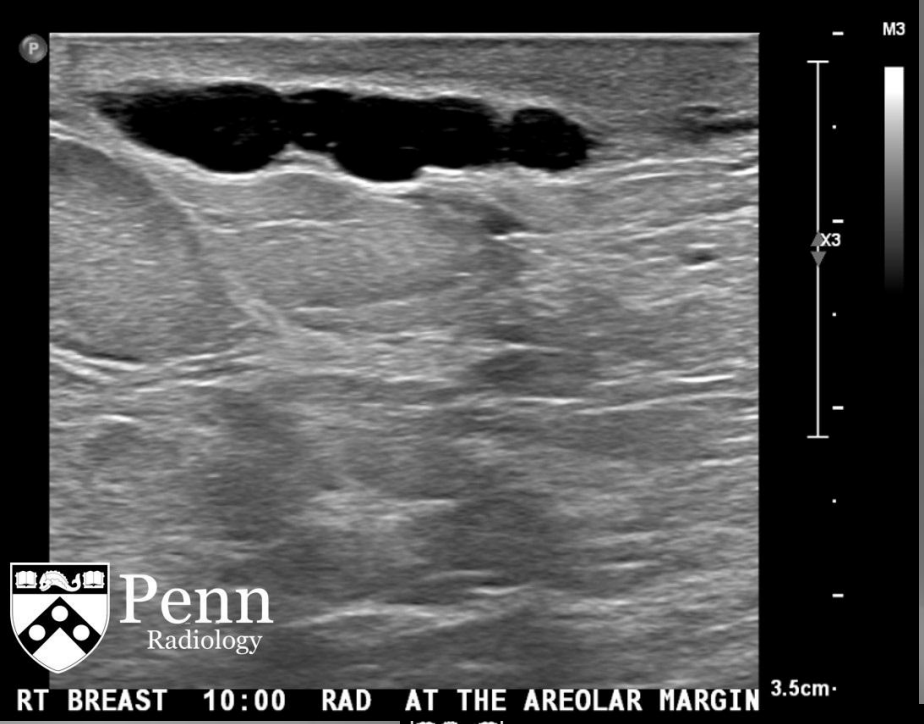
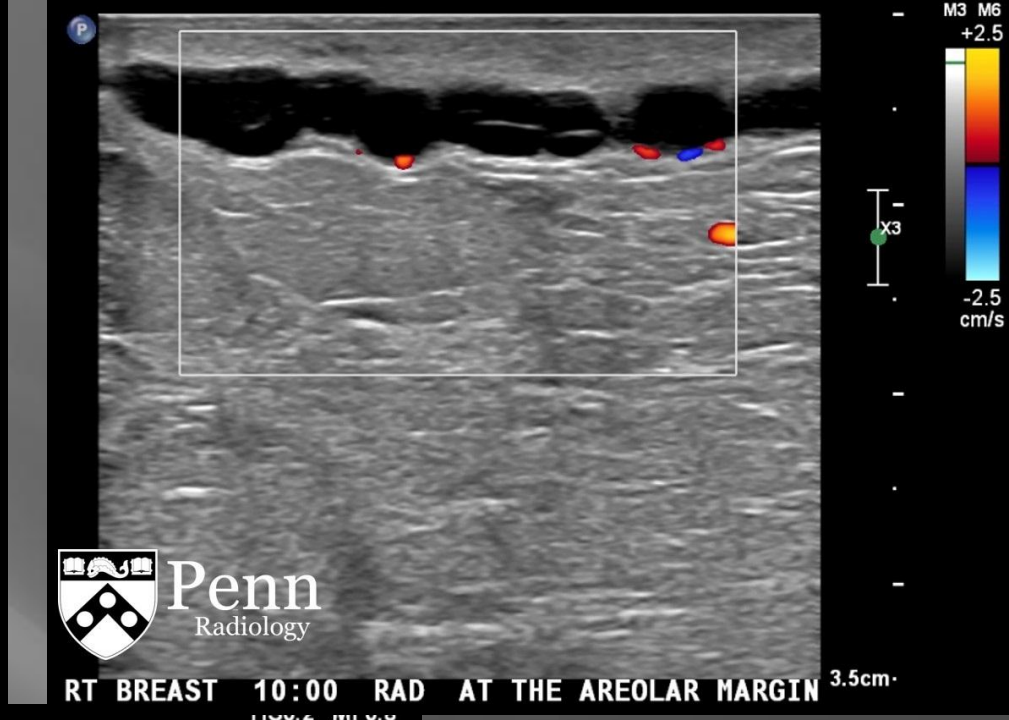
- 46-year-old woman with bilateral silicone breast implants who presented for bilateral mammography because of clinical concern for implant rupture. Axial unenhanced silicone-hyperintense inversion recovery MR image of both breasts shows keyhole sign (*solid arrow)* in left breast, which indicates intracapsular implant rupture. Normal radial folds (*dashed arrow*) are shown in right breast.


Penn
Radiology

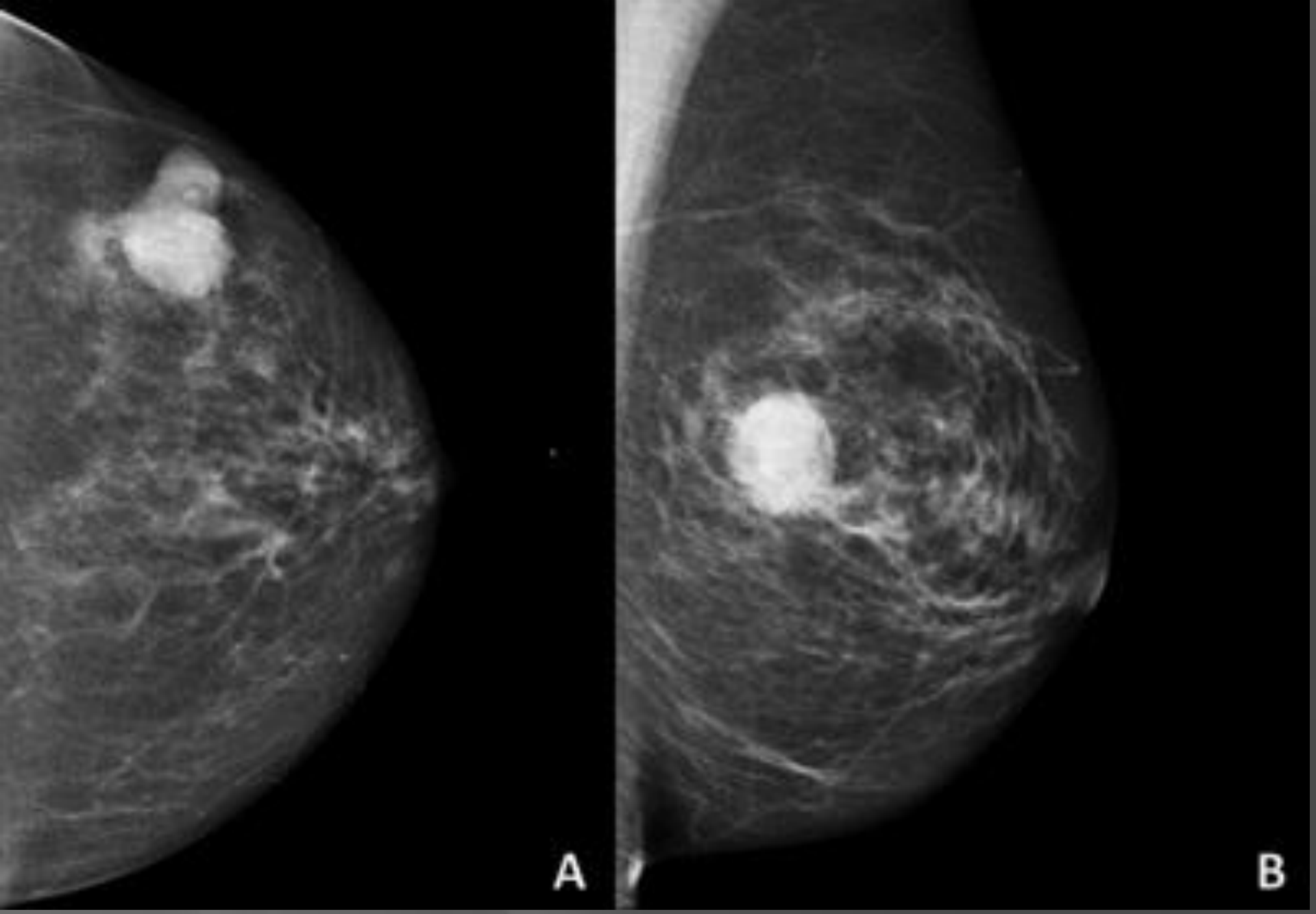

Penn
Radiology

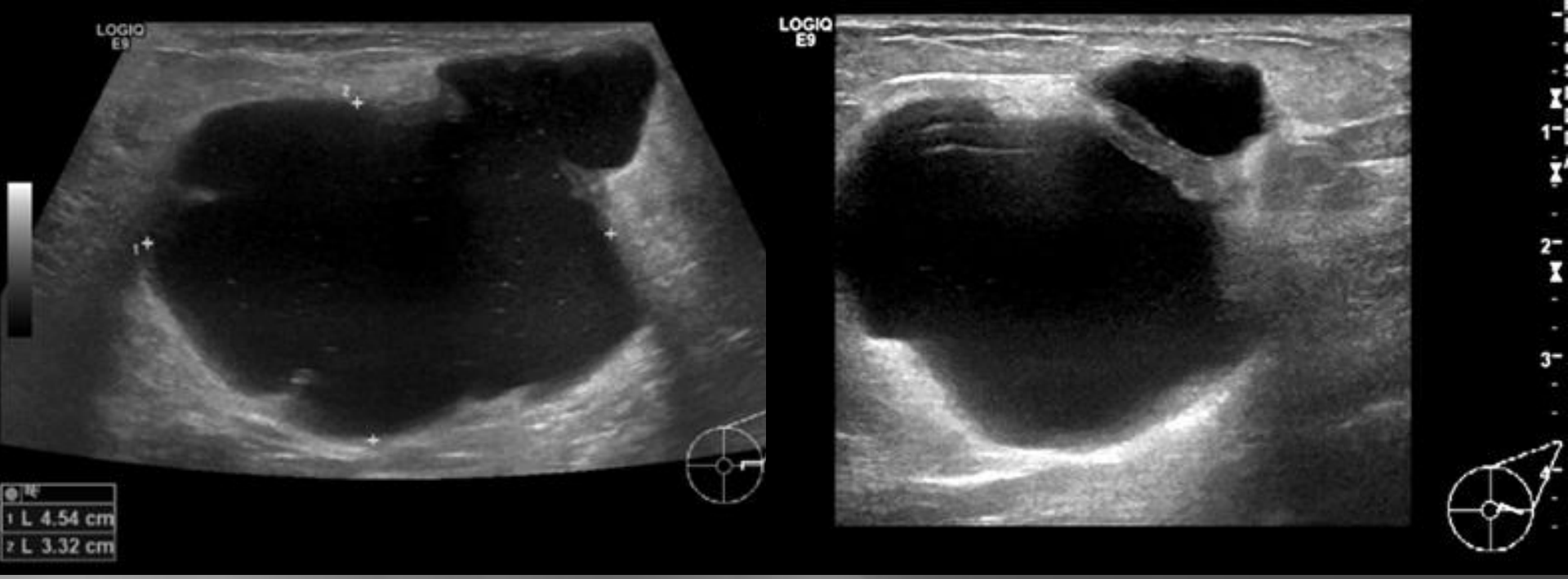

M3
X3
Penn
Radiology
RT BREAST 10:00 RAD AT THE AREOLAR MARGIN
3.5cm

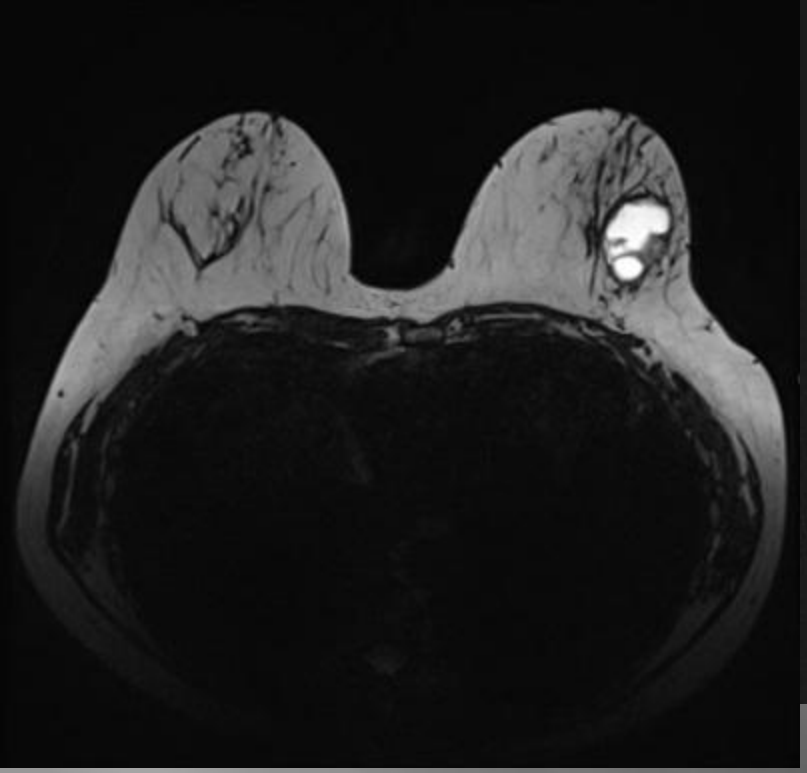

M3 M6
+2.5
-2.5
cm/s
X3
Penn
Radiology
RT BREAST 10:00 RAD AT THE AREOLAR MARGIN
3.5cm

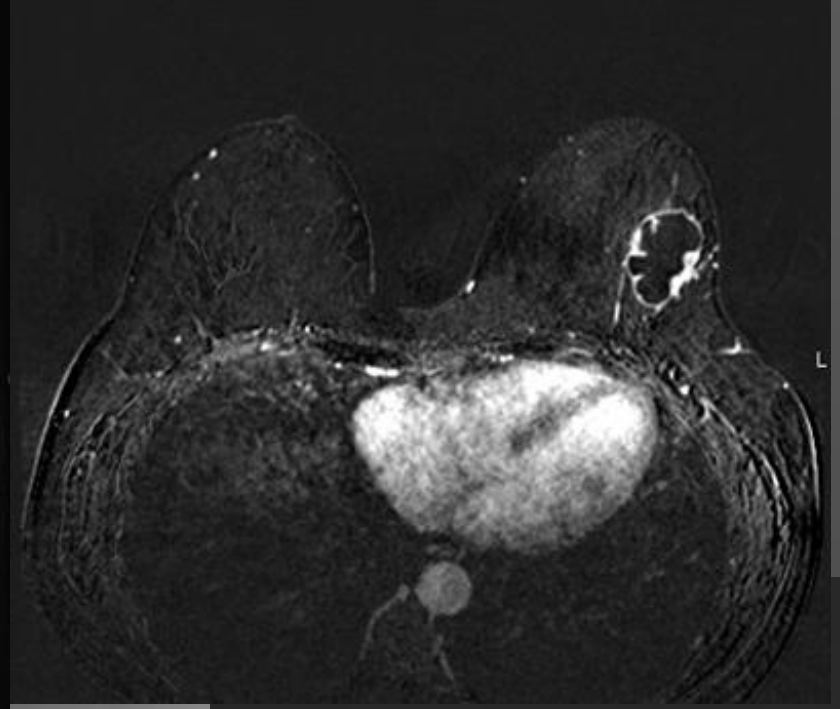

Penn
Radiology
M3
X3
3.5cm
cm/s
-6.0
RT BREAST 10:00 RAD AT THE AREOLAR MARGIN
36mm/s

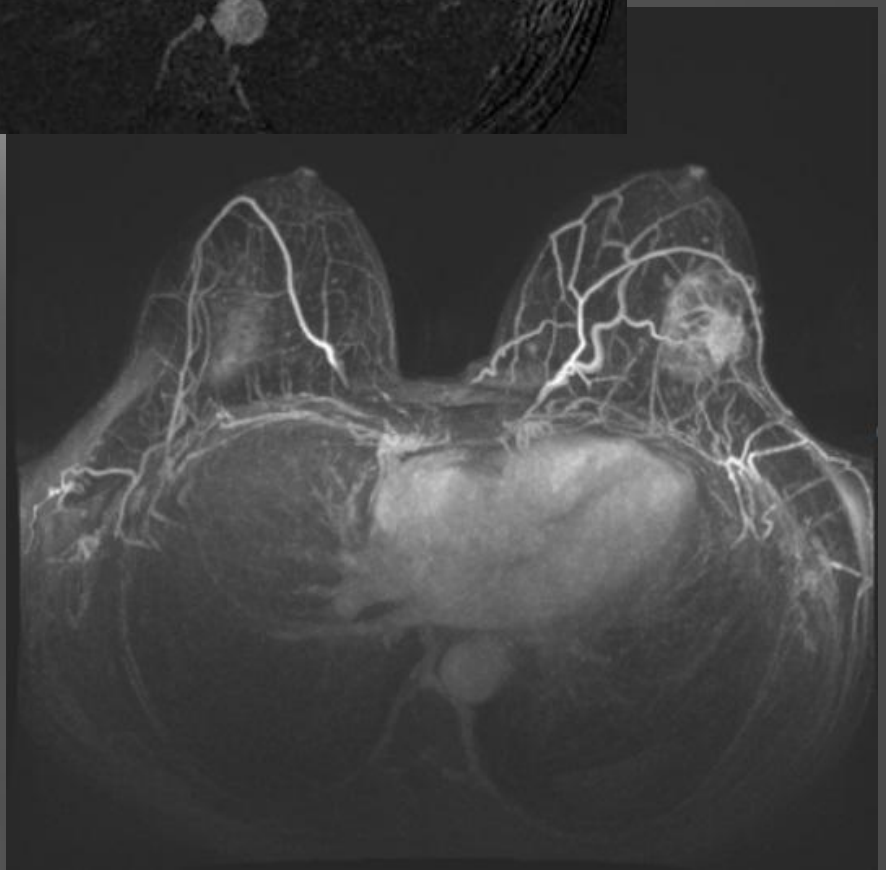
- **Findings**
- **Mammography:** There are scattered areas of fibroglandular density in the right breast. There is a tubular mass in the lateral right periareolar region with associate mild skin thickening. No calcifications or other abnormal findings are seen in the breast.
- **Ultrasound:** There is a superficially located, tubular, noncompressible anechoic structure with beaded appearances without flow on color Doppler studies and mild skin thickening.
- **Differential diagnosis**
- Thrombophlebitis migrans
- Infectious mastitis
- Inflammatory breast cancer
- **Diagnosis:** Superficial thrombophlebitis (Mondor's disease), BI-RADS 2: benign


A
B


LOGIQ
E9
1 L 4.54 cm
2 L 3.32 cm
LOGIQ
E9







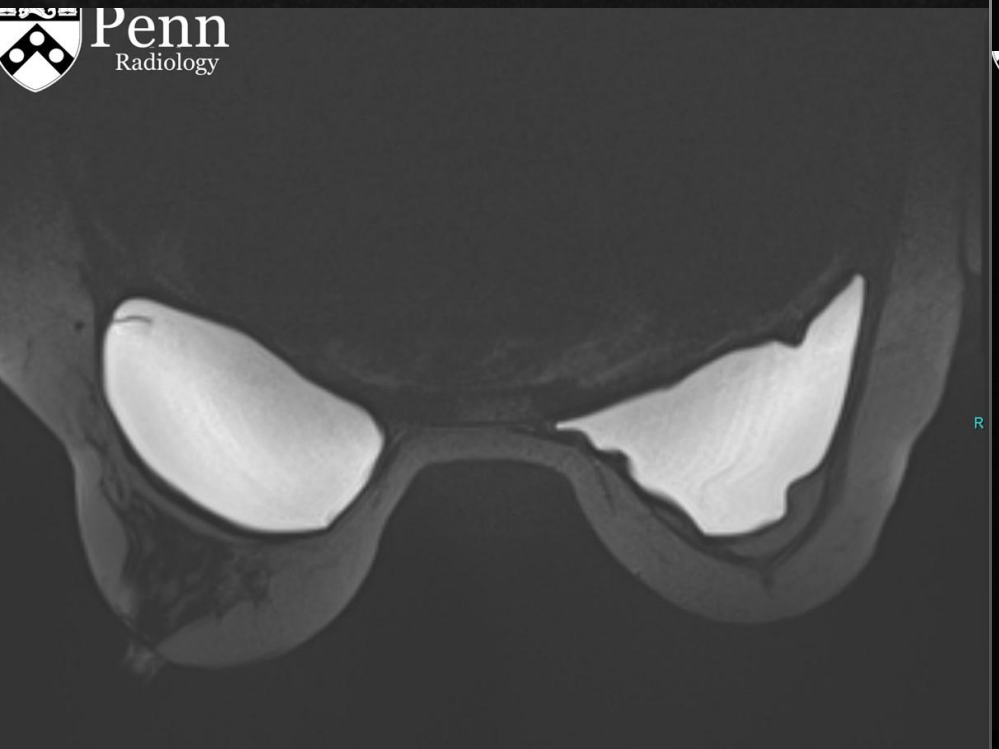
- **Findings**
- The palpable lump was initially interpreted on mammography as two adjacent simple cysts, which had been aspirated to dryness. After five months, the palpable lump in the left breast reoccurred; an ultrasound showed a bigger complex cystic lesion measuring 43 x 33 x 45 mm with internal septations and a thickened irregular wall superiorly.
- Following the second ultrasound, a core biopsy was performed due to the complex appearances of the cyst.
- The histopathological examination showed invasive ductal carcinoma.
- Preoperative MRI showed a large, predominantly cystic mass with a thin rim-enhancement at the periphery and a thicker nodular enhancing solid component at the outer aspect of the lesion, corresponding with the biopsy-proven malignancy.
- **Differential diagnosis**
- Intracystic papillary breast carcinoma
- Cystic degeneration of ductal carcinoma (not otherwise specified)
- Mucinous breast carcinoma (rarely)
- Focal fibrocystic change of the breast
- Intraductal or intracystic papilloma
- Atypical ductal hyperplasia
- Lobular neoplasia
- Ductal carcinoma in situ (DCIS)
- **Diagnosis:** Complex cysts


Penn
Radiology

Right breast hamartoma -- fibroadenolipoma


Radiology
L


Penn
Radiology


Penn
Radiology
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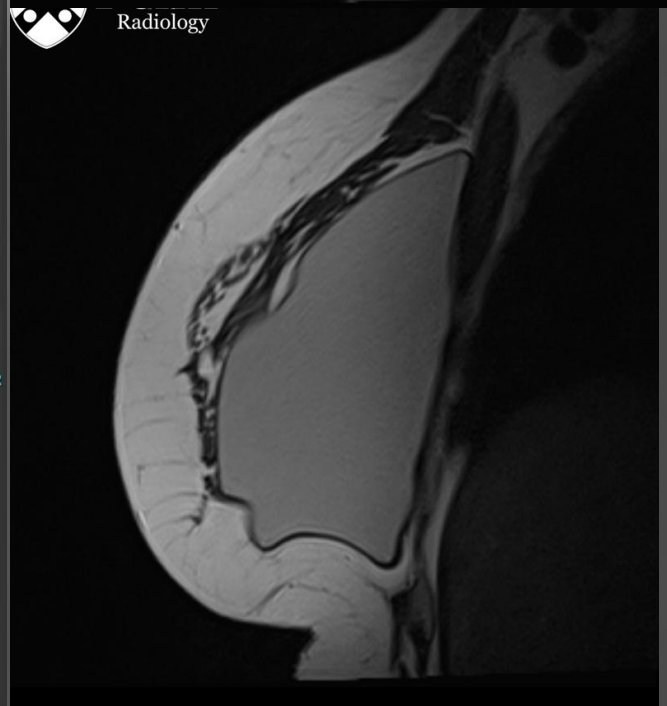
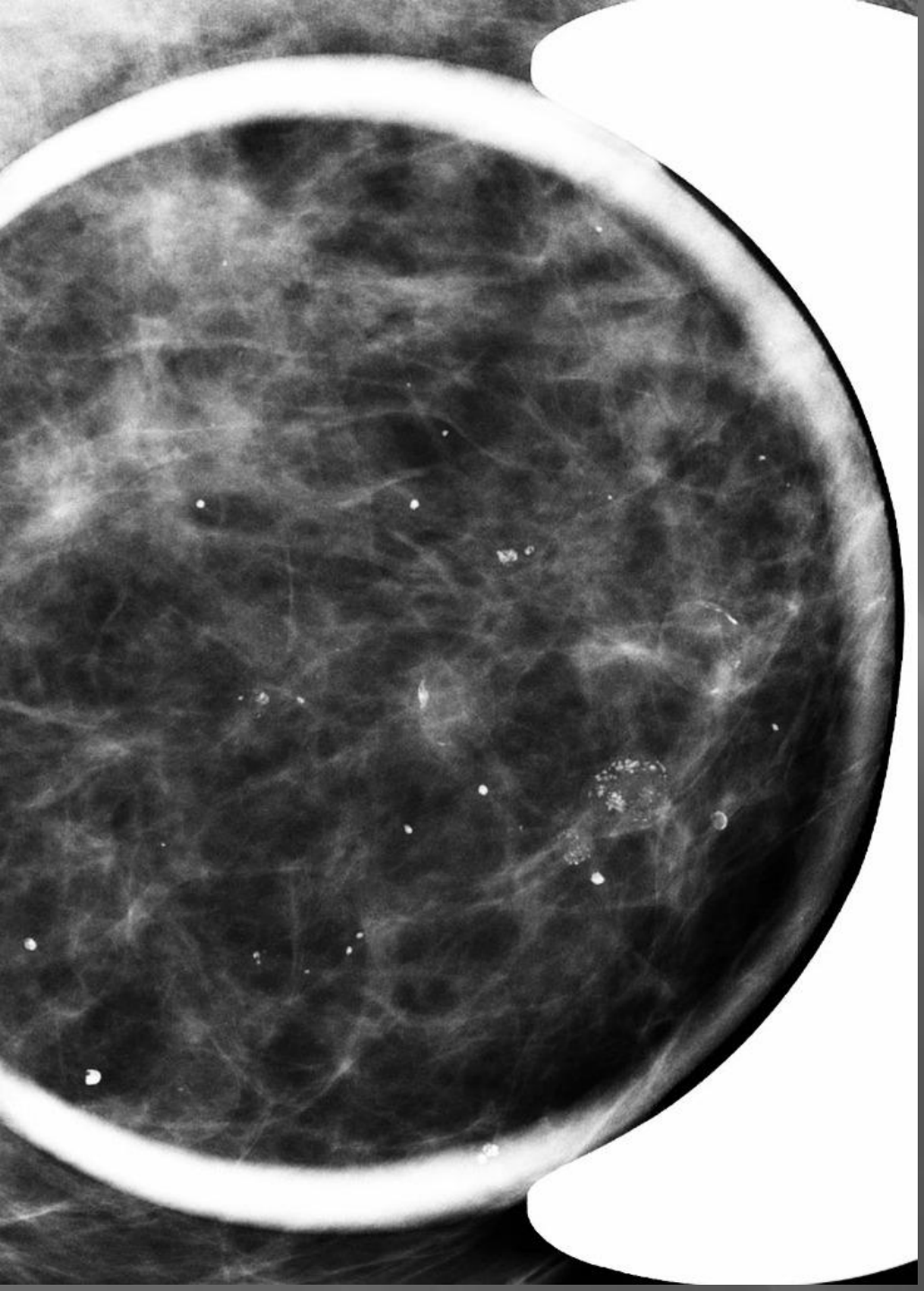
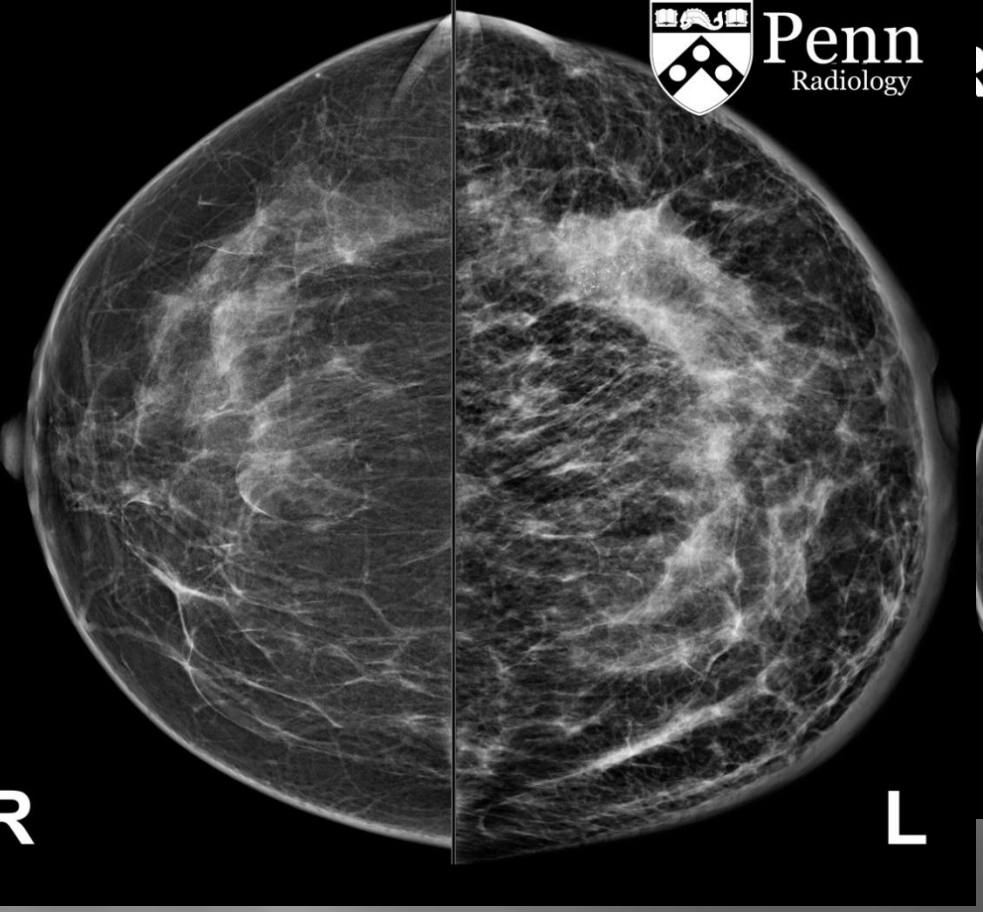

Radiology

- **MRI:** The breast has scattered fibroglandular tissue. There are bilateral subpectoral silicone implants. There is intracapsular rupture of the left breast implant without extracapsular rupture. The right breast implant is intact.
- **Diagnosis:** Silicone breast implant intracapsular rupture of the left breast



Fat necrosis left breast

- Note the lucent pools of fat necrosis with peripheral punctate calcifications.


Penn
Radiology
R
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L
Penn
Radiology


SIEMENS
18L6 HD
*Breast
General
MI: 0.9
54fps
2D – 100%
GEN
15.00 MHz
0dB / DR65
CTI 1
ASC 3
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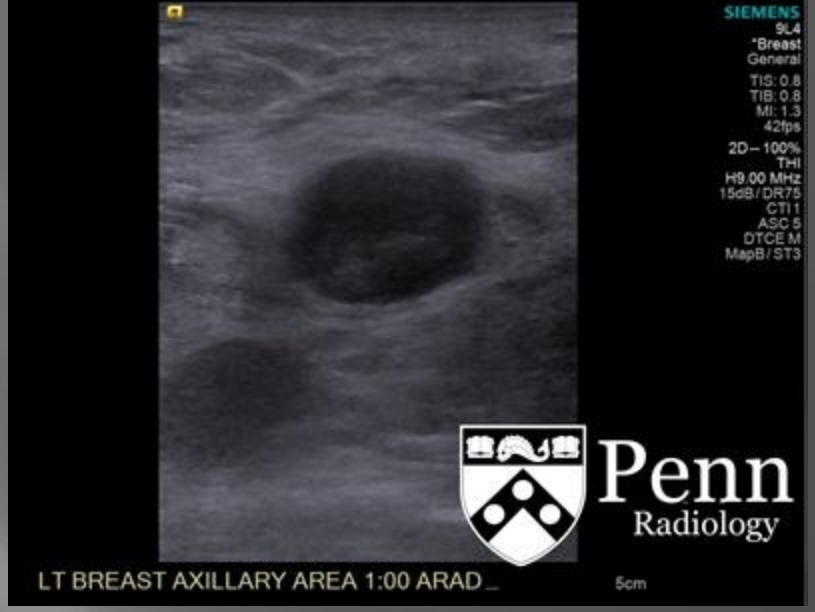
MapC / ST3
D=0.85 cm
Penn
Radiology
LT BREAST|RETRO AREOLAR
4.5cm


SIEMENS
9L4
*Breast
General
TIS: 0.8
TIB: 0.8
MI: 1.3
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THI
H9.00 MHz
15dB / DR75
CTI 1
ASC 5
DTCE M
MapB / ST3
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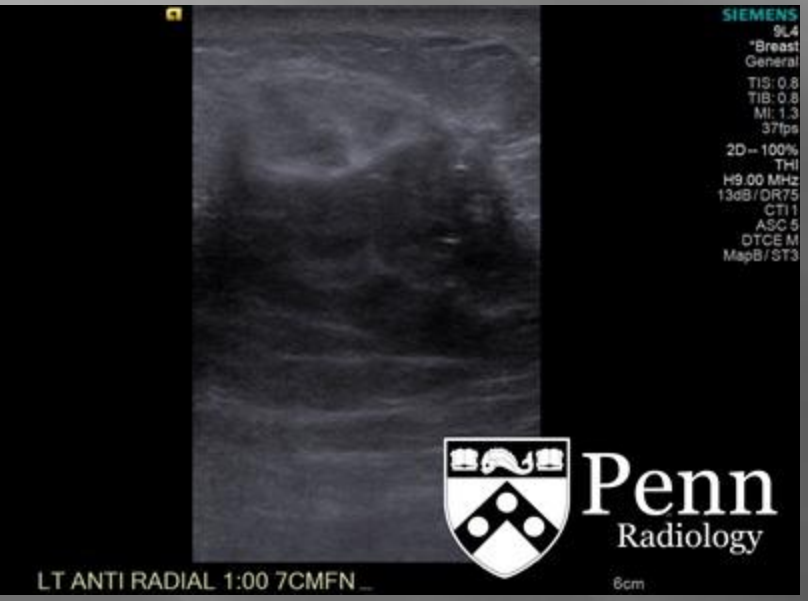
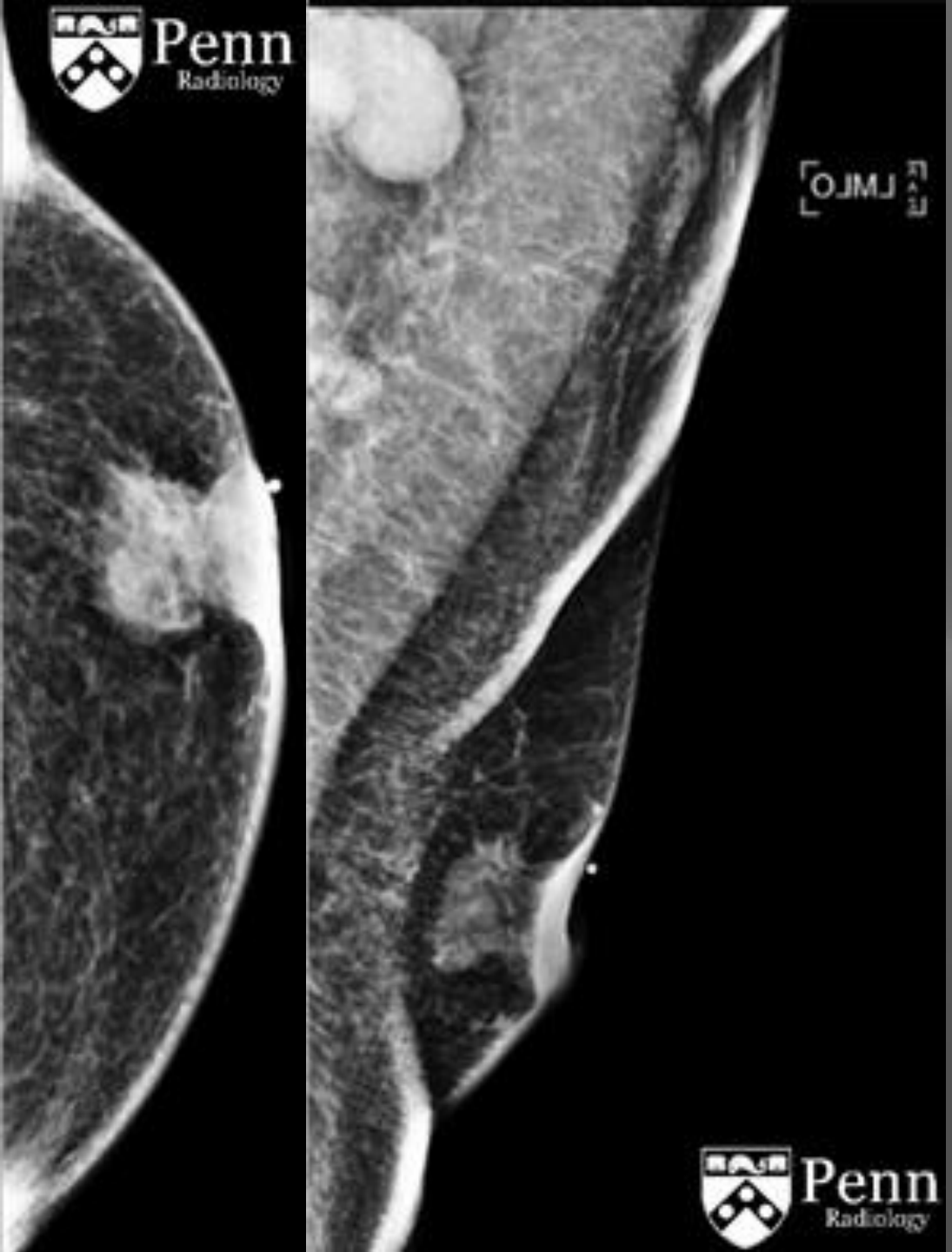
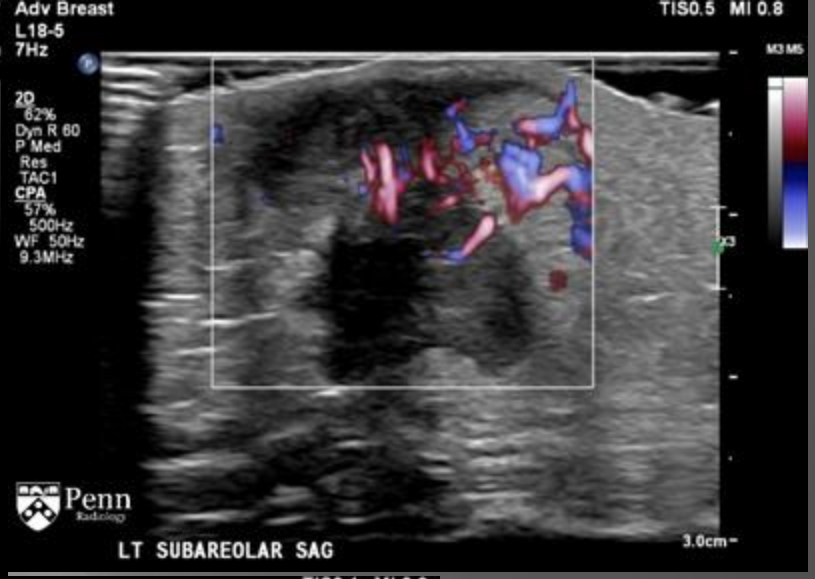
Radiology
LT BREAST AXILLARY AREA 1:00 ARAD _
5cm


SIEMENS
9L4
*Breast
General
TIS: 0.8
TIB: 0.8
MI: 1.3
37fps
2D – 100%
THI
H9.00 MHz
13dB / DR75
CTI 1
ASC 5
DTCE M
MapB / ST3
Penn
Radiology
LT ANTI RADIAL 1:00 7CMFN _
6cm

- **Mammography:** There is a diffuse increase in breast density and interstitial markings with associated skin thickening and asymmetric enlargement of the left breast. There is focal asymmetry in the left outer upper quadrant with associated coarse calcifications. There is suspicious asymmetric enlargement of the left axillary lymph nodes.
- **Ultrasound:** There is skin thickening with associated thickening and echogenicity of the subcutaneous tissue. At 1:00, 7 cm from the nipple, there is a 4-cm irregular hypoechoic, spiculated, nonparallel mass with posterior acoustic shadowing. This mass correlates with the mammographic finding. In addition, there is suspicious left axillary lymphadenopathy, characterized as round nodes with diffuse cortical thickening and displaced echogenic hilum.
- **Differential diagnosis**
- Inflammatory breast cancer
- Acute puerperal mastitis with abscess
- Infected galactocele
- Nonpuerperal subareolar mastitis
- Postprocedural mastitis
- Infected sebaceous cysts
- Idiopathic granulomatous mastitis
- Xanthogranulomatous mastitis
- Plasma cell mastitis
- Diabetic mastopathy
- **Diagnosis:** Inflammatory breast cancer


Penn
Radiology
LMLO
Penn
Radiology


Adv Breast
L18-5
45Hz
RS
2D
60%
Dyn R 68
P Low
Res
TAC1
TIS0.1 MI 0.7
Penn
Radiology
LT SUBAREOLAR SAG
3.0cm


Adv Breast
L18-5
7Hz
2D
62%
Dyn R 60
P Med
Res
TAC1
CPA
57%
500Hz
WF 50Hz
9.3MHz
TIS0.5 MI 0.8
Penn
Radiology
LT SUBAREOLAR SAG
3.0cm

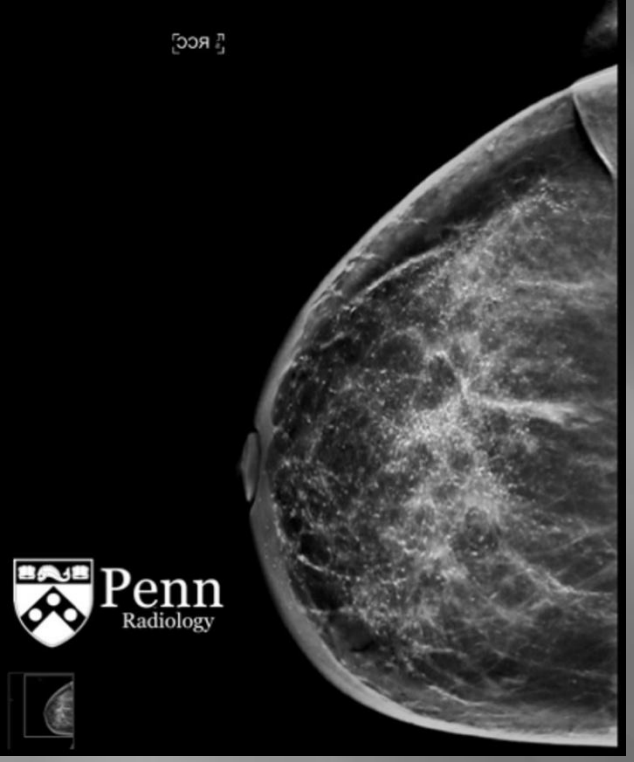

Adv Breast
L18-5
38Hz
RS
2D
59%
Dyn R 68
P Low
Res
TAC1
TIS0.1 MI 0.9
Penn
Radiology
Dist 2.50 cm AXILLA
Dist 1.88 cm
5.0cm

- **Mammography:**
  - Irregularly shaped mass with spiculated margins in the subareolar region of the left breast
  - Left nipple retraction
  - Skin thickening involving the anterior breast in the nipple areolar complex
  - Multiple enlarged left axillary lymph nodes
- **Ultrasound:**
  - Heterogeneous, hypervascular, subareolar mass with nipple involvement
  - Multiple enlarged left axillary lymph nodes with effaced fatty hila (only one is shown)
- **Differential diagnosis**
- Breast malignancy
- Mastitis
- **Diagnosis:** Infiltrating ductal carcinoma with partial micropapillary features and axillary metastases -- pathology-proven

- **Risk factors**
- Recognized risk factors include:
- exposure to ionizing radiation: especially to the chest wall
- cryptorchidism
- testicular injury / infectious orchitis [ref]
- increased levels of estradiol
  - consider this risk in transgender patients
- Klinefelter syndrome
- liver dysfunction: cirrhosis
- prostate cancer
- family history: ~30% of cases can have a positive family history
- chest trauma
- age
- certain racial groups: may have a comparatively higher incidence
- *BRCA2* gene mutation [2]
- Please note gynecomastia is not a risk factor per se.

Male breast ca.

- Histologically, the vast majority are invasive ductal carcinoma (85-90%) or ductal carcinoma in situ.
-


RCC
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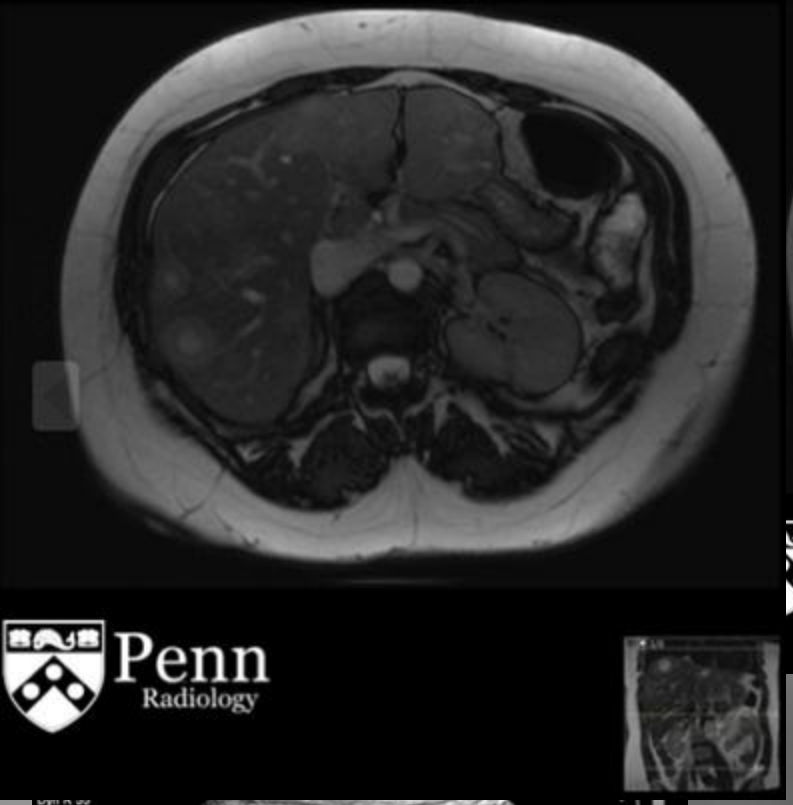
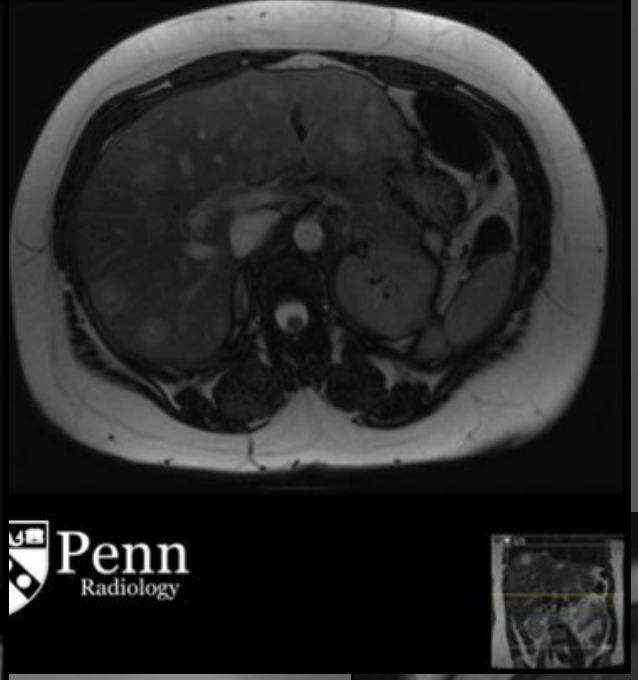
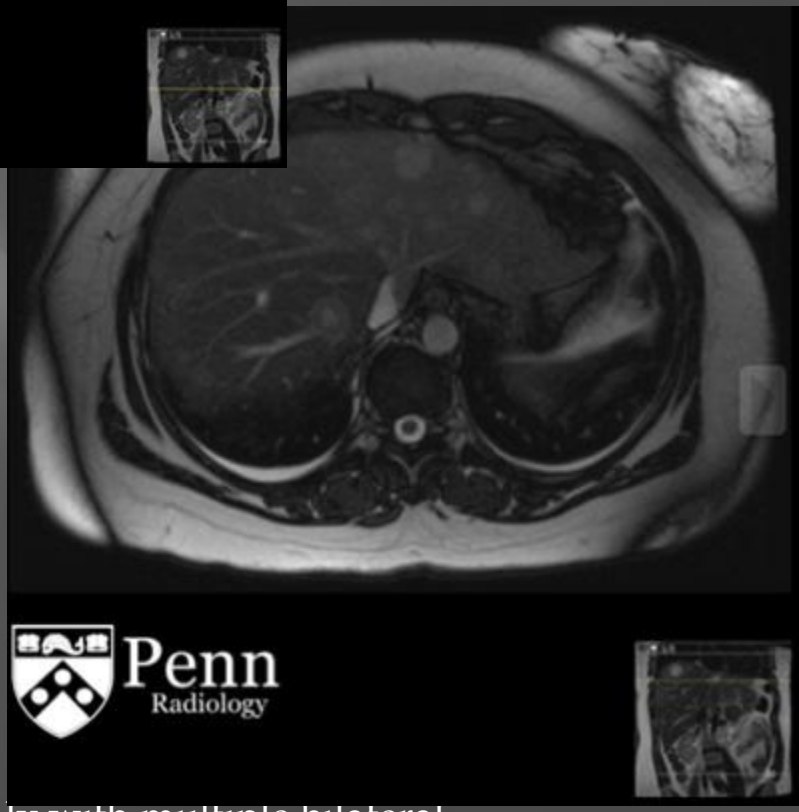
Radiology


RMLO
Penn
Radiology

- This patient's right breast shows an upper central irregular, spiculated mass with diffuse fine pleomorphic and fine linear branching calcifications. There is also diffuse skin thickening raising suspicion for inflammatory breast cancer. These findings are highly suggestive of malignancy (> 95% risk of cancer), according to the fifth edition of BI-RADS, and require tissue diagnosis.
-

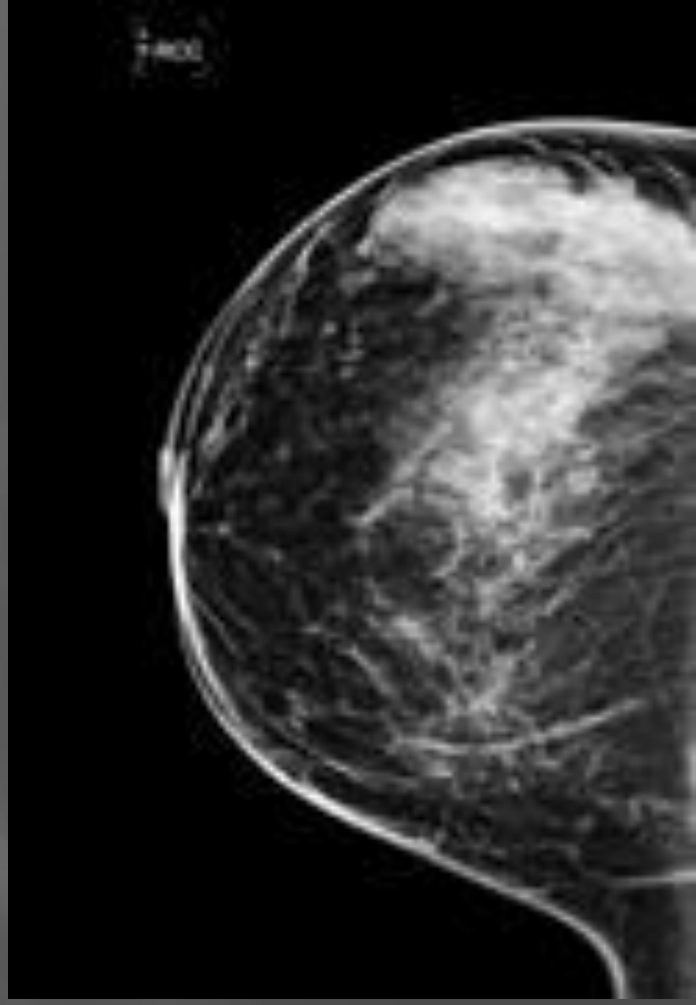






- **Abdominal ultrasound:** Ultrasound shows hepatomegaly with multiple bilateral hypoechoic lesions with hypoechoic halos in the liver.
- **MRI:** MRI demonstrates multiple bilobar target lesions with central T2 hyperintensity.

Diagnosis: Metastatic invasive ductal carcinoma



- Next step?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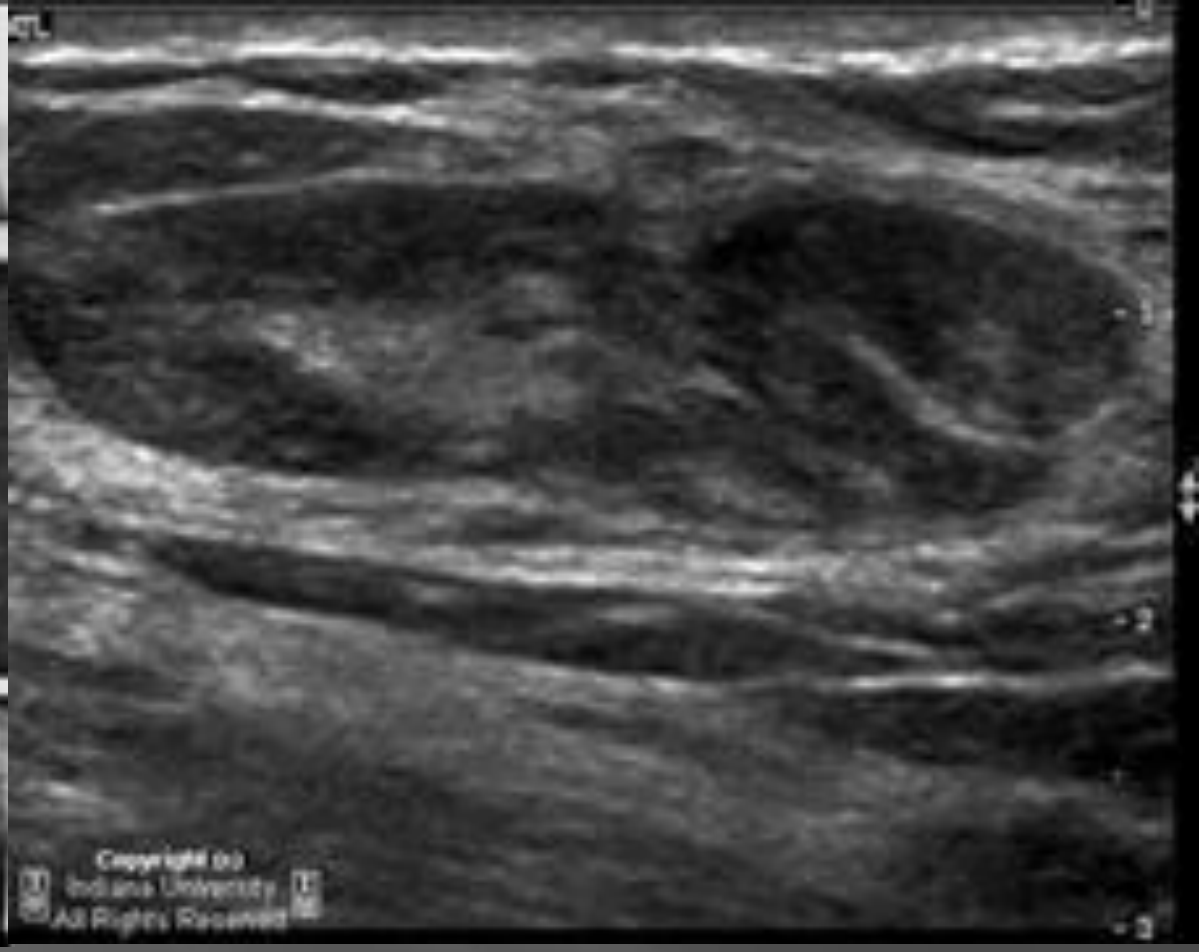
RMLO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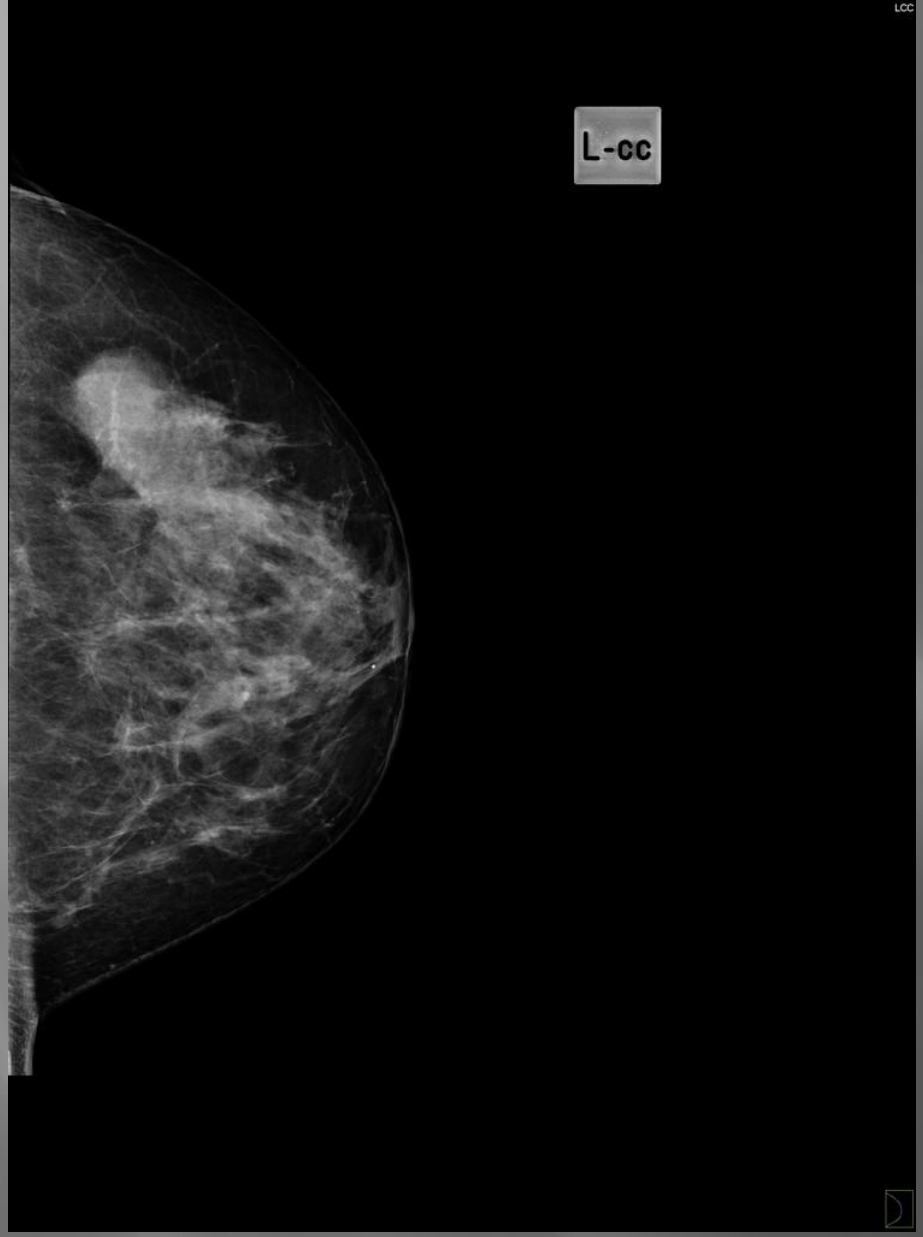
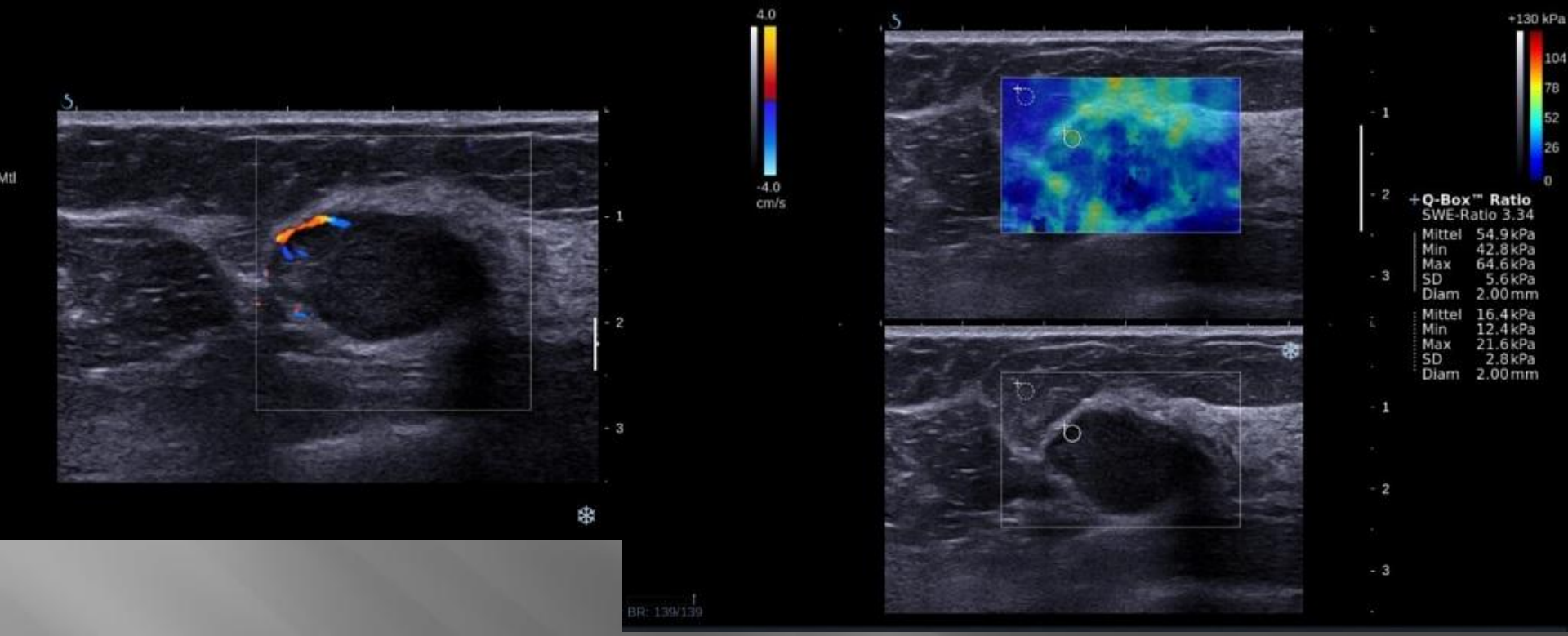
- **Findings**
- **Mammography:**
  - Screening mammogram shows scattered fibroglandular densities. There are no suspicious findings present within the left breast. There is an oval, hyperdense mass within the middle third of the upper outer quadrant of the right breast.
  - Diagnostic mammogram shows a round to oval hyperdense mass with partially circumscribed, partially obscured borders.
- **Ultrasound:** Right breast shows an oval, largely hypoechoic mass with circumscribed margins and that is wider than tall. There was no evidence of increased color flow within the mass.
- **Differential diagnosis**
- Breast carcinoma
- Cyst
- Fibroadenoma
- Pseudoangiomatous stromal tumor
- Myofibroblastoma
- **Diagnosis:** Myofibroblastoma of the breast

Mammary myofibroblastoma

- **Mammary myofibroblastoma** is a rare, benign, circumscribed mesenchymal breast tumor.
- **Epidemiology**
- It is the only breast tumor that occurs more commonly in males than females [2]. It also has a tendency to occur more often in elderly males and postmenopausal women.
- **Pathology**
- It arises from the stromal spindle cells of the breast [1]. It stains positive for immunoreactive markers for desmin, smooth muscle, and actin.
- **Radiographic features**
- **Mammography**
- circumscribed mass
- no calcifications
- greatest diameter no more than 1-4 cm
- **Ultrasound**
- It usually has the appearance of a fibroadenoma:
- circumscribed homogenous
- slightly hypoechoic
- **MRI**
- circumscribed mass
- internal septations
- homogenous enhancement
- **Treatment and prognosis**
- Complete resection is recommended as it has a high rate of recurrence if not completely excised [3].
- **Differential diagnosis**
- fibroadenoma
- hamartoma
- lipoma



- Palpable mass.
- Breast parenchyma density: Heterogeneously dense (ACR type c).
- Findings: In the left breast, at 3 o'clock, there is a round, partly indistinct marginated, high density mass with a 22 mm diamter.



- Hypoechoic mass with hypervascularization in the margin and high values in the shear wave elastography. Diamter 11 x 17 x 21 mm.