Breast imaging

MD PhD Kristina Lång

Lund University

GOOD SCIENCE
BETTER MEDICINE
BEST PRACTICE

Disclosure:

Received speaker's fee and travel grant from Siemens

Siemens Scientific Advisory Board Member (2017)

Research collaboration with Philips

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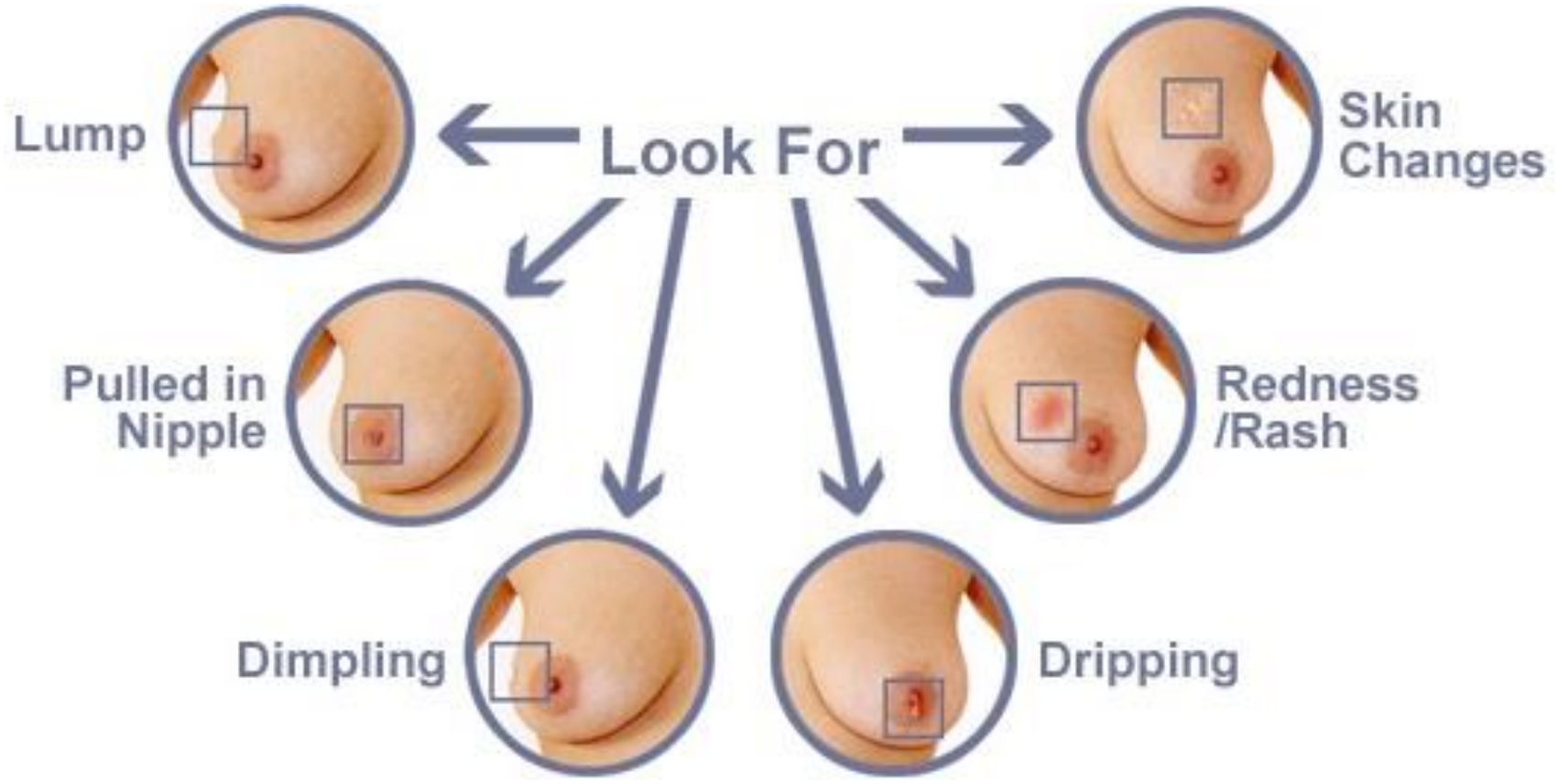
Assessment of symptomatic women



- Classification — Benign or Malignant cause of the symptoms? Tripple assessment
- Staging — Characterizing the cancer: size, multiplicity, lymph node status

Breast imaging techniques

- Mammography
- Ultrasonography
- MRI
- Tomosynthesis
- Contrast enhanced spectral mammography
- Breast CT, optical imaging, foto-acoustic imaging, breast specific gamma imaging, thermography, phase-contrast mammography…

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Mammography

- X-ray imaging technique
- Attentuation differences of tissues with different densities
- Women age > 30–35

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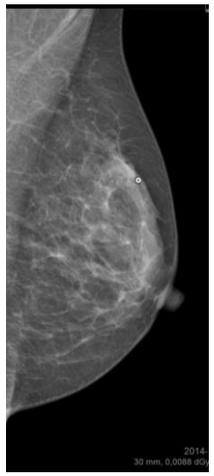
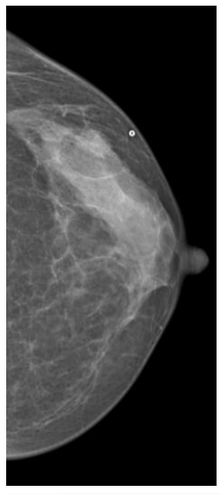
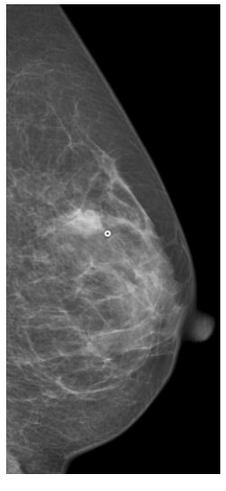
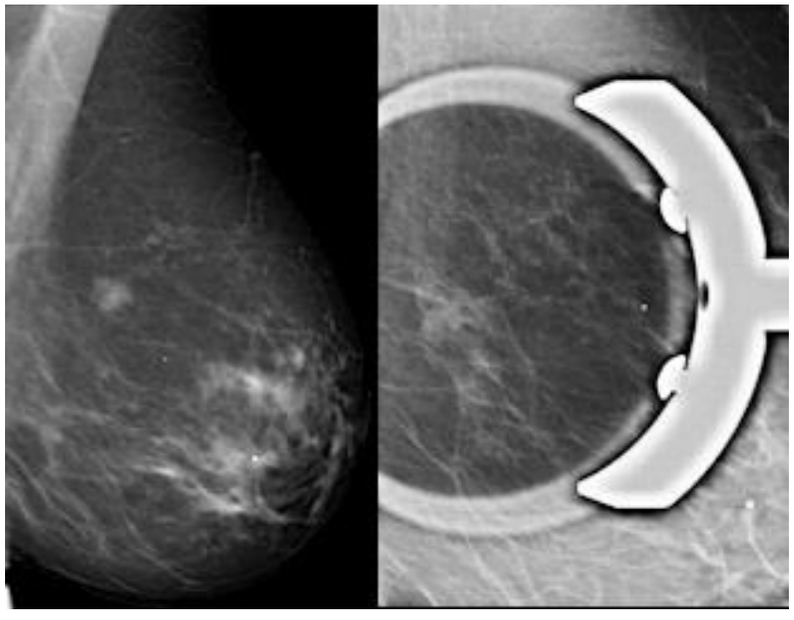
Mammographic views







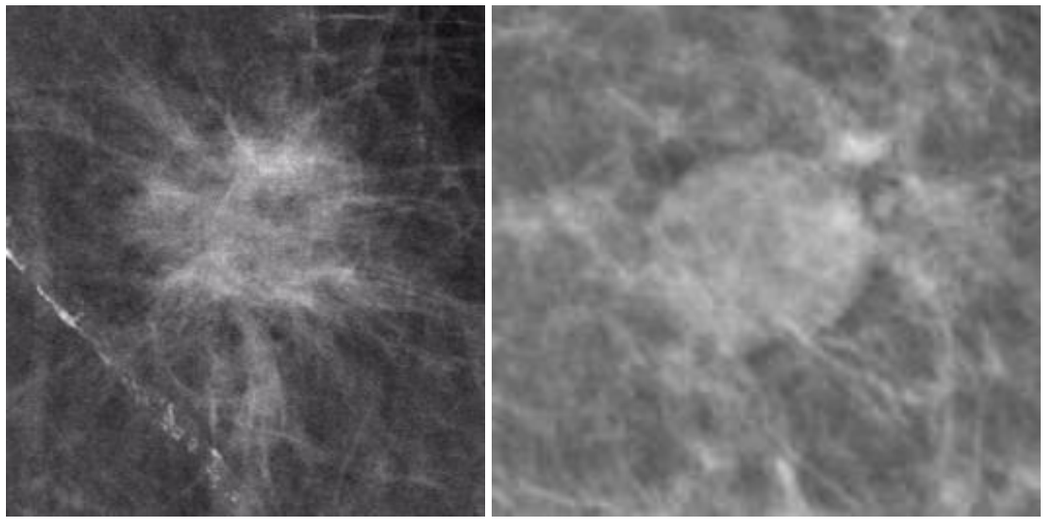
- Mediolateral oblique (MLO)



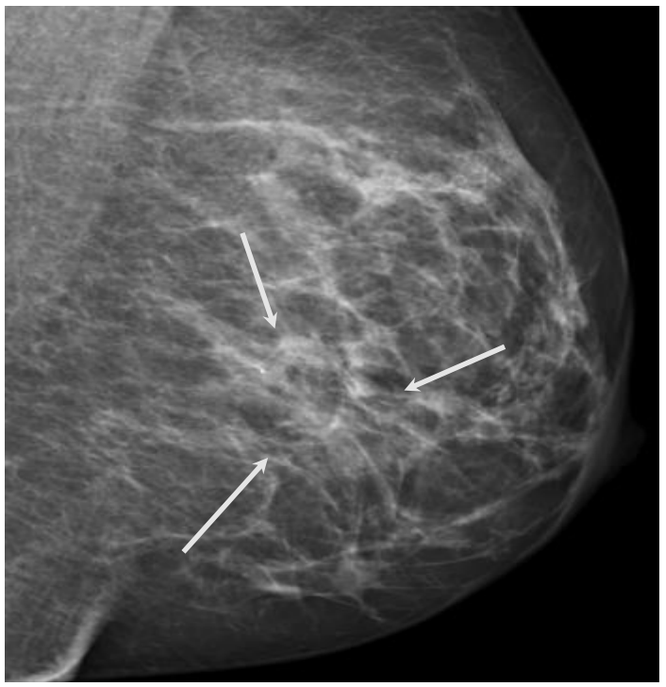
- Spot compression
- Magnification view

- Lateral (ML or LM)

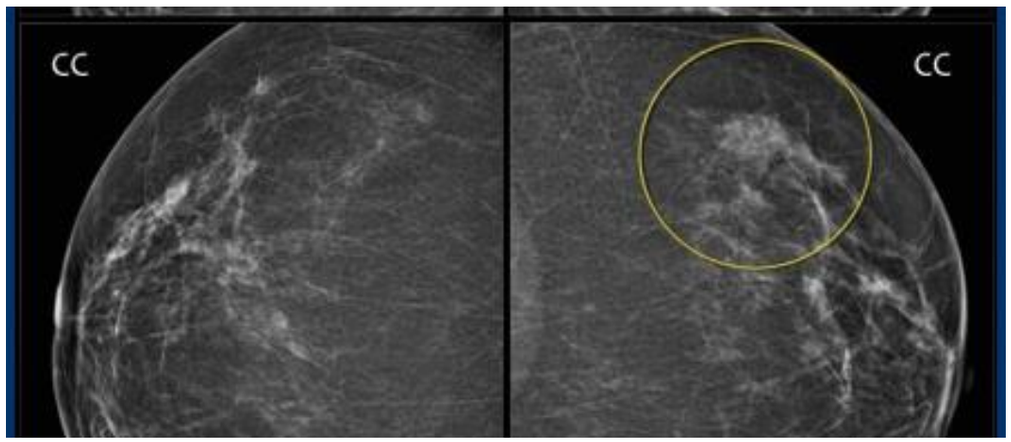
Breast cancer appearances on mammography



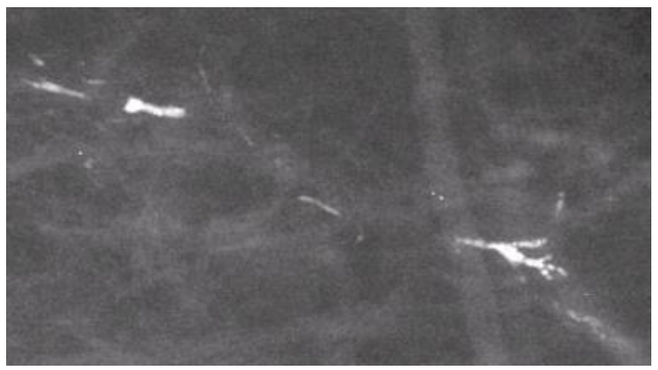
Soft tissue mass



Architectural distortion



Focal asymmetry



Microcalcifications

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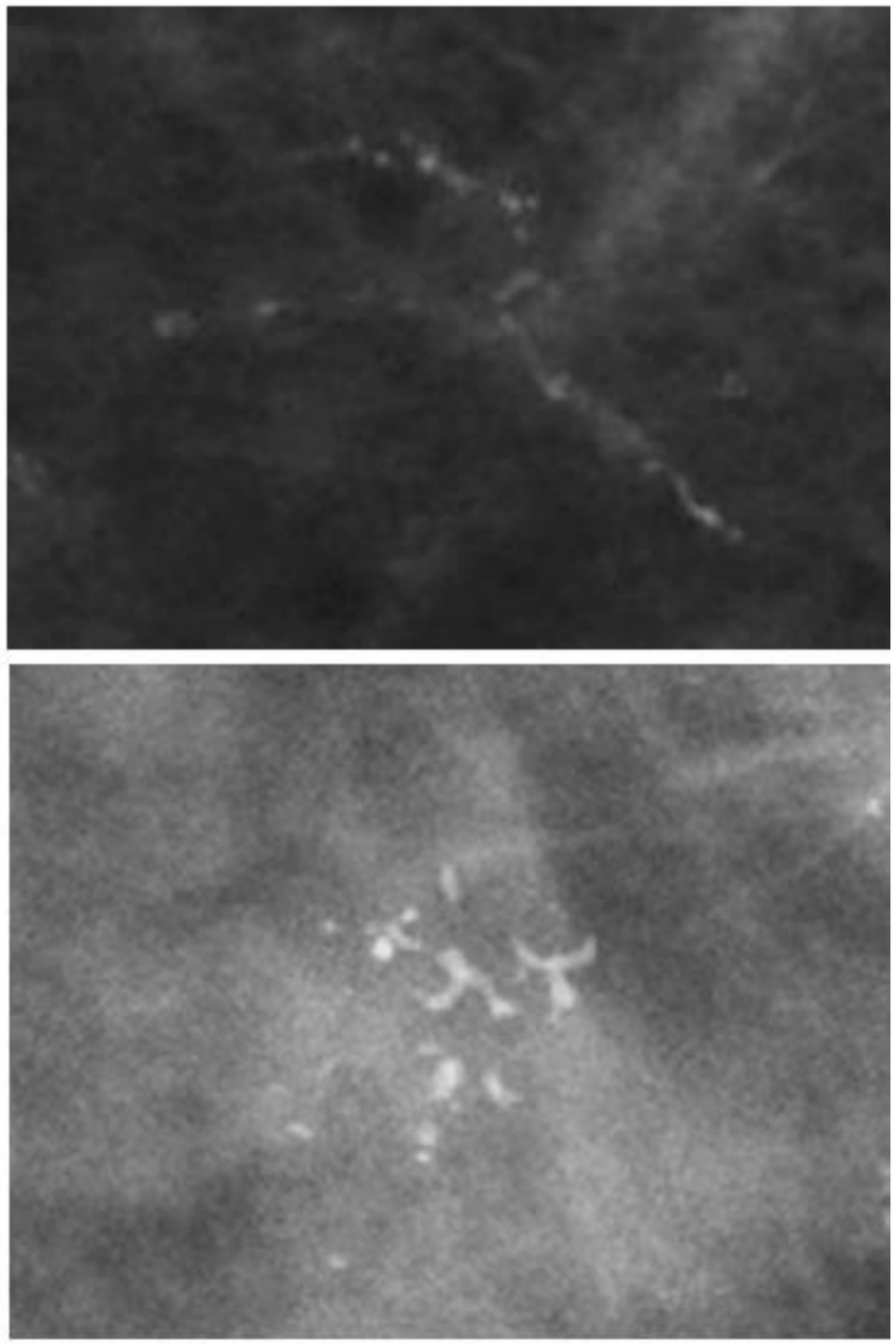
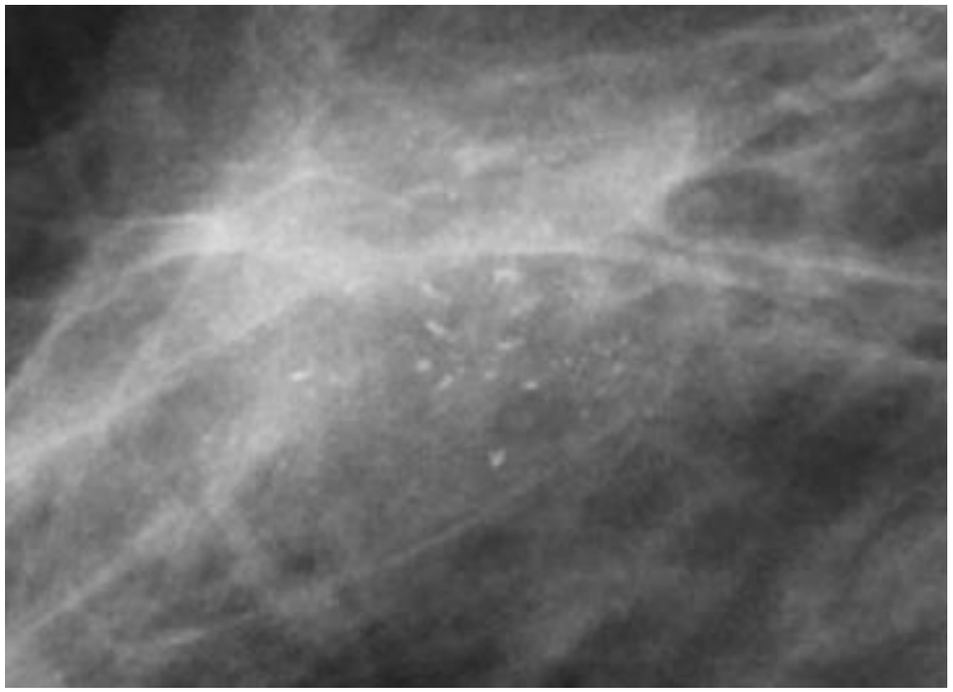
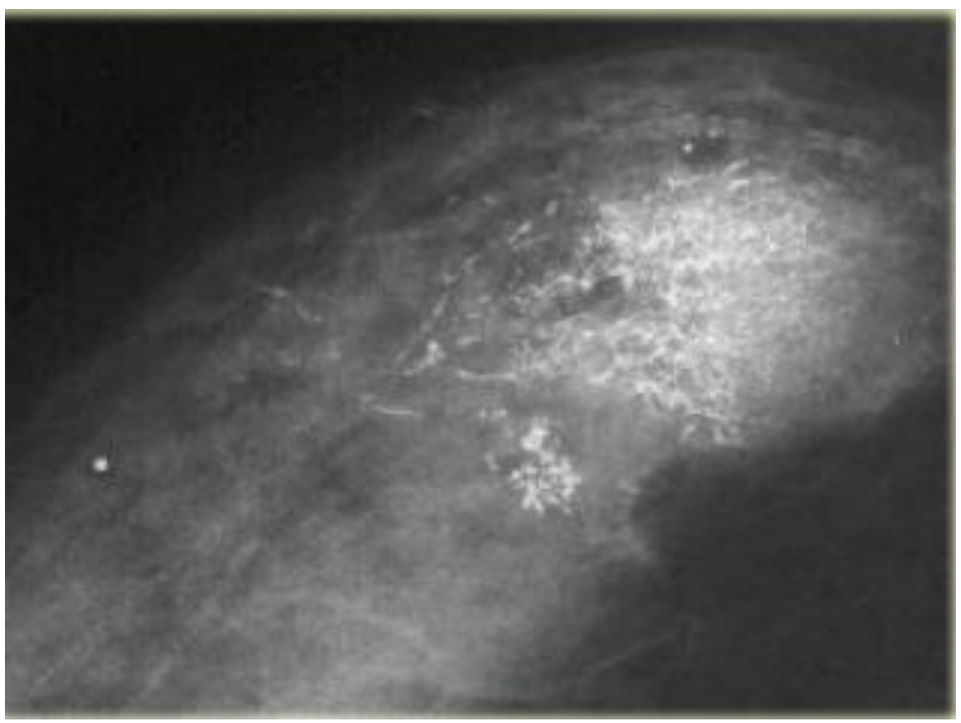
Microcalcifications of high-grade DCIS

Microcalcification can be the only sign of DCIS (+/- associated soft tissue mass)







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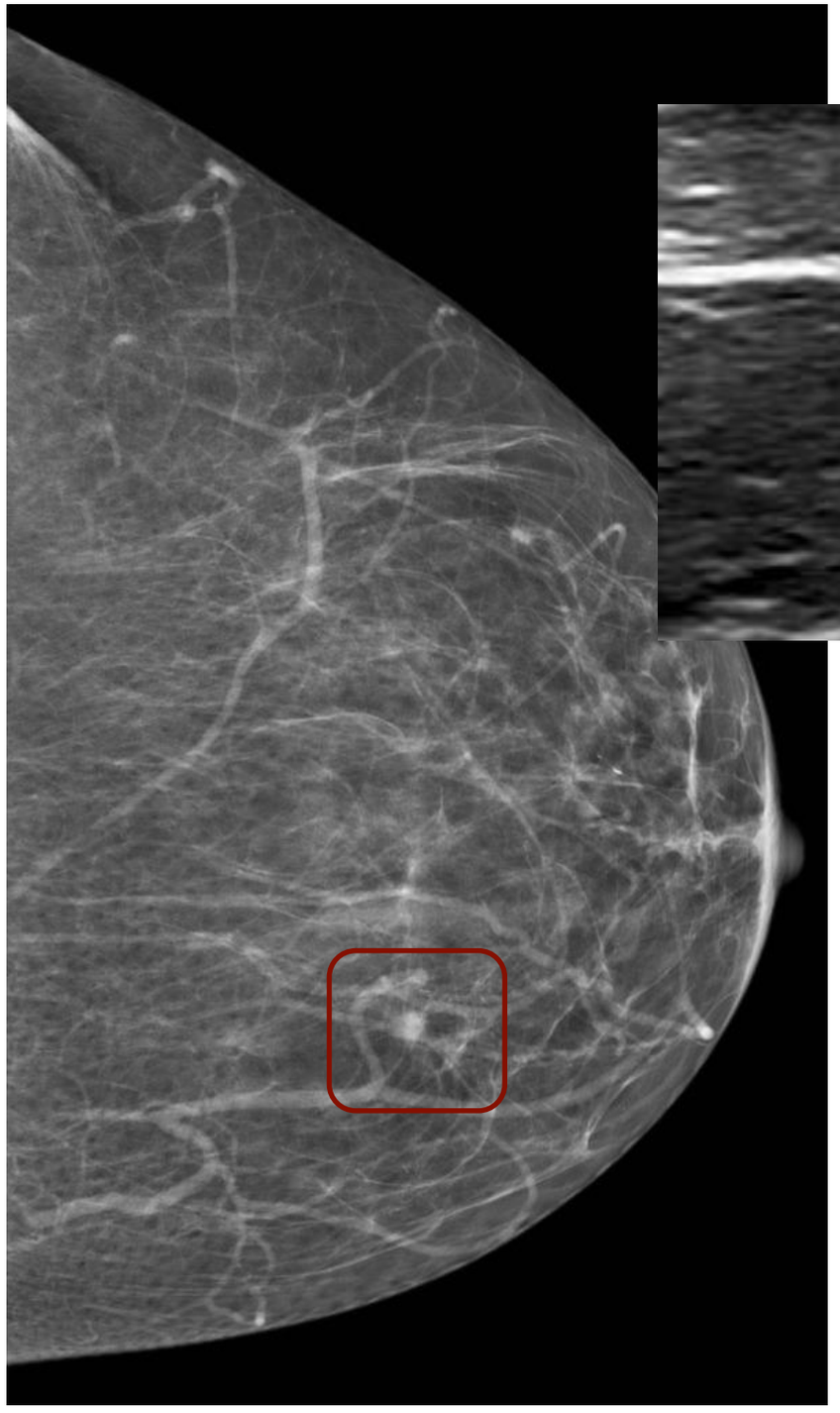
Soft tissue mass

The importance of prior mammograms



4 mm ILC

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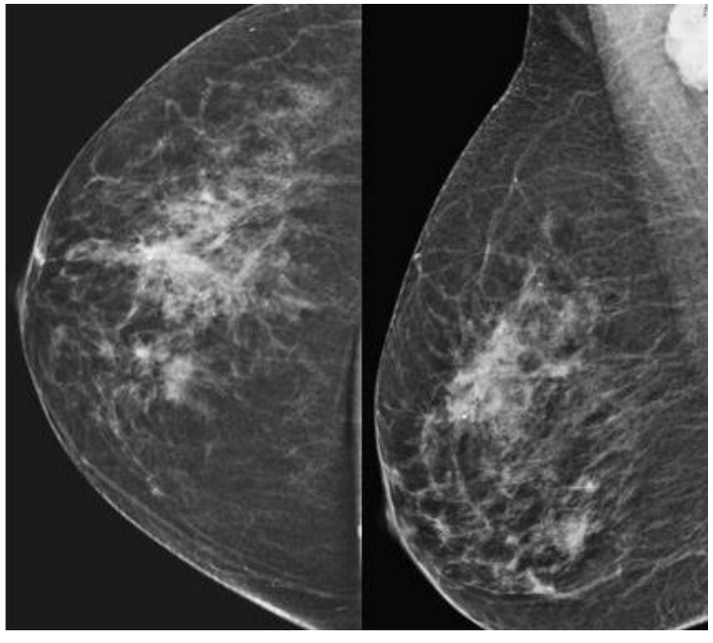
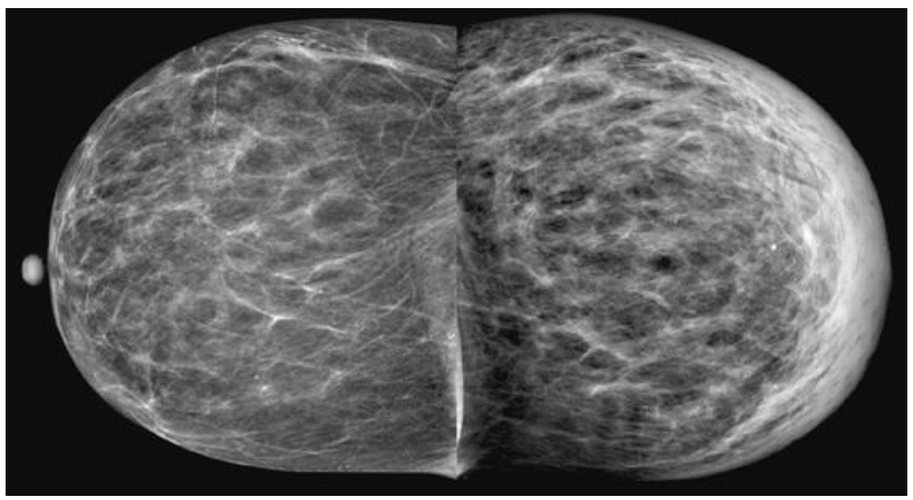
Associated features



Pathological lymph node

Skin retraction



Unilateral oedema, skin thickening

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Diagnostic classification scores

1. Normal
2. A lesion having benign characteristics
3. An abnormality present of indeterminate significance
4. Features suspicious of malignancy
5. Malignant features

European guidelines for quality assurance in breast cancer screening and diagnosis (4th ed)

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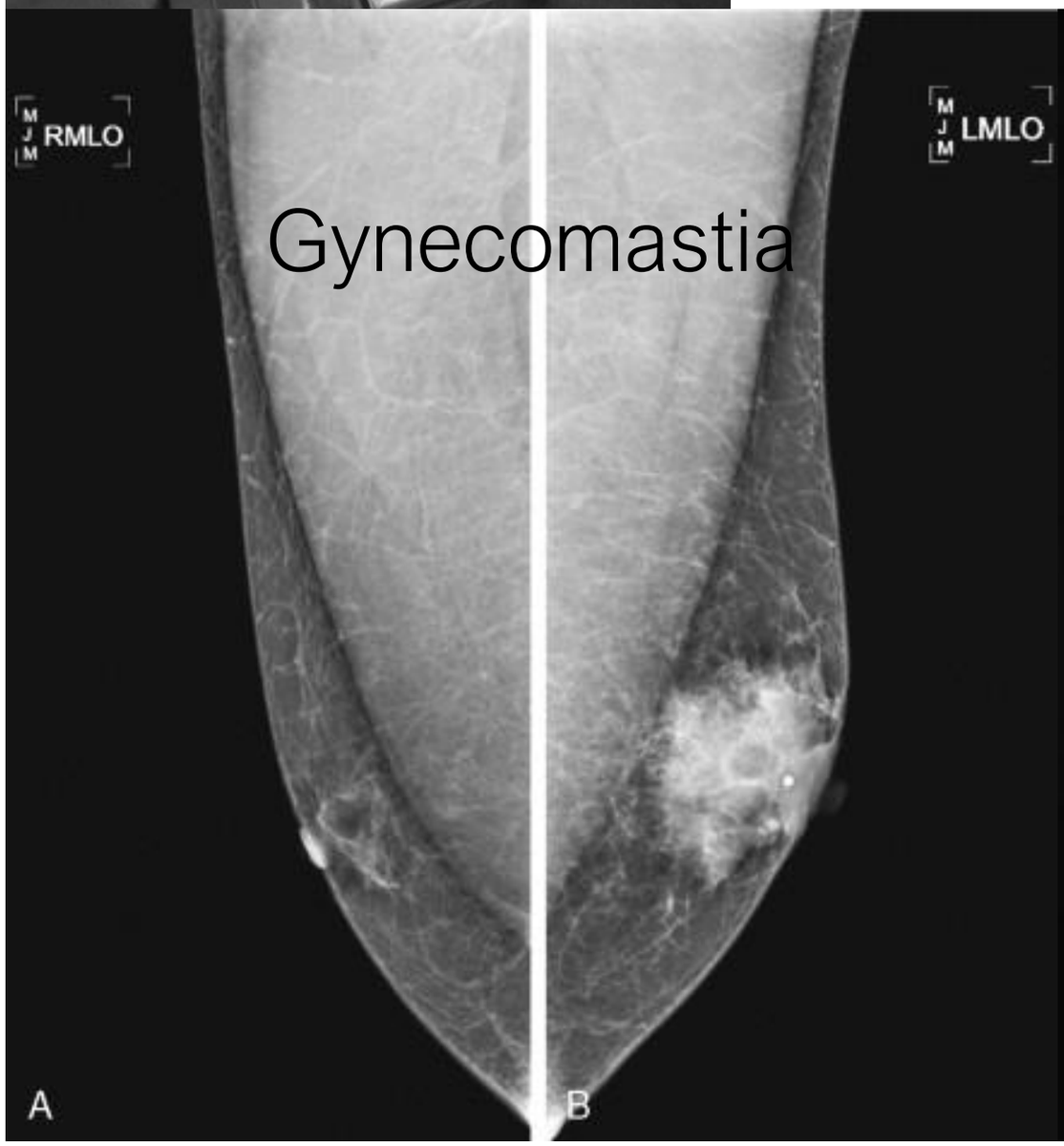
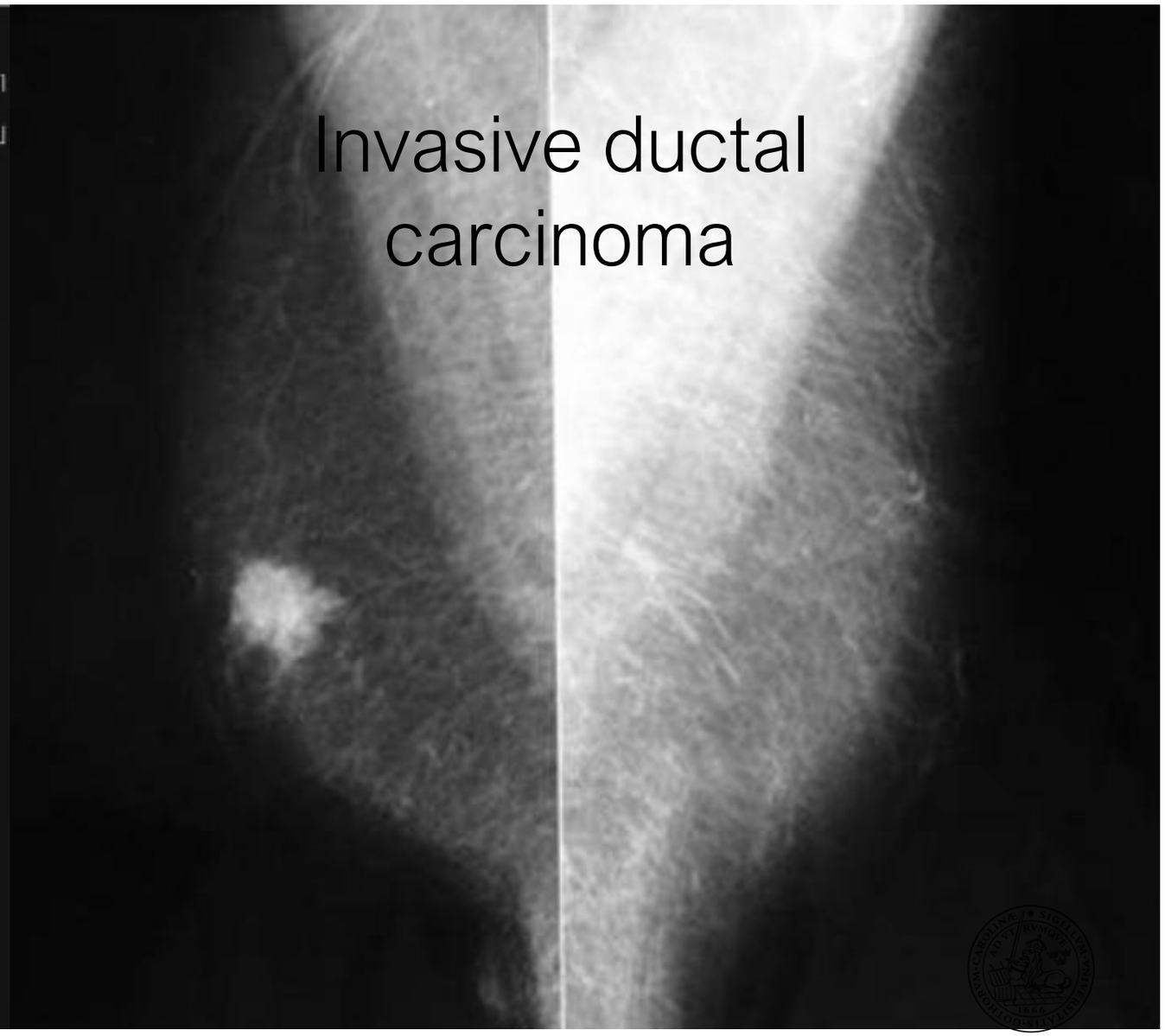
Mammography of the male breast

- Male breast cancer (life time risk 1/1,000)
- Gynecomastia (mostly adolescent boys, elder men)





Mammography

The most common medical imaging method

Advantages

The whole breast is examined

Enables comparison with prior examinations

Sensitive for microcalcifications

Fast, cheap and accessible

Disadvantages

Radiation - not suitable for young women

Limited sensitivity in dense breasts

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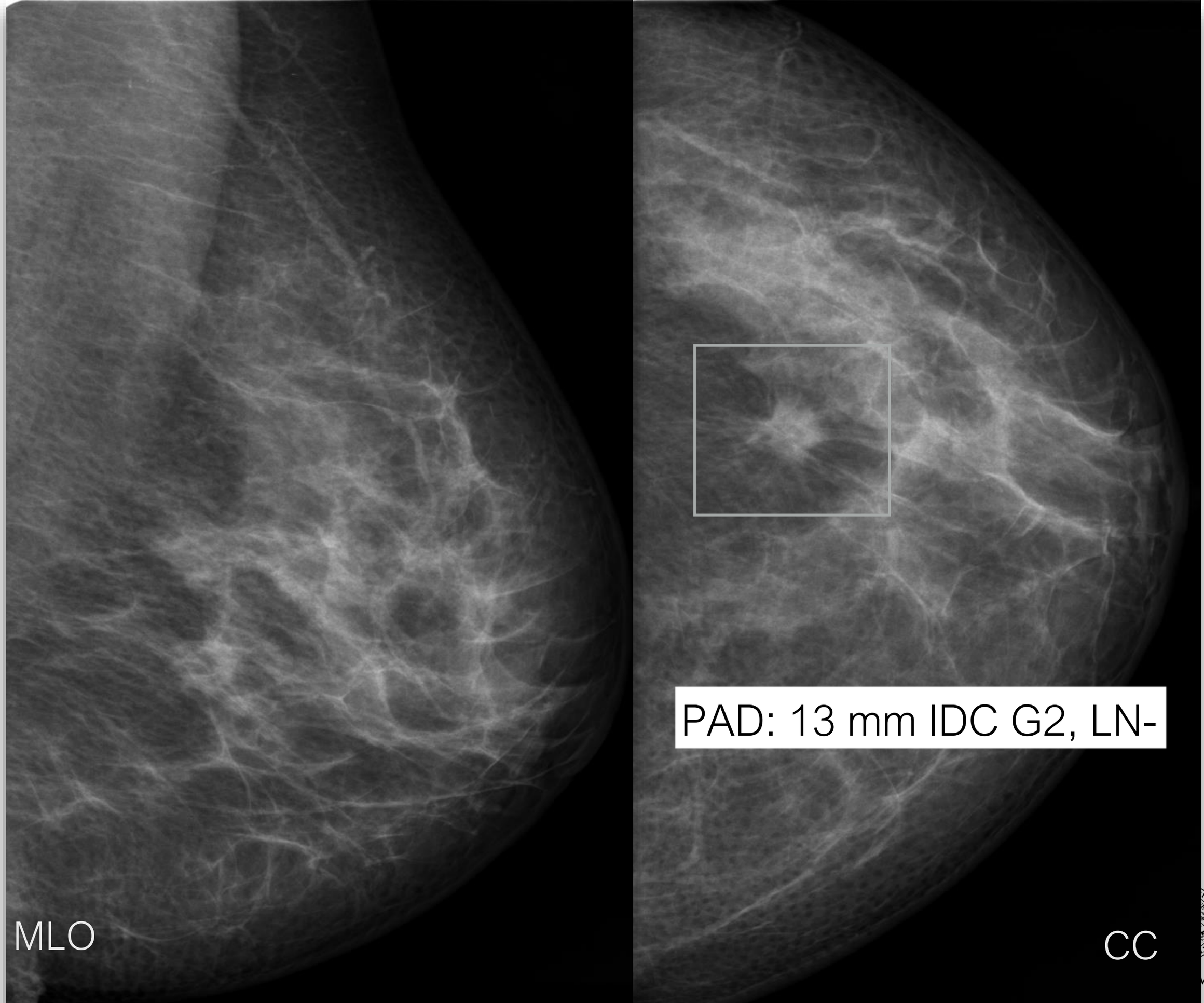
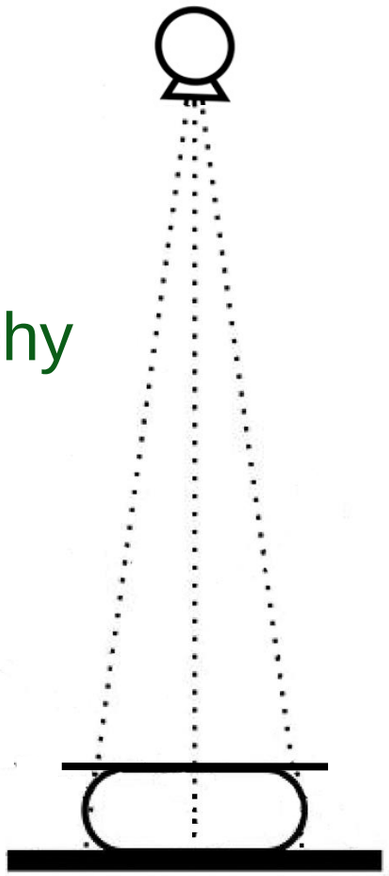
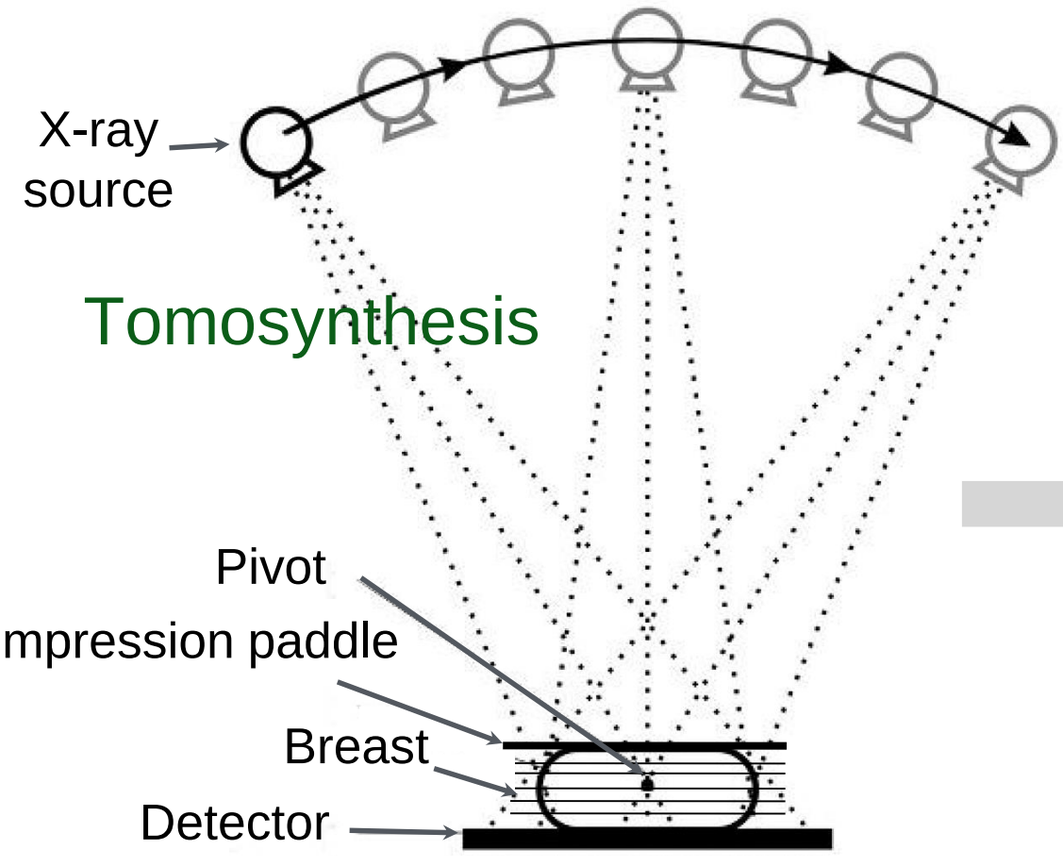
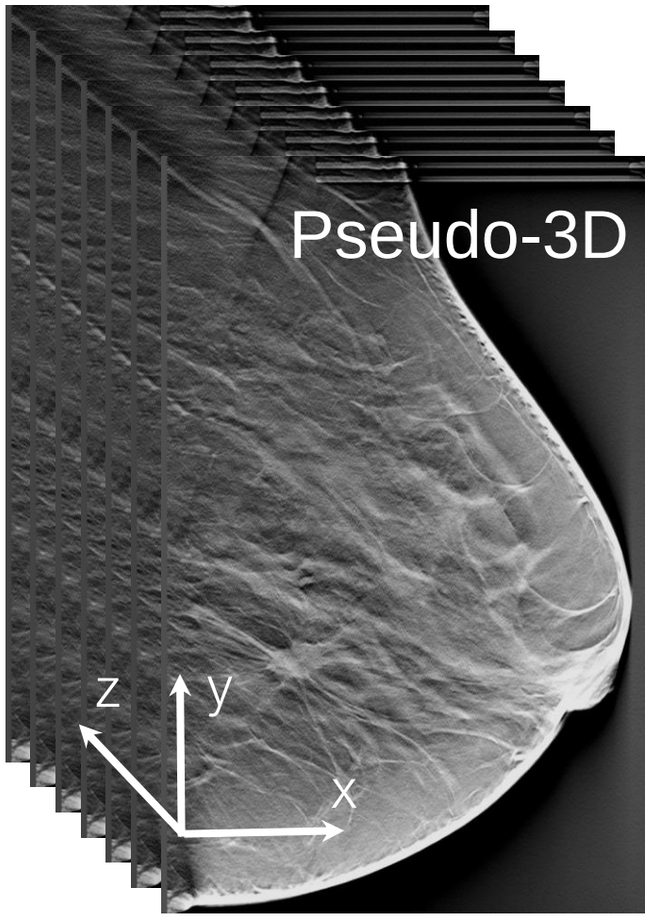

PAD: 13 mm IDC G2, LN-
MLO
CC

Mammography



Tomosynthesis





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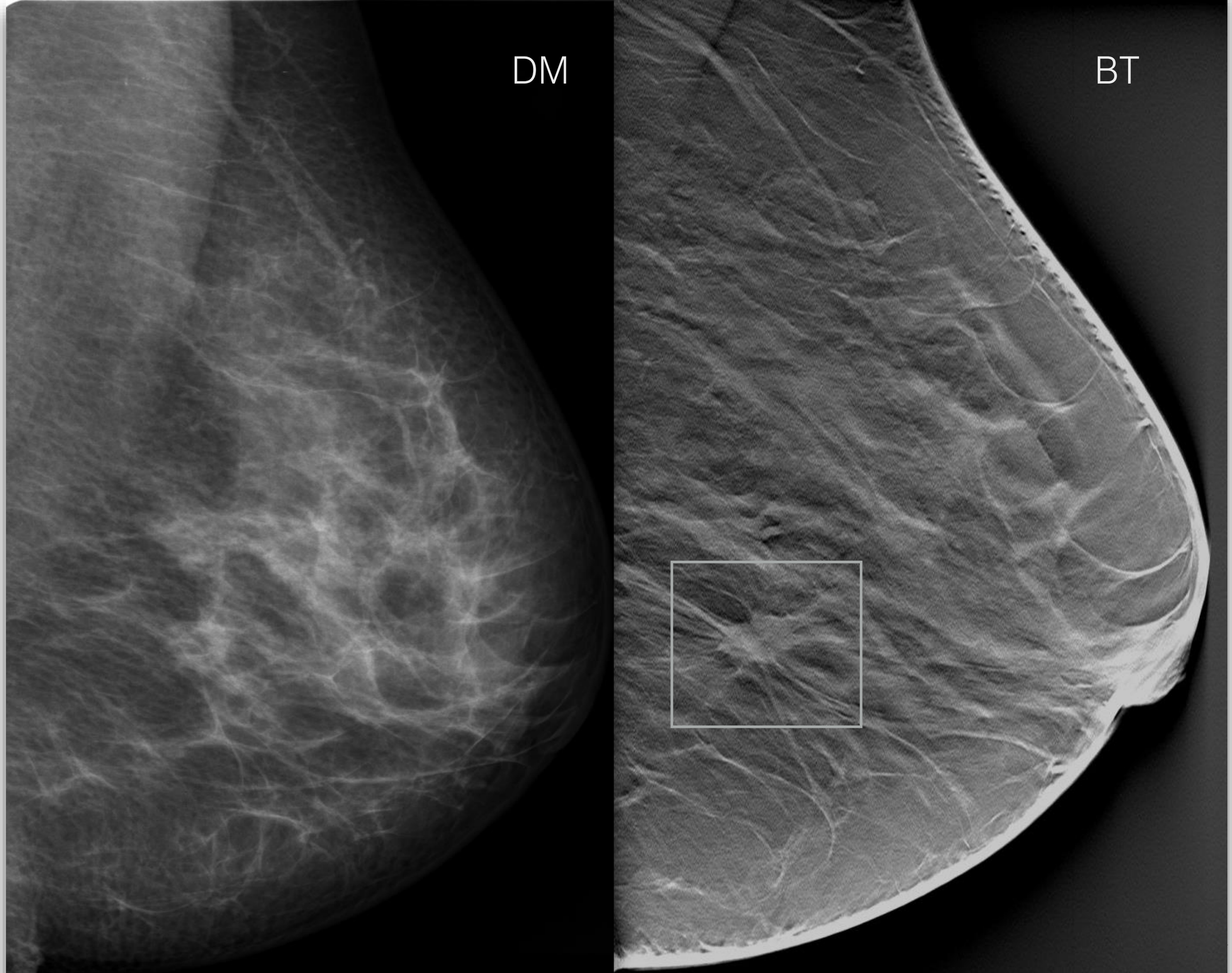
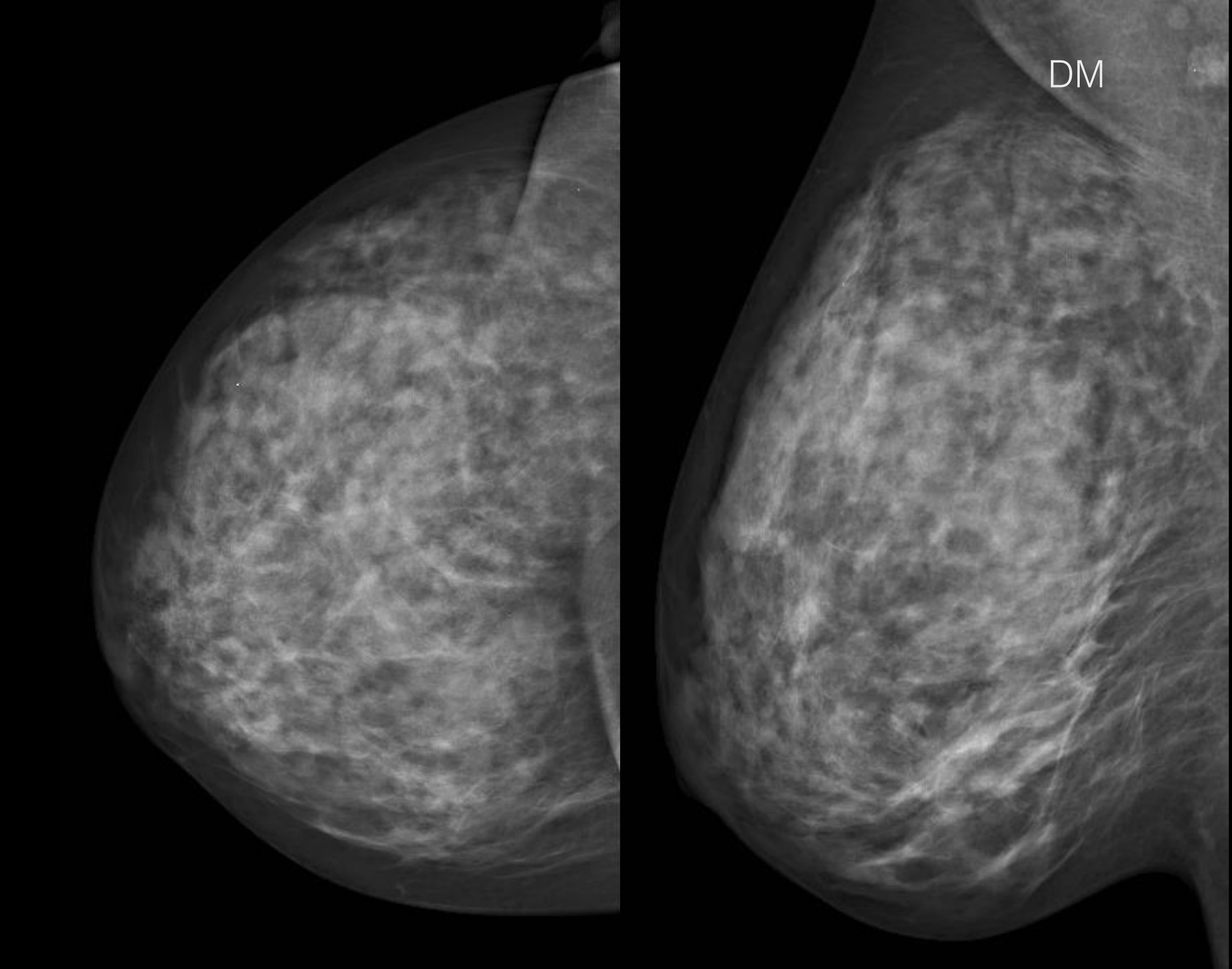

DM
BT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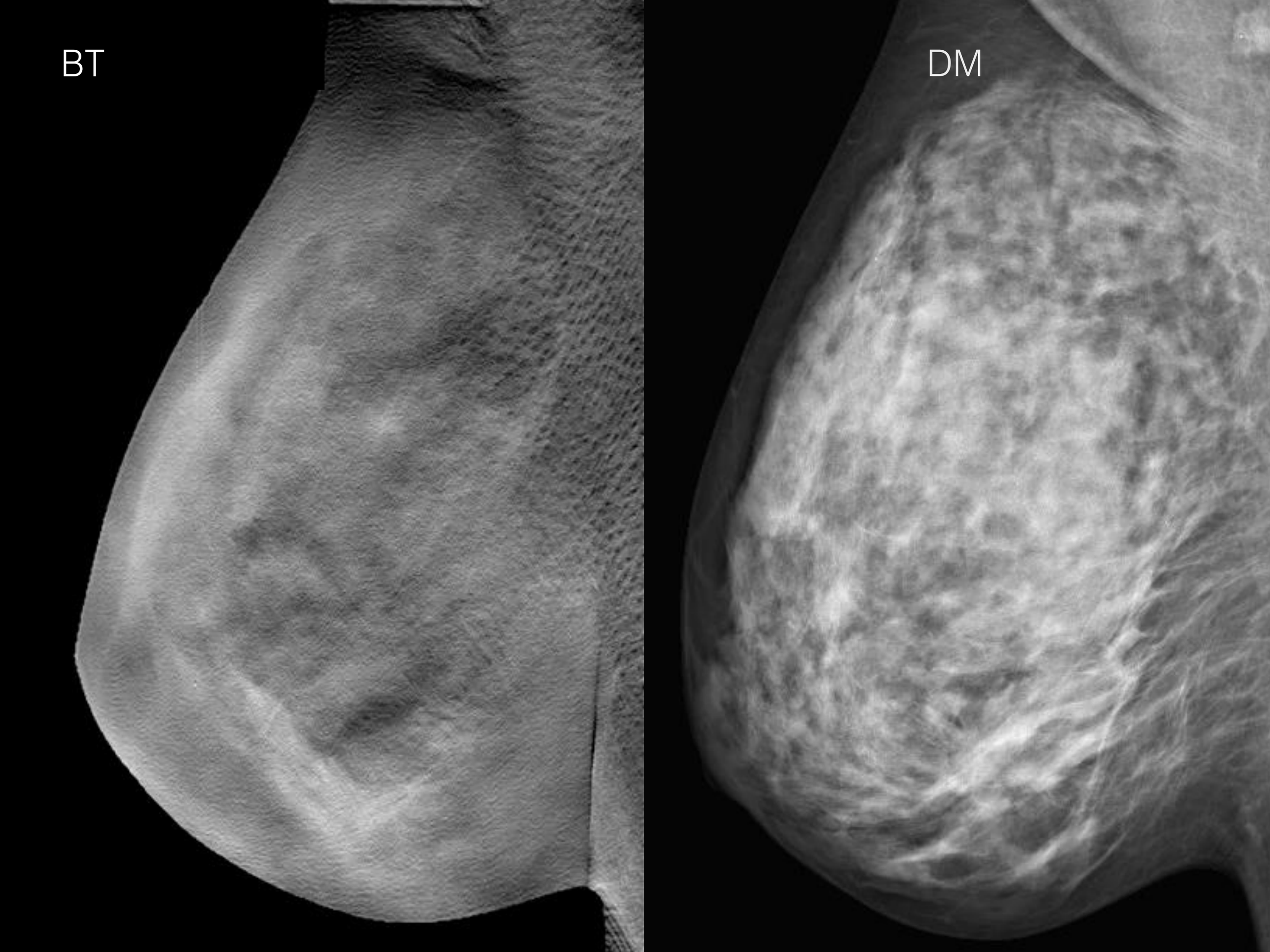
BT
DM

BT

DM

PAD: 30 mm IDC G3, LN+

Tomosynthesis

Provides a better mammogram

Advantages

Increased sensitivity

Improved preoperative staging

Use the same unit for
mammography and tomosynthesis

Next screening modality?!

Disadvantages

Radiation based method

Not 100% sensitivity!

Reading time x 2-4

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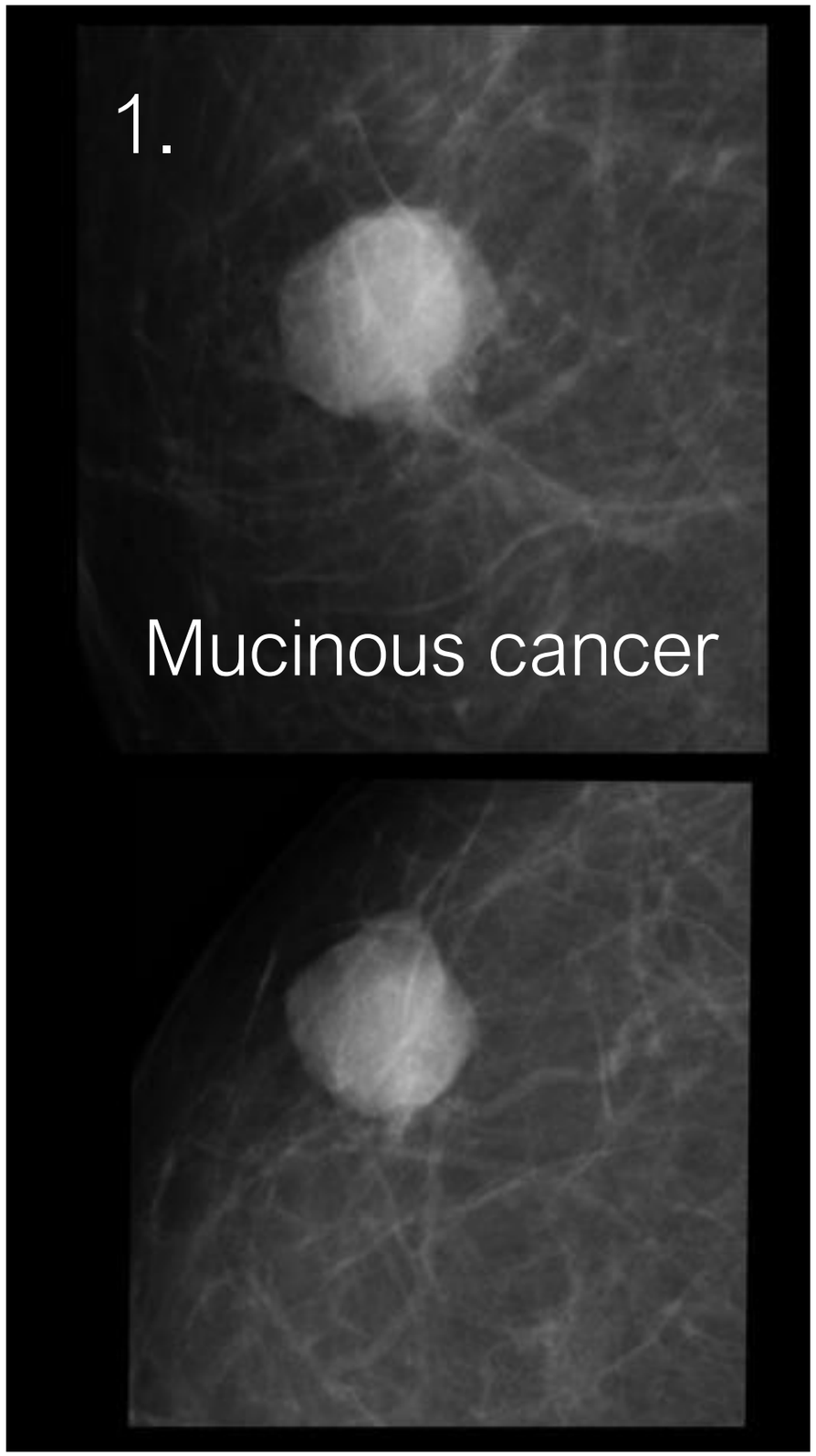

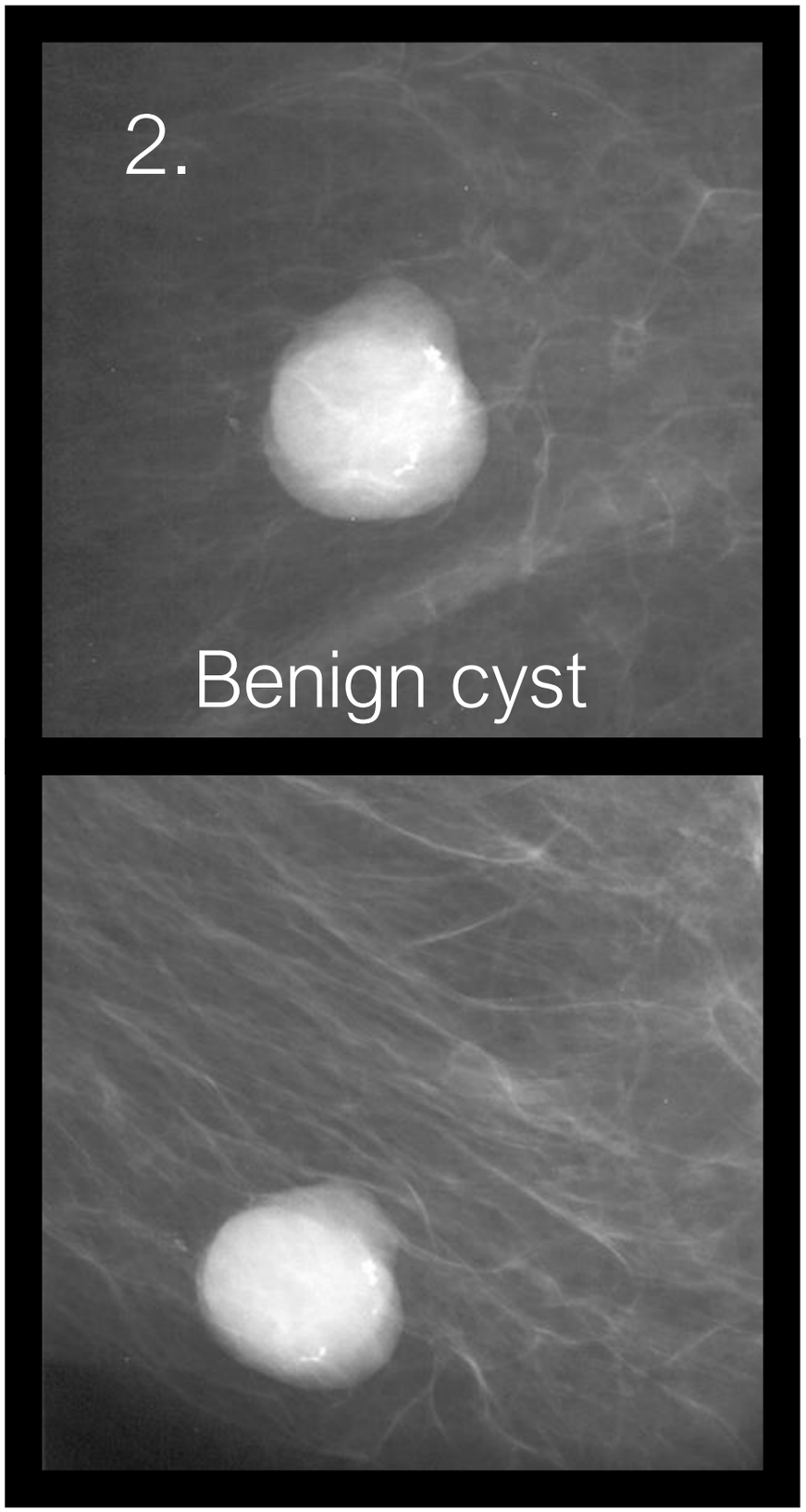

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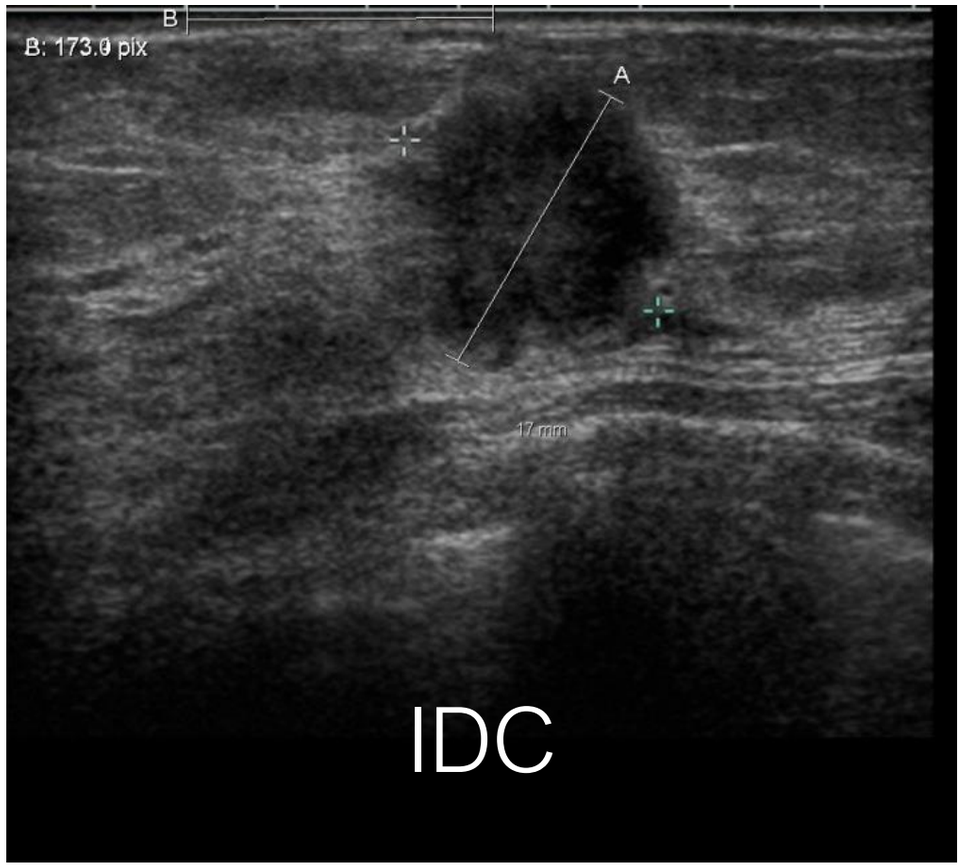
Ultrasonography

- Uses pulses of high-frequency sound waves that are reflected in various degrees in different types of tissues

- Indications:
  - Young women (age <30–35)
  - Dense breasts
  - Characterize/classify lesions seen on mammography
  - Lymph node assessment
  - Guidance at interventional procedures (FNAC, biopsy, preoperative localization, etc)



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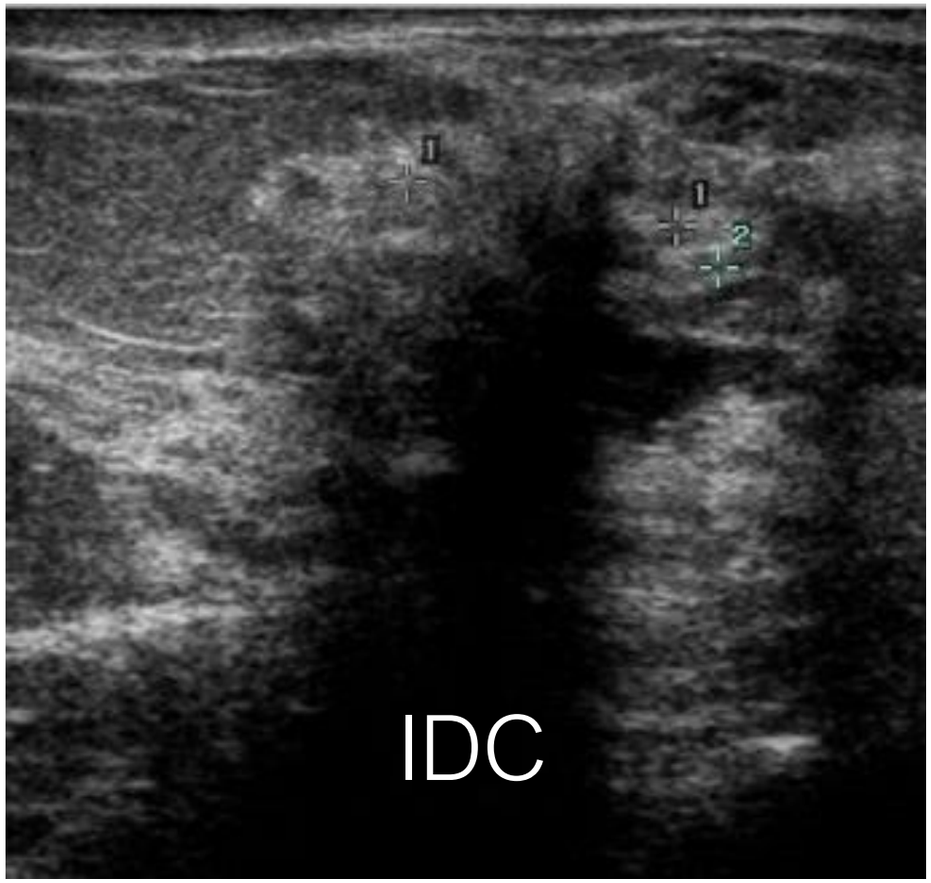

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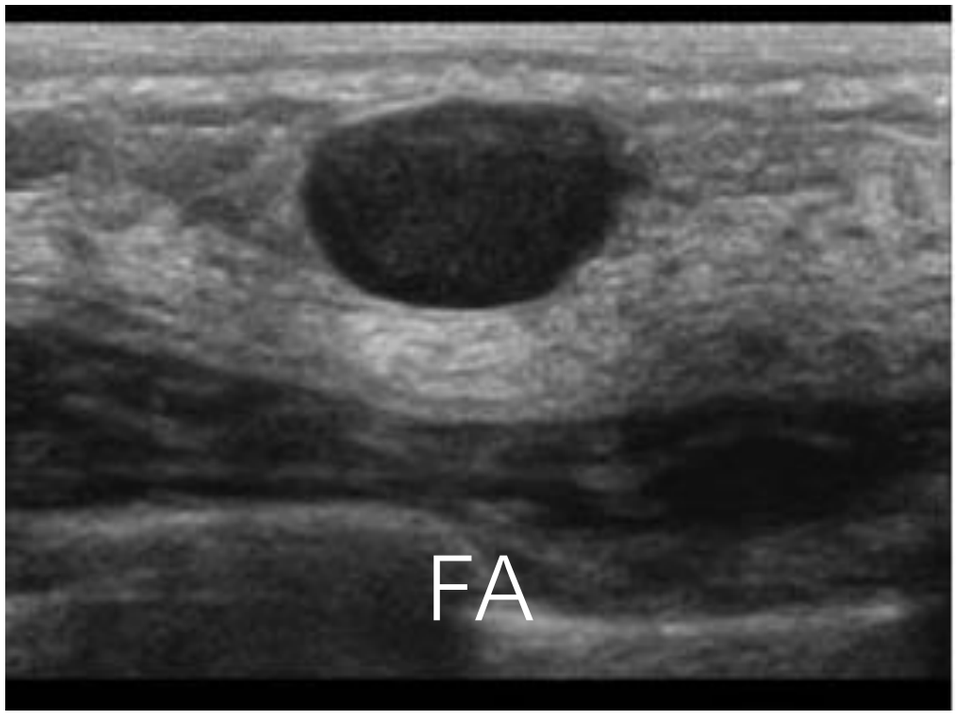
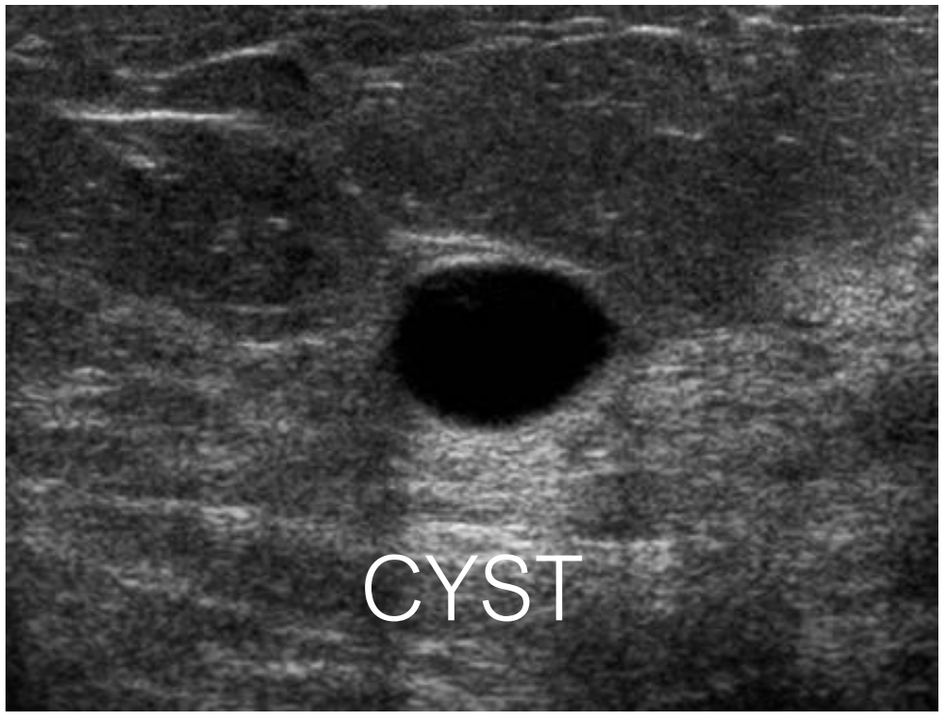


FA



CYST

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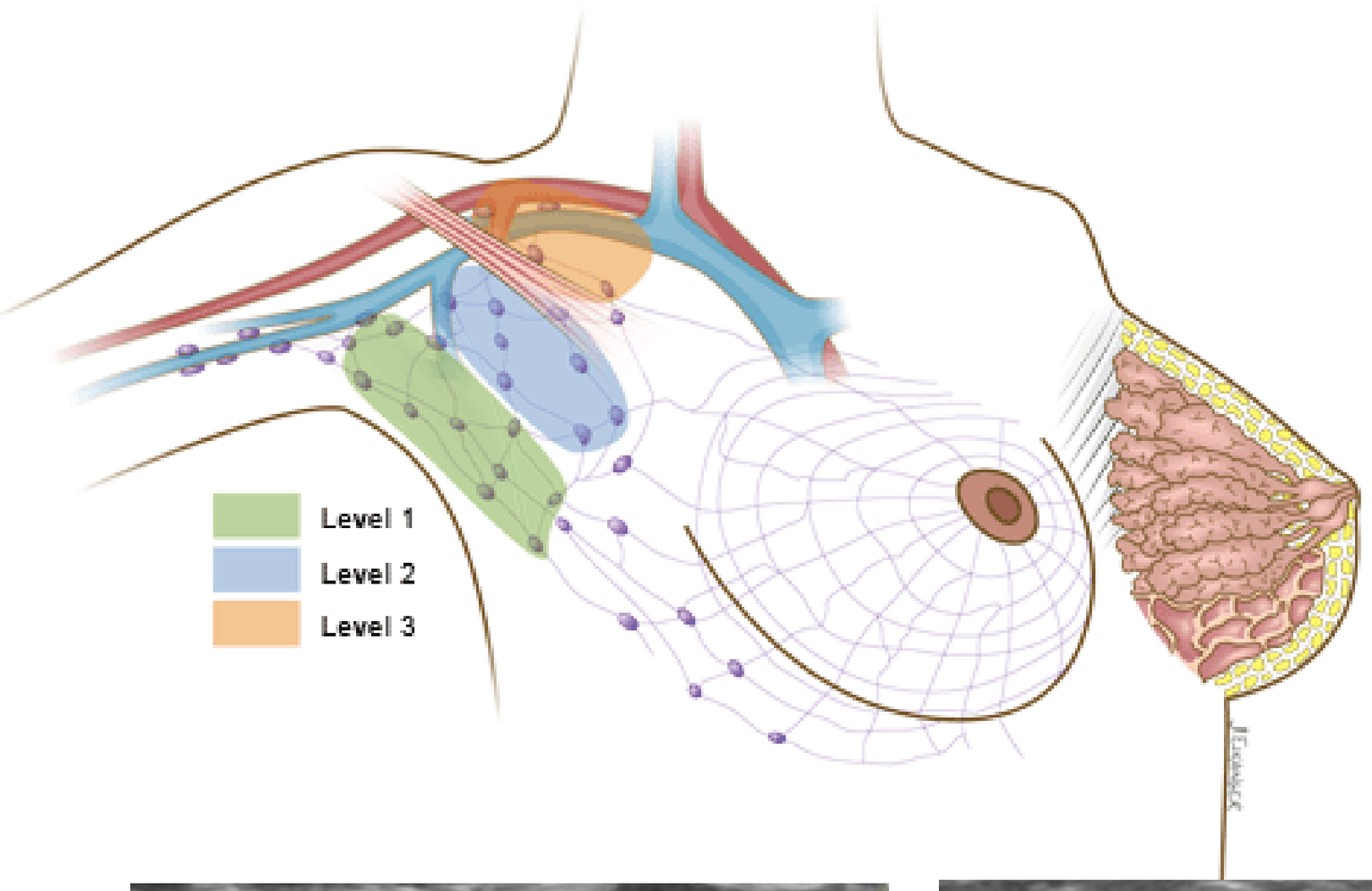
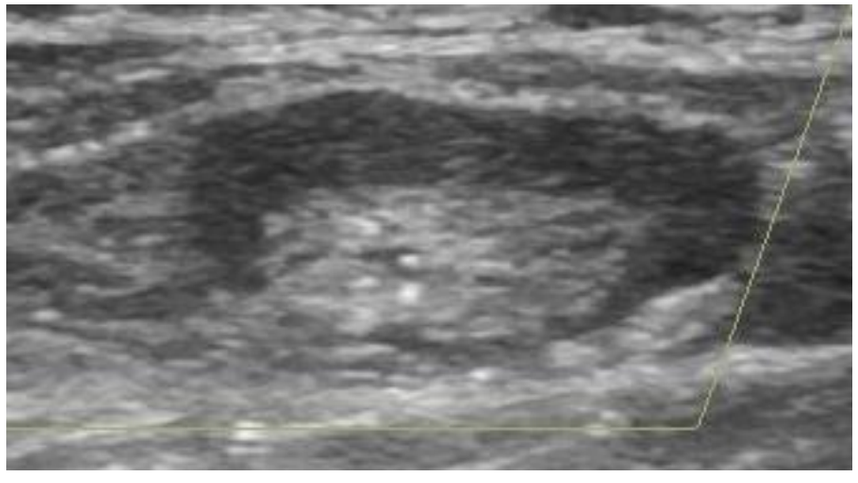
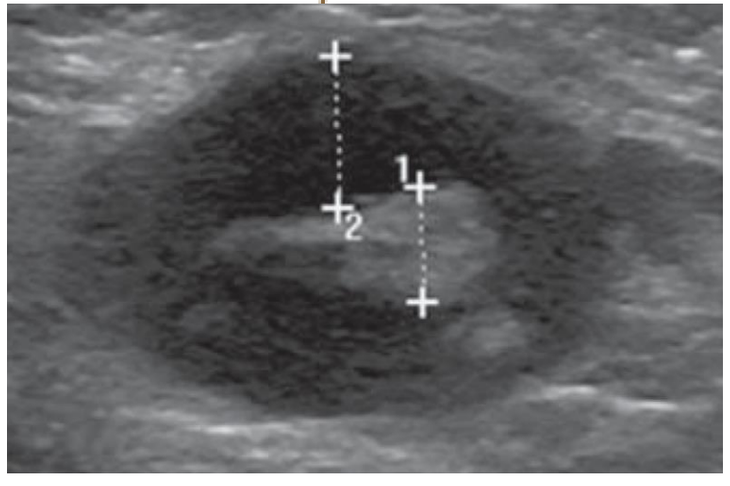
Lymph node assessment







Ultrasonography

Advantages

Young women

Dense breasts

Characterize dense lesions seen on mammography

Guide at interventional procedures

Disadvantages

Microcalcifications

Operator dependent

False positives

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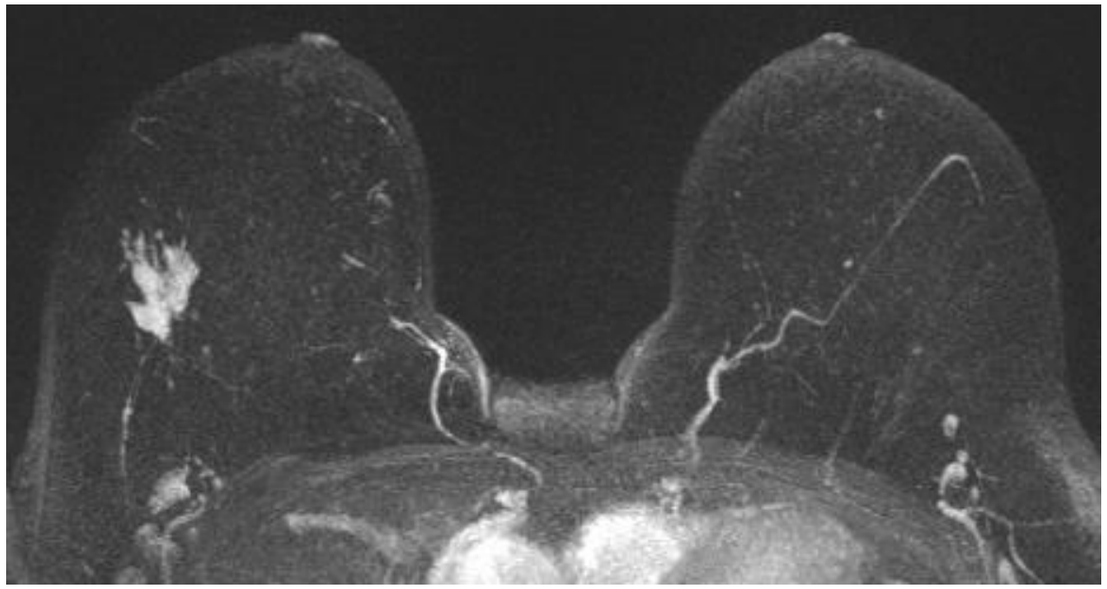
Breast MRI



- Dynamic contrast-enhanced MRI (Gadolinium)
- Study the contrast dynamics
- High sensitivity (90%), specificity (72%)

Peters et al. 2008 Radiology

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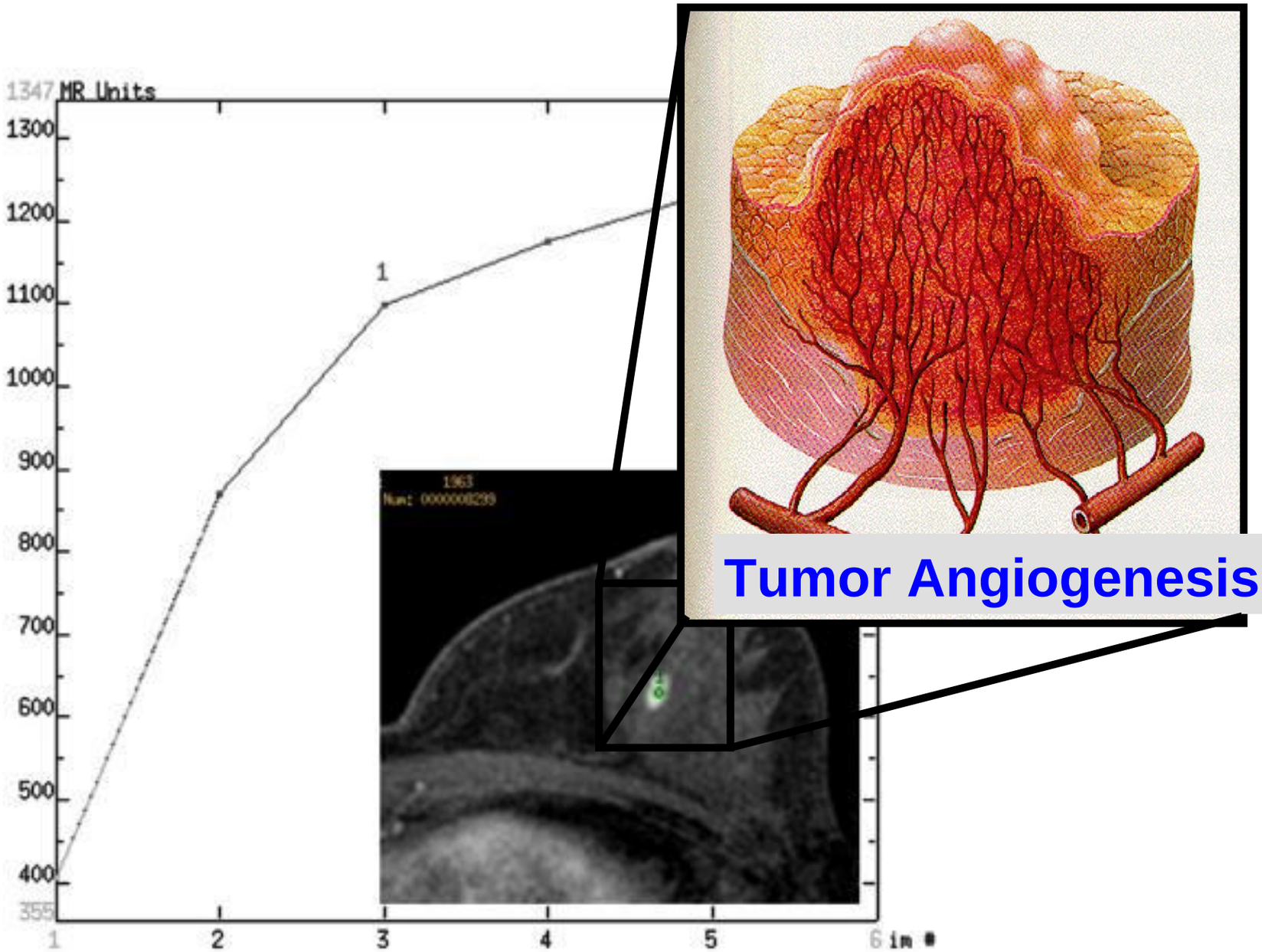
Gadolinium contrast enhancement



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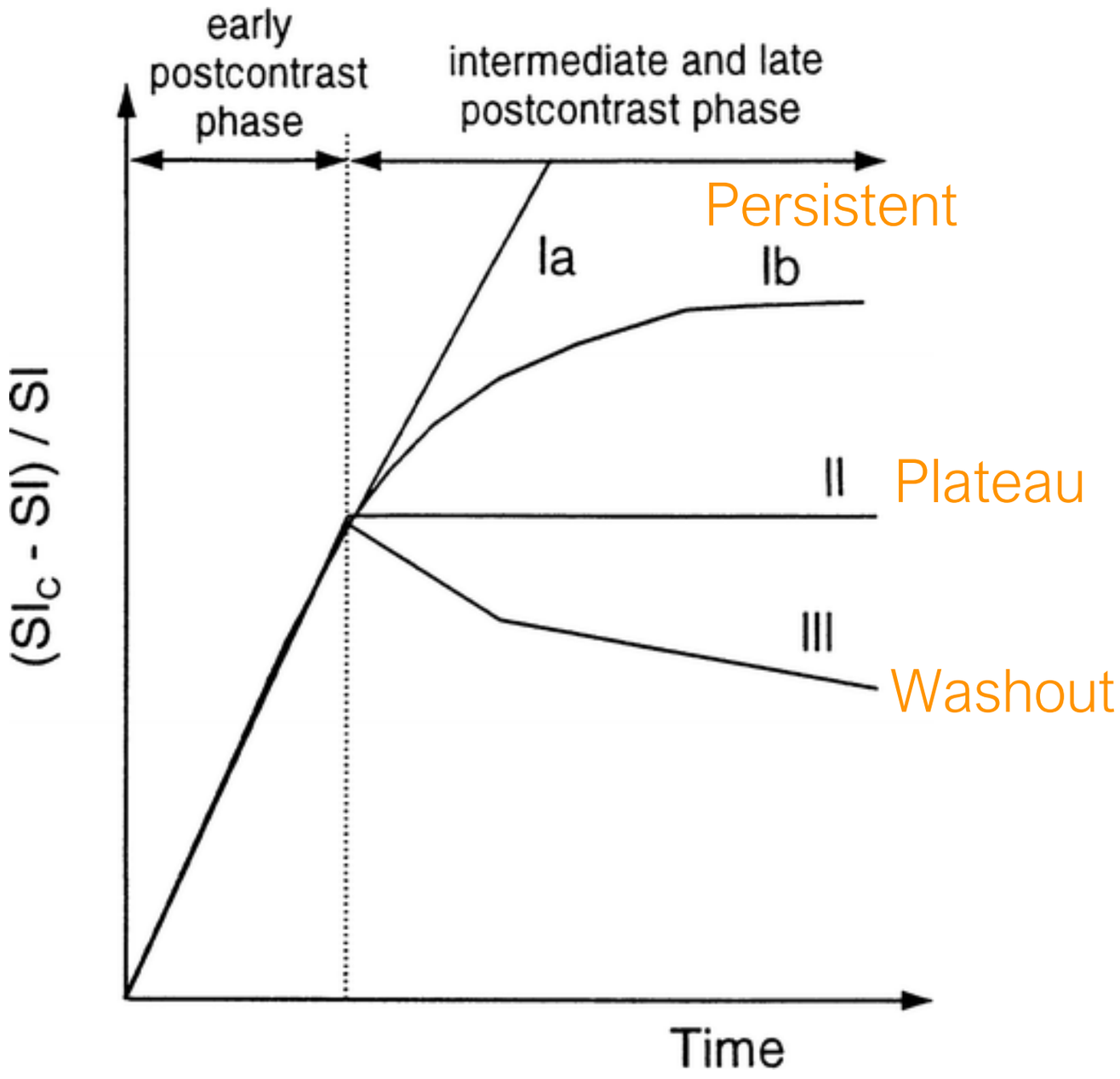
Contrast dynamics

Probability of cancer:

Typ Ia,b: 6%

Typ II: 64%

Typ III: 87%



Kuhl CK et al. Radiology 1999

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Indications for breast MRI

- Problem solving in case of inconclusive findings on conventional imaging.
- Screening of the contralateral breast in women with histological evidence of unilateral breast cancer.
- Evaluation of the breasts in case of metastases of an unknown primary carcinoma.
- Evaluation of therapy response in patients treated with neoadjuvant chemotherapy.
- Exclusion of local recurrence after breast-conserving therapy.
- Screening of women with a lifetime risk of 20% or more to develop breast cancer, including mutation carriers.

R Mann et al. Breast MRI: guidelines from the European Society of Breast Imaging. Eur Radiol 2008

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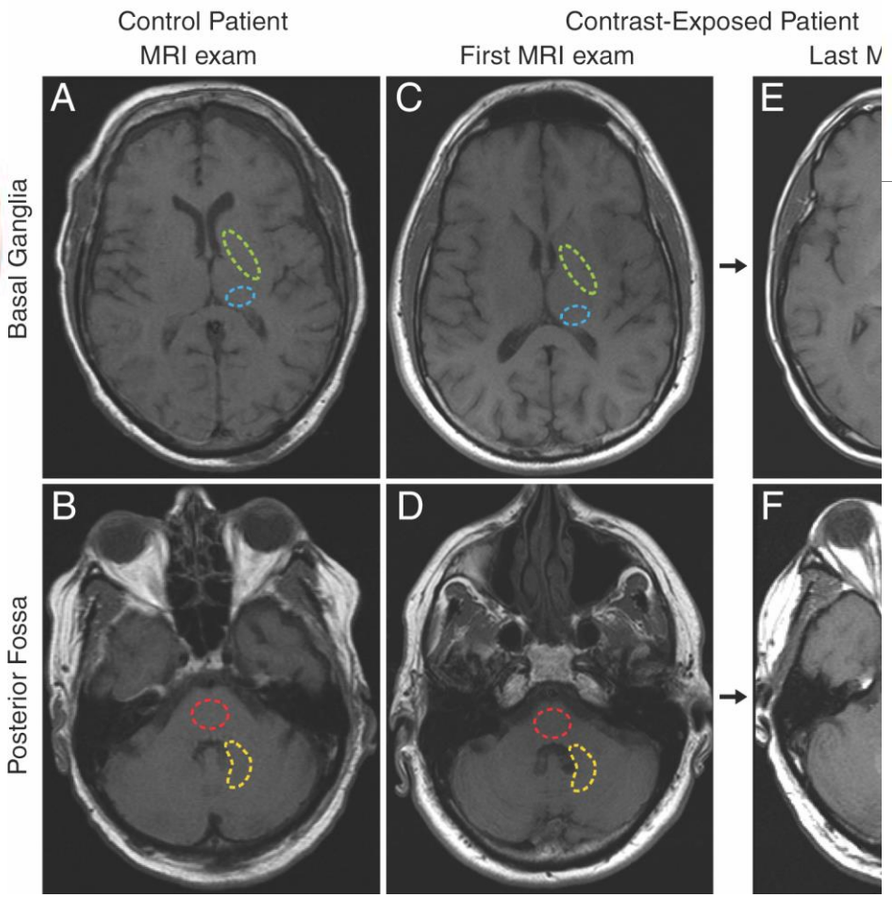
Pre-operative staging with MRI

- Tumour size can be underestimated with mammography and ultrasound, especially invasive lobular carcinoma
- MRI is accurate in estimating tumour extension (multifocality, multicentricity)
- Pre-operative MRI is clinical practice in many countries
- Meta-analysis clearly shows that pre-operative MRI does not reduce the risk of BC recurrence
- Pre-operative MRI is associated with increased odds of receiving ipsilateral mastectomy and contralateral prophylactic mastectomy

Houssami N et al J Clin Oncol 2014

Houssami N et al Breast Cancer Res Treat. 2017



EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

Product	Type (formulation)	Recommendation
Artirem / Dotarem (*gadoteric acid*)	macrocyclic (i.v.)	maintain
Artirem / Dotarem (*gadoteric acid*)	macrocyclic (intra-articular)	maintain
Gadovist (*gadobutrol*)	macrocyclic (i.v.)	maintain
Magnevist (*gadopentetic acid*)	linear (intra-articular)	maintain
Magnevist (*gadopentetic acid*)	linear (i.v.)	suspend
Multihance (*gadobenic acid*)	linear (i.v.)	restrict use to liver scans
Omniscan (*gadodiamide*)	linear (i.v.)	suspend
Optimark (*gadoversetamide*)	linear (i.v.)	suspend
Primovist (*gadoxeticacid*)	linear (i.v.)	maintain
Prohance (*gadoteridol*)	macrocyclic (i.v.)	maintain

- MRI signal changes in deep nuclei linked with repeated administration of Gd contrast agents
- The clinical significance remains unknown

Gulani V et al. Lancet Neurol. 2017 Jul

Assessment of breast implants

Ruptured implant

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Breast MRI

Advantages

No ionizing radiation

Dense breasts

High sensitivity

Disadvantages

Microcalcifications

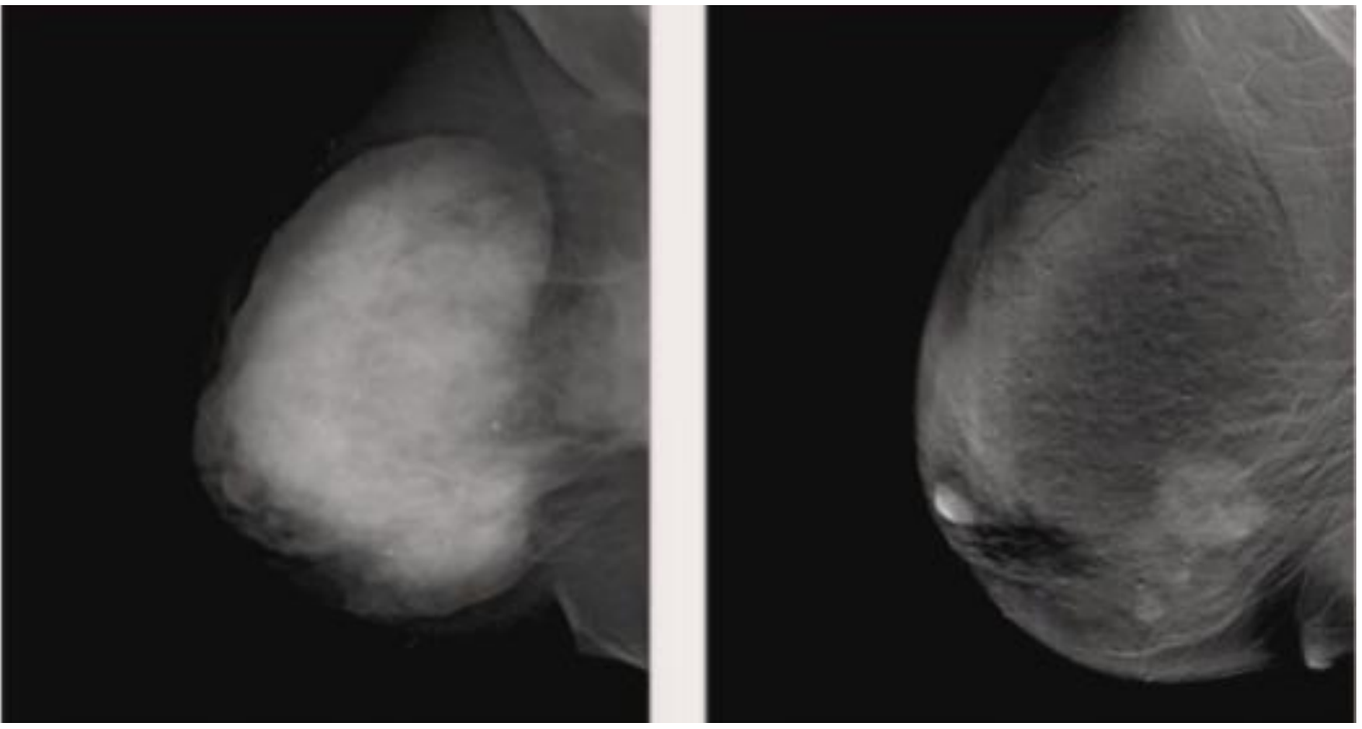
Specificity

Accessibility

Expensive

Gadolinium

Contrast enhanced spectral mammography



Low energy High energy

”Poor mans MRI”

- Iodinated contrast agent
- Dual energy
- Similar sensitivity and better specificity than MRI
- Advantage compared to MRI:
  - Increased specificity
  - Microcalcifications
  - Accessibility
  - Cost-effective

Triple assessment

1. Medical history and clinical breast examination
2. Imaging – mammography and/or ultrasonography
3. Non-excision biopsy – fine needle aspiration (FNA) cytology and/or core biopsy

- Sensitivity 99.6%

Irwig L, Macaskill P. Evidence relevant to guidelines for the investigation of breast symptoms. Woolloomooloo (NSW): NHMRC National Breast Cancer Centre, 1997

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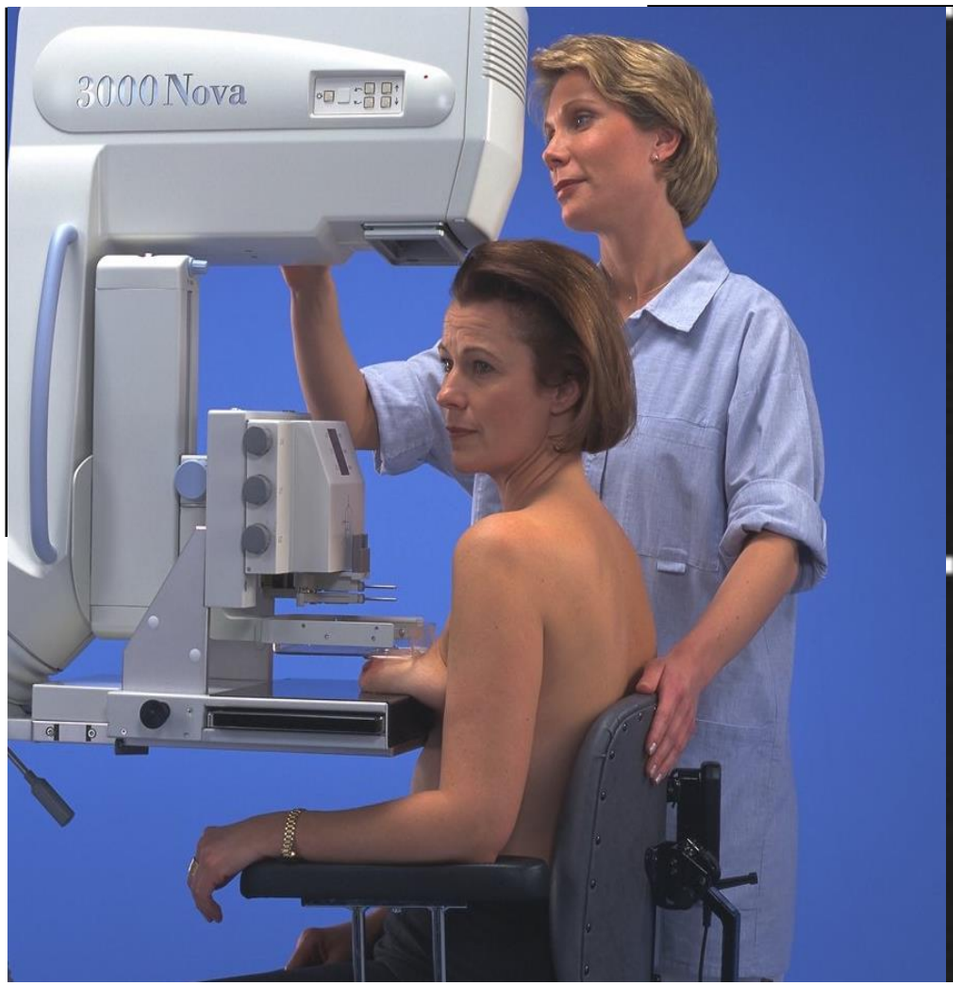
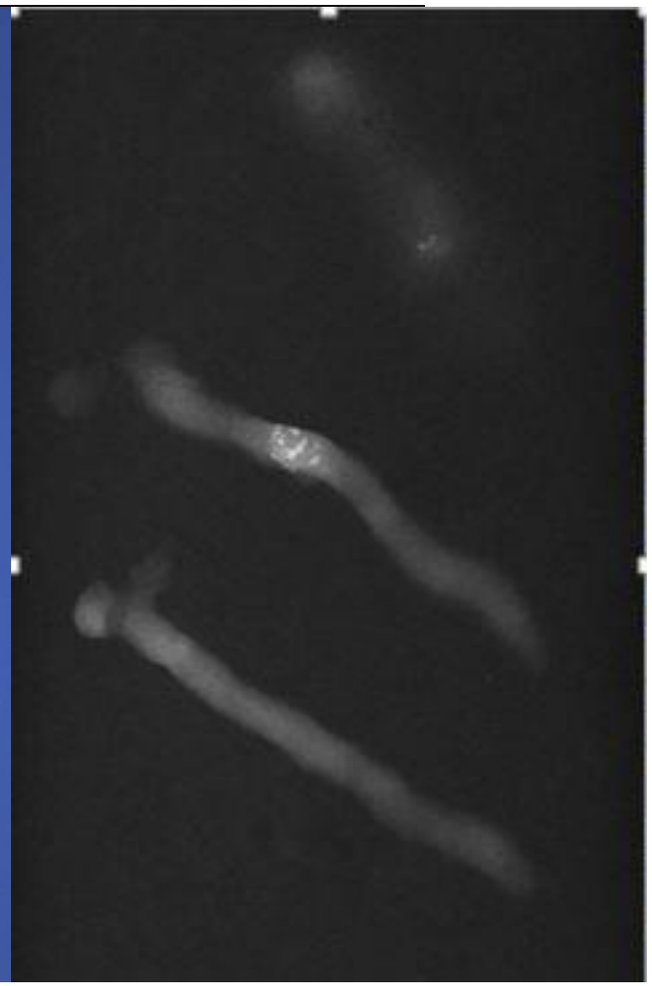
Core needle biopsy





- High sensitivity (97%)
- Ultrasound guided
- Stereotactic biopsy

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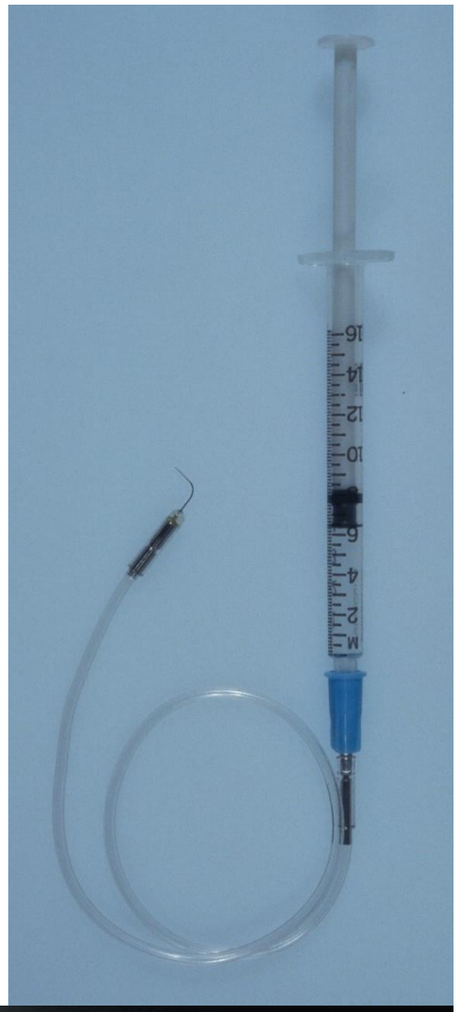
Ductography

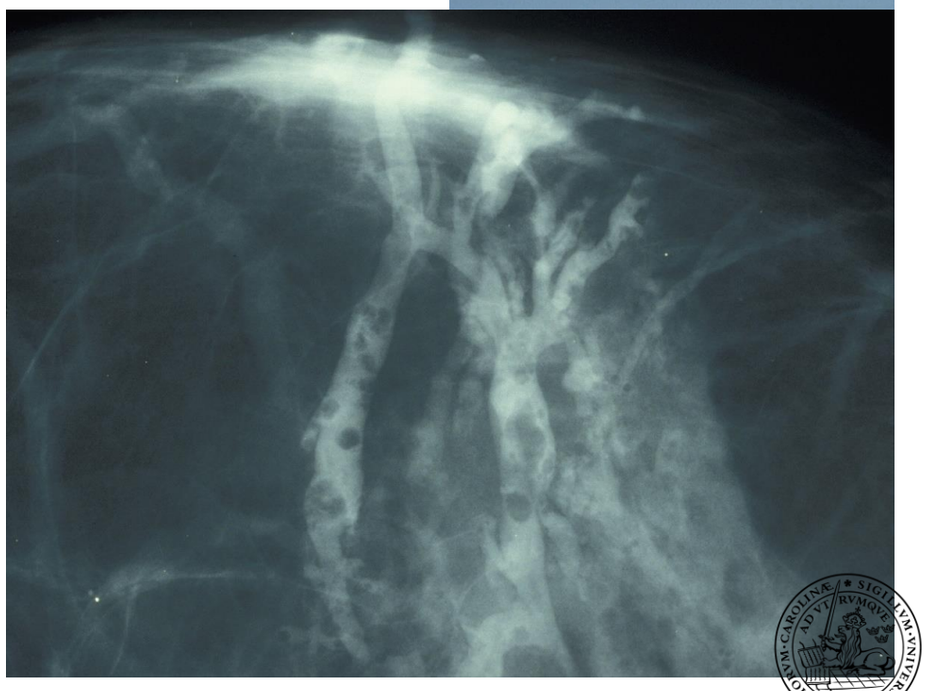
Indications:

- Unilateral, single-pore, spontaneous nipple discharge (bloody or clear)

Aim:

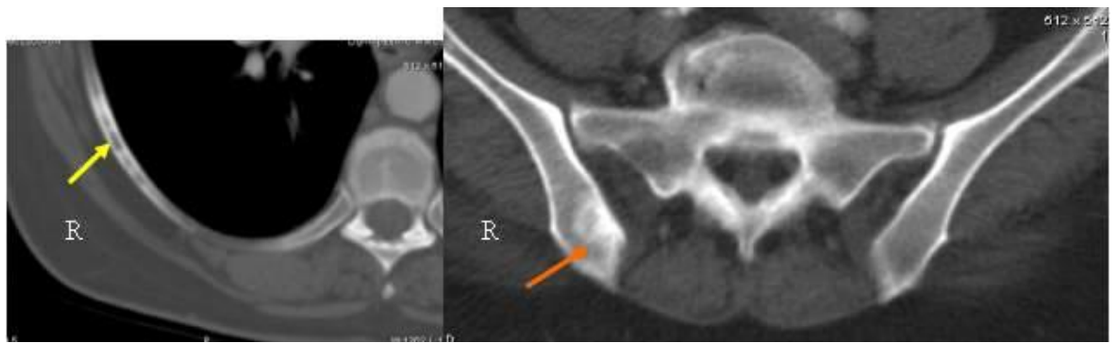
- Localize the origin of the secretion
- To identify intraducutal abnormalities:
  - papillomas
  - DCIS





Screening for metastatic disease

- Incidence of metastatic disease in early-stage BC <2%
- Whole body screening (CT) justified: N2 disease, T4 tumour, or local and regional recurrence



www.rcr.ac.uk

The Royal College of Radiologists. Guidance on screening and symptomatic breast imaging, 3rd ed (2013)

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Summary

- Mammography and ultrasonography are the cornerstones of breast imaging
- New imaging techniques can provide additional value
- MRI has high sensitivity and can be a problem solver in the clinic
- Triple assessment should be used

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Thank you for your attention!

kristina.lang@med.lu.se

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