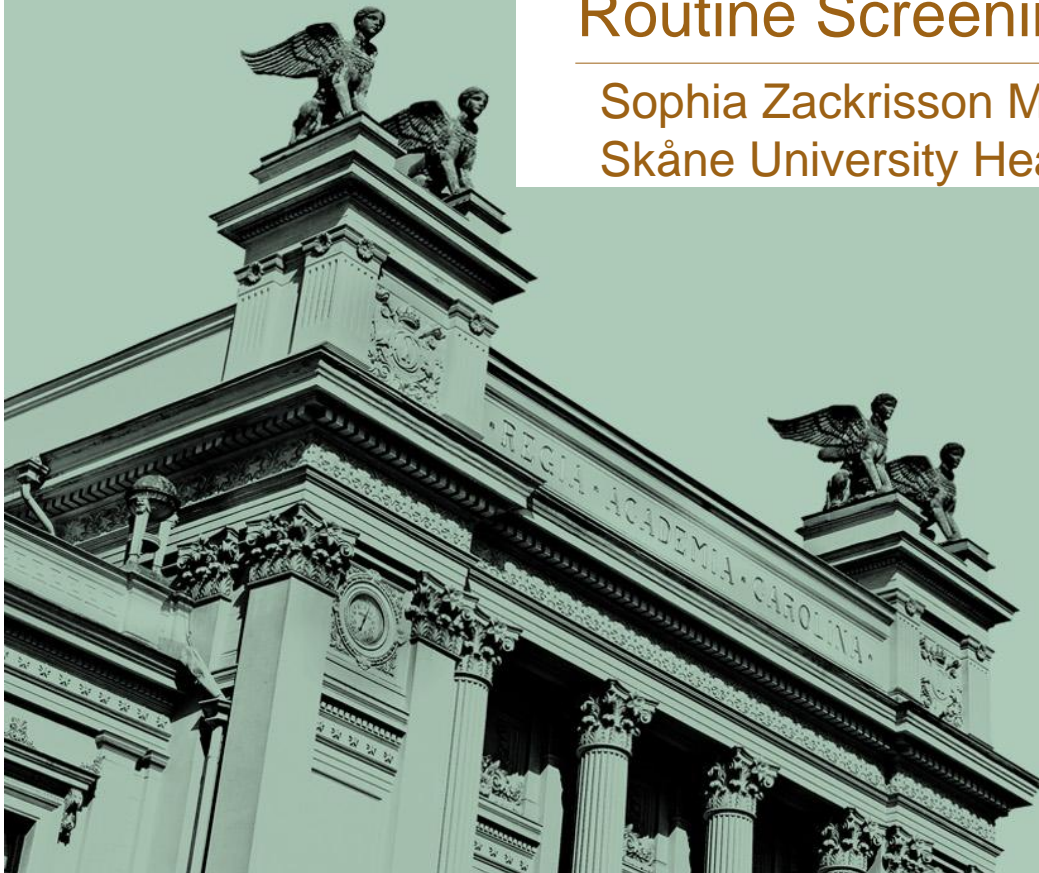




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Digital Breast Tomosynthesis – Ready for Routine Screening?

Sophia Zackrisson MD, PhD, Assoc Prof of Radiology
Skåne University Healthcare, Lund University, Sweden



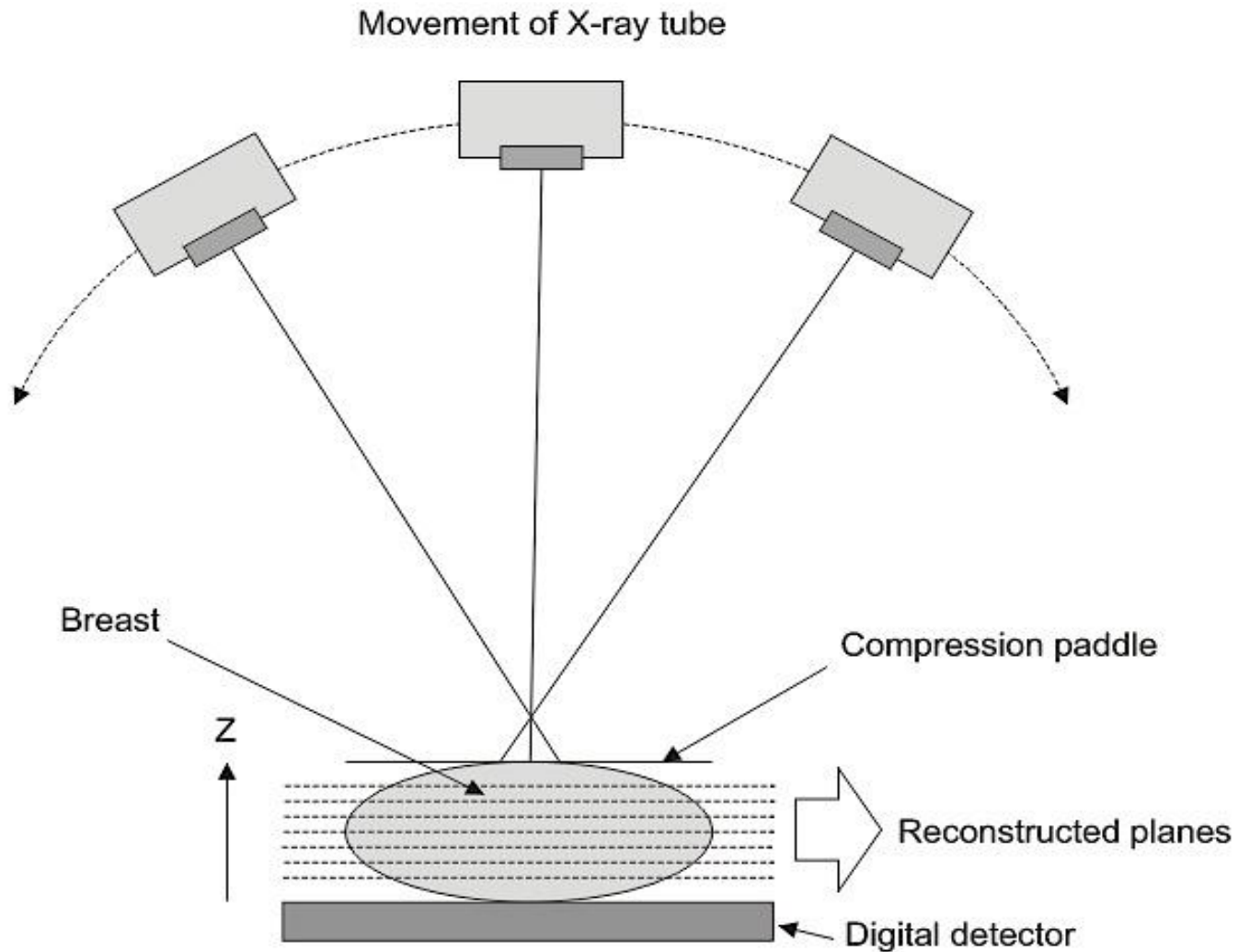
Mammography screening

- 20% reduced breast cancer mortality (Marmot review, Lancet 2012)
- 15-30% tumors missed

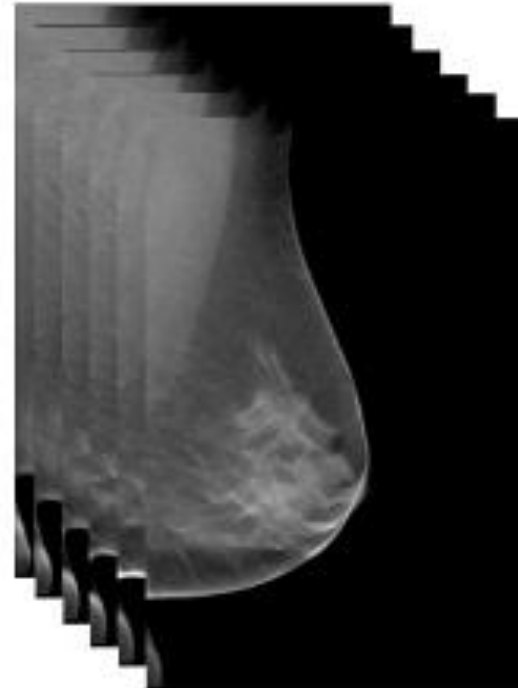
Törnberg S et al 2010
Laming D. and Warren R. 2000
Bassett et al 1987
Baines et al 1986



Digital breast tomosynthesis is 3D-mammography



Digital breast tomosynthesis is 3D-mammography

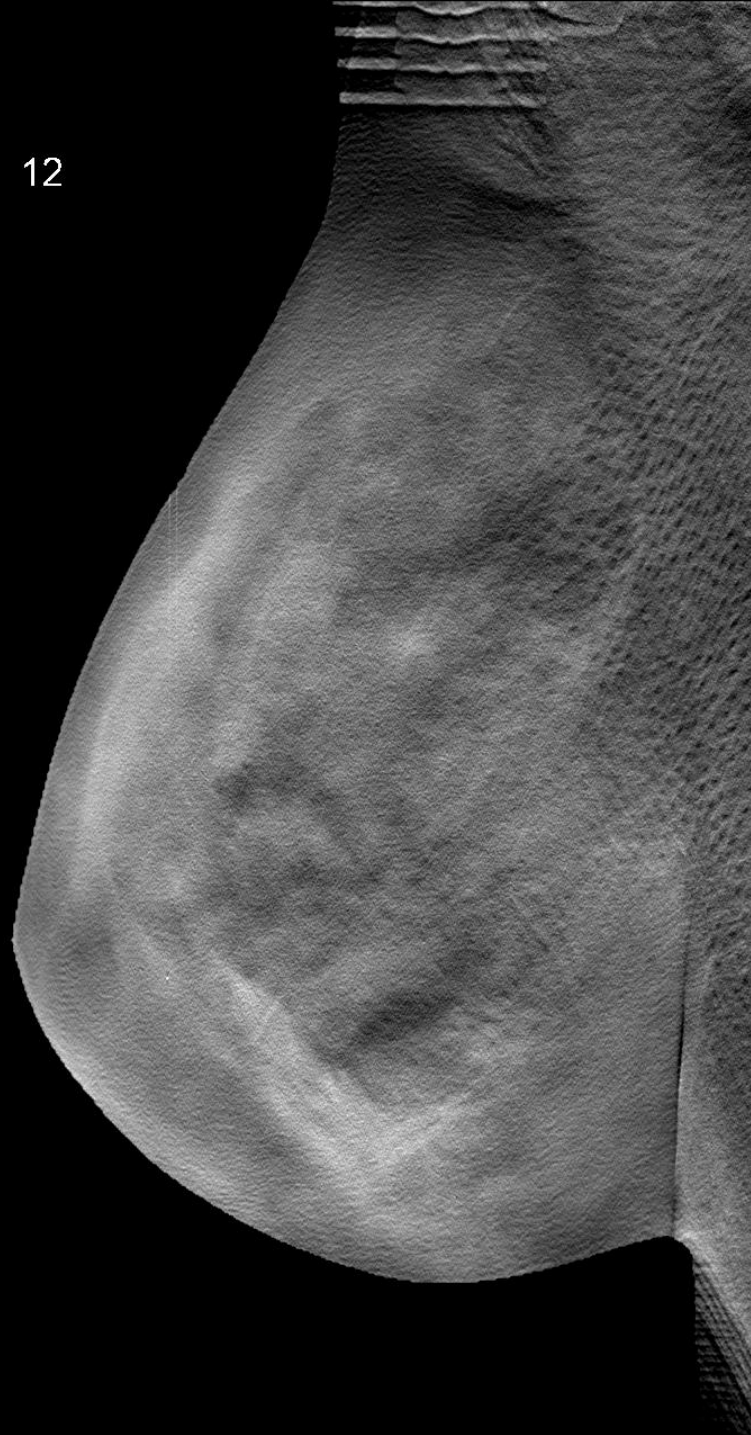


Tómos = Greek for slice, cut

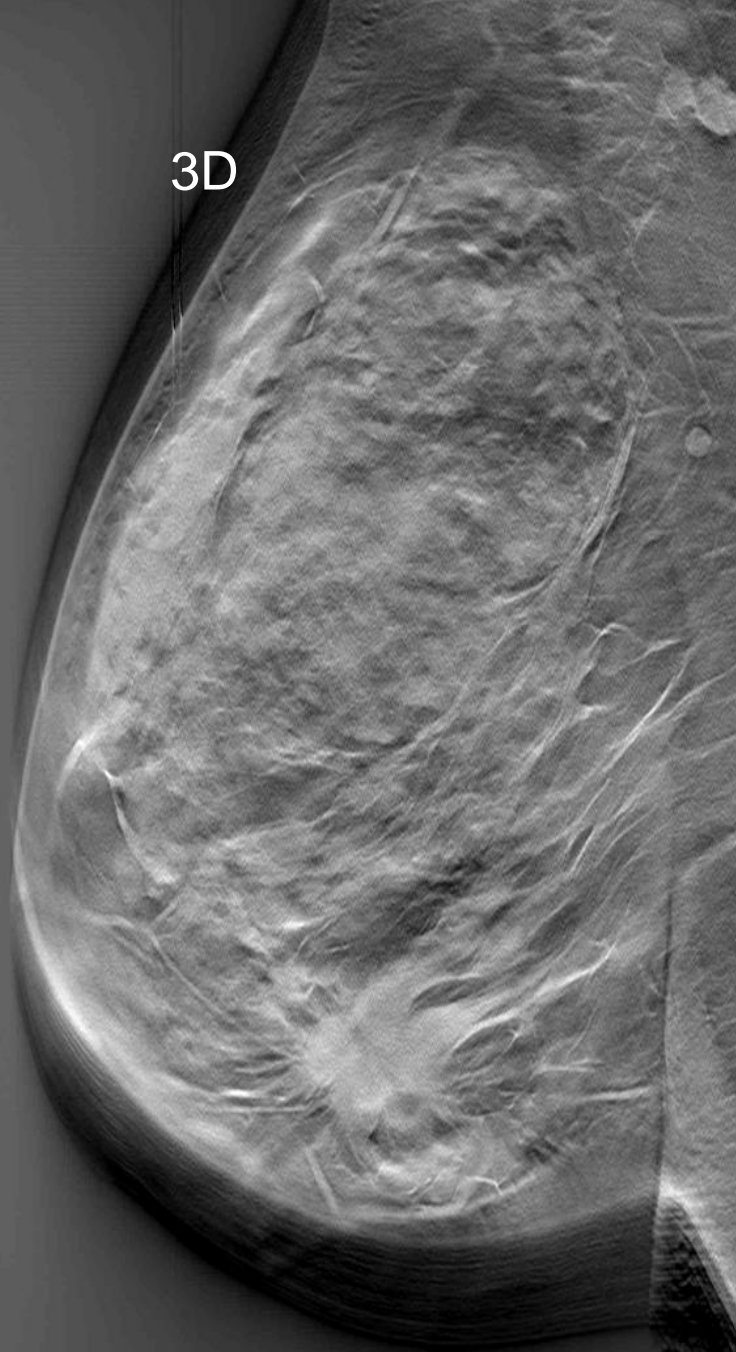


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12

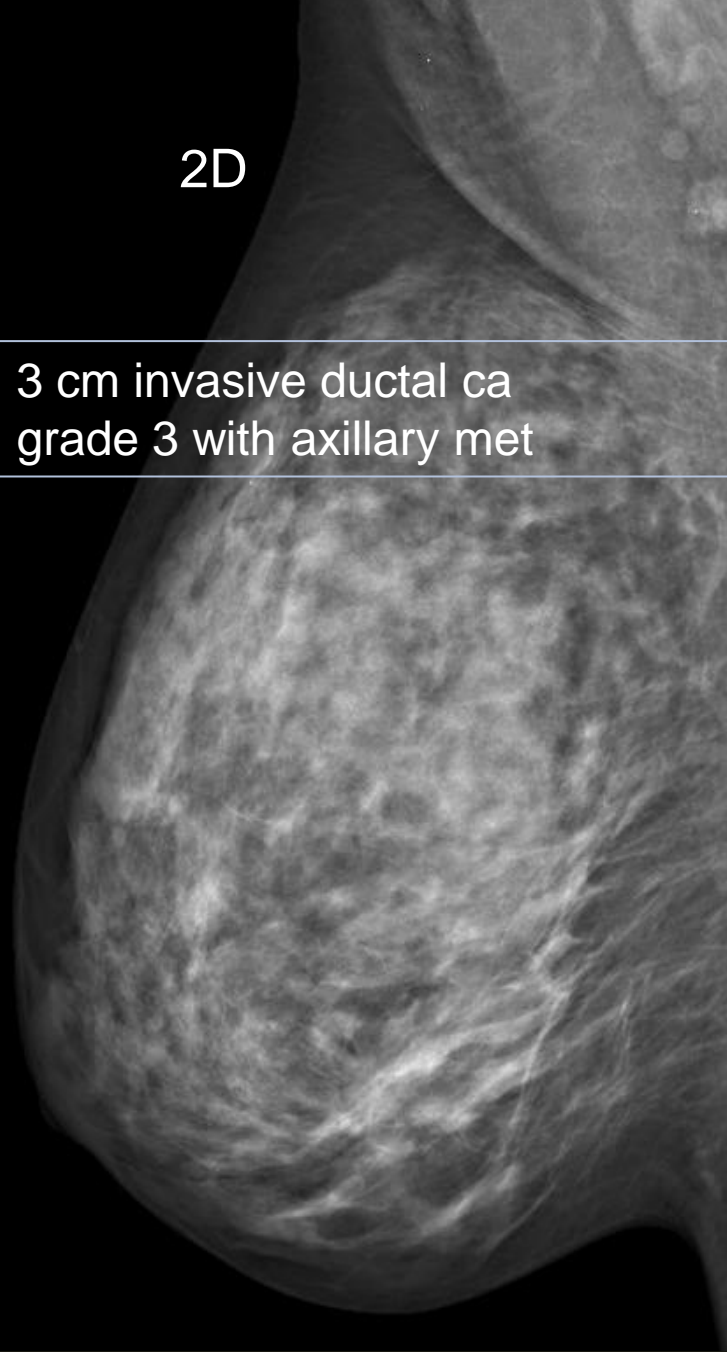


3D



2D

3 cm invasive ductal ca
grade 3 with axillary met





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Performance of one-view breast tomosynthesis versus two-view mammography in breast cancer screening

FIRST RESULTS FROM THE MALMÖ BREAST TOMOSYNTHESIS SCREENING TRIAL

Zackrisson S, Lång K, Rosso A, Timberg P, Tingberg A, Andersson I



Rationale

- Initial studies indicate equal or better accuracy in cancer detection with breast tomosynthesis (BT) compared to digital mammography (DM)
- Population-based studies needed to assess efficacy of BT in screening
- Published screening trials report combinations of 2-view BT and DM (*Skaane et al 2013, 2014, Ciatto et al 2013*)

Aim

Malmö Breast Tomosynthesis Screening trial - MBTST

To study the accuracy of one-view BT versus 2-view DM in population based screening

Materials and methods

MBTST



Population based screening program Malmö

Ages 40-74 yrs

Screening intervals: 18 months 40-55 yrs
 24 months >55 yrs

MBTST

Random sample

N = 15,000

DM: CC + MLO

BT: MLO

One screening occasion

Reading arms

Double reading & independent scoring

DM

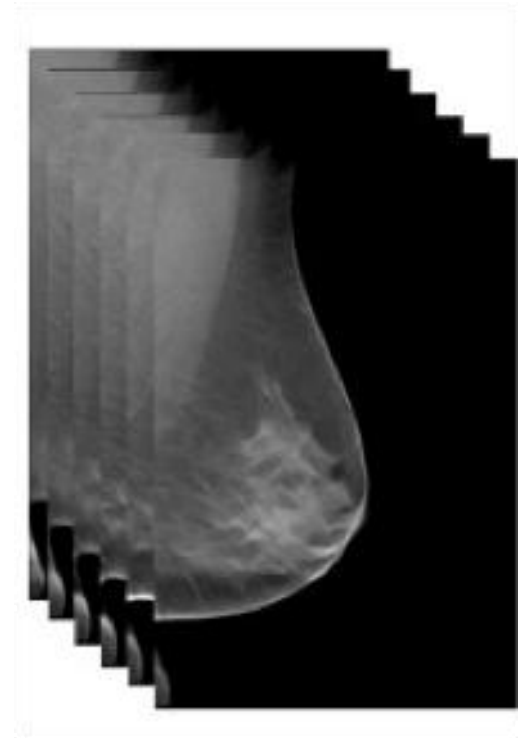
1. DM (CC, MLO)
2. DM (CC, MLO) + prior DM
3. Density rating, BIRADS 1-4

BT

1. BT (MLO)
2. BT (MLO) + DM CC-view
3. BT + DM CC-view + prior DM (CC + MLO)

Image acquisition

- Siemens Mammomat Inspiration (BT and DM)
- 25 low-dose projections
- Angular range 50°
- Scanning time 20-25 s
- 1-view (MLO)
- Reduced compression
- Absorbed dose slightly lower than 2-view DM
- W/Rh. No grid



Population and case ascertainment

- January 2010 - December 2012
- 10,547 invited, 7,500 attended (71%)
- Record matching South Swedish Cancer Register
- One year follow-up
- Ethical approval and informed consent

[ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT01091545) NCT01091545

Results- explorative analysis MBTST

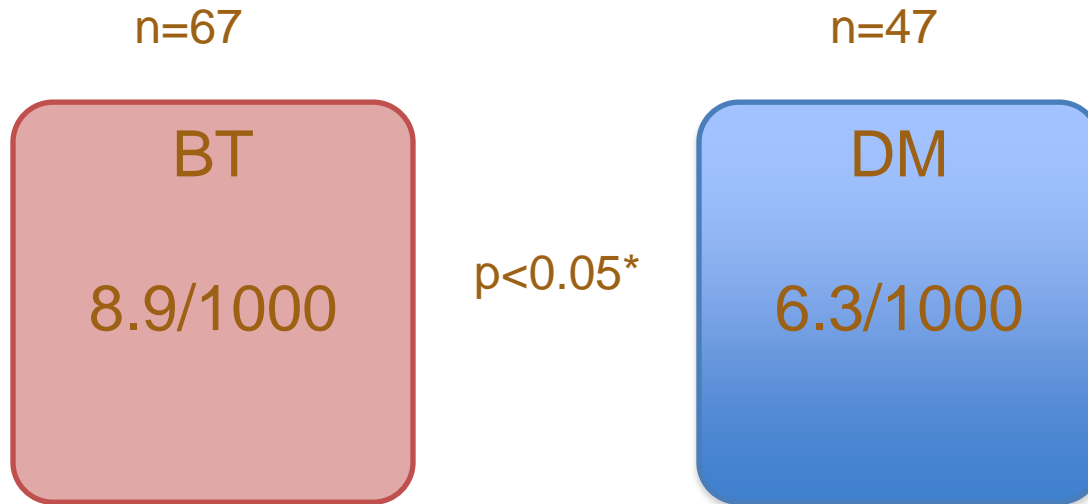
Lång K, Andersson I, Rosso A, Timberg P, Tingberg A, Zackrisson S.
Submitted



Results (7500 women)

- 67 cancers with BT, 47 with DM
- One case found only with DM (8 mm DCIS grade 2)
- Interval cancers $n = 4$

Cancer detection rate



Incremental increase with 1-view BT =
2.6/1000

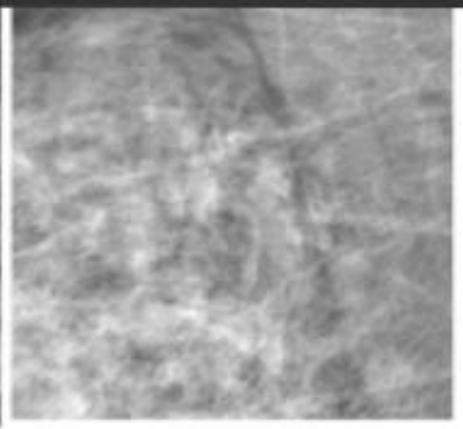
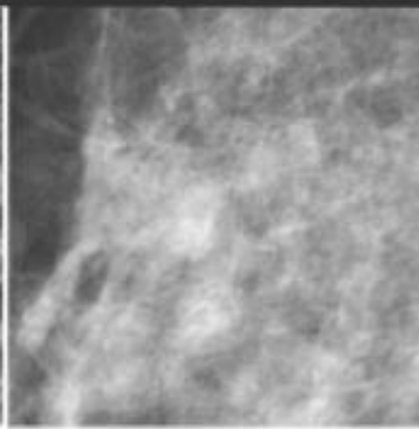
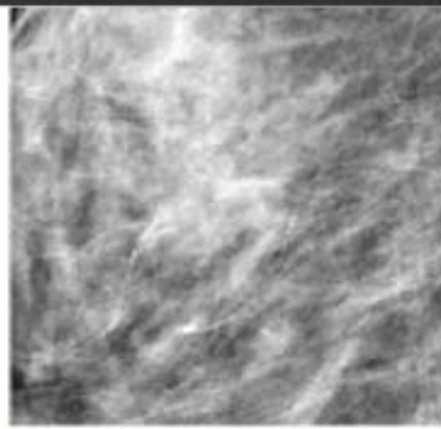
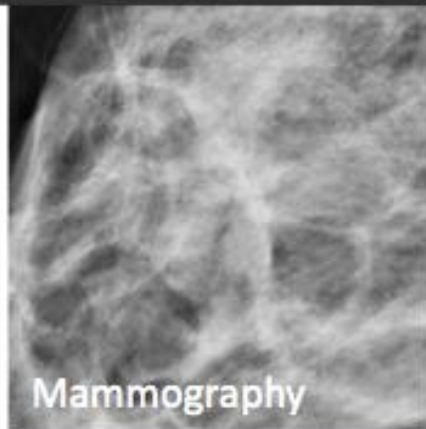
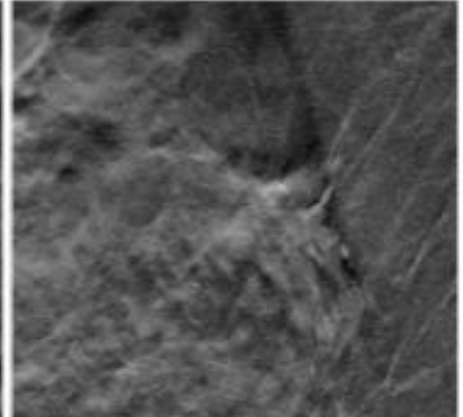
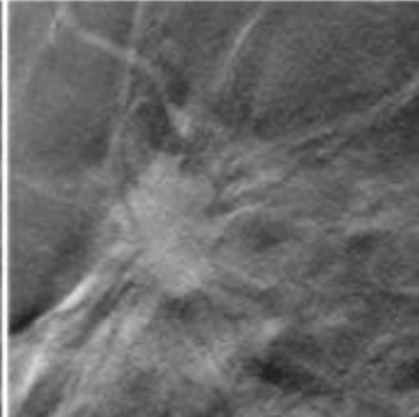
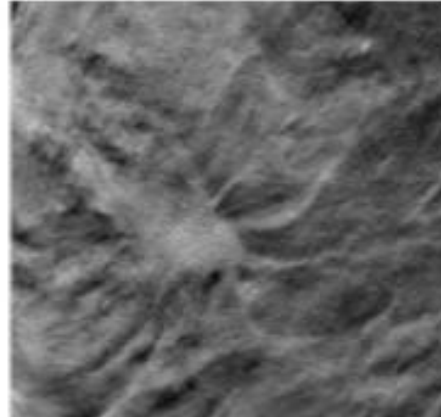
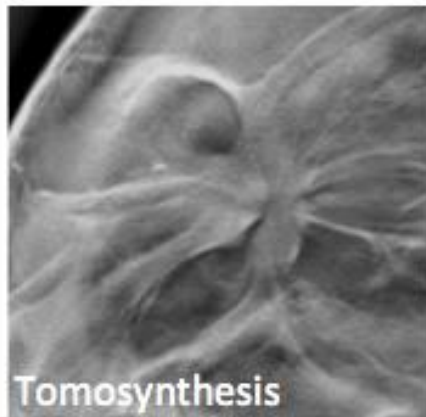
+ 43%

* McNemar's test

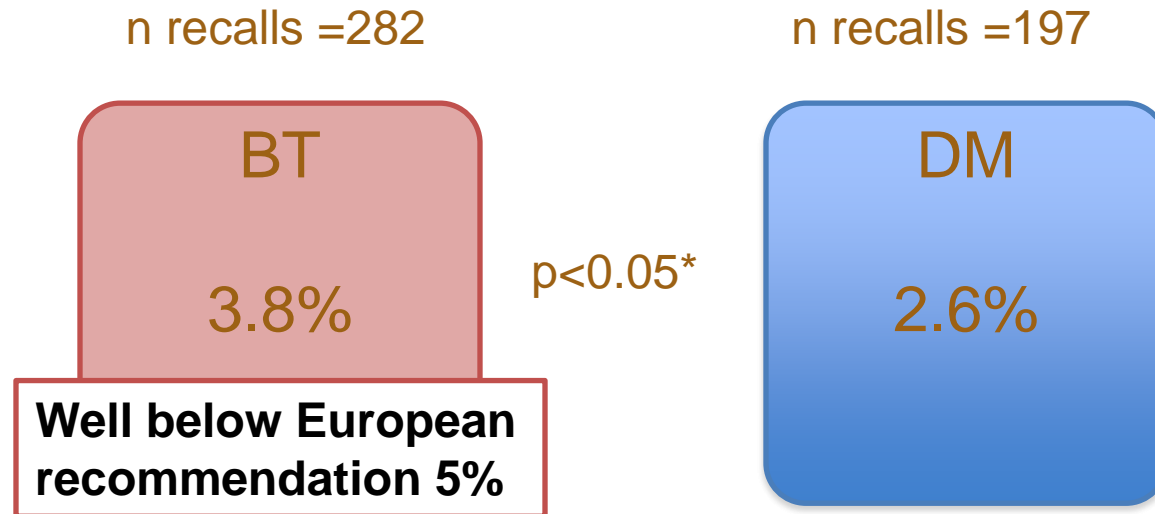


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Cancers at DBT and DM- spiculated masses not well visualized at DM- overlapping tissue



Recall rate after arbitration



Increase with BT = 1.2/100 women screened
+ 43%

* McNemar's test

Cancer characteristics BT only (n=21)

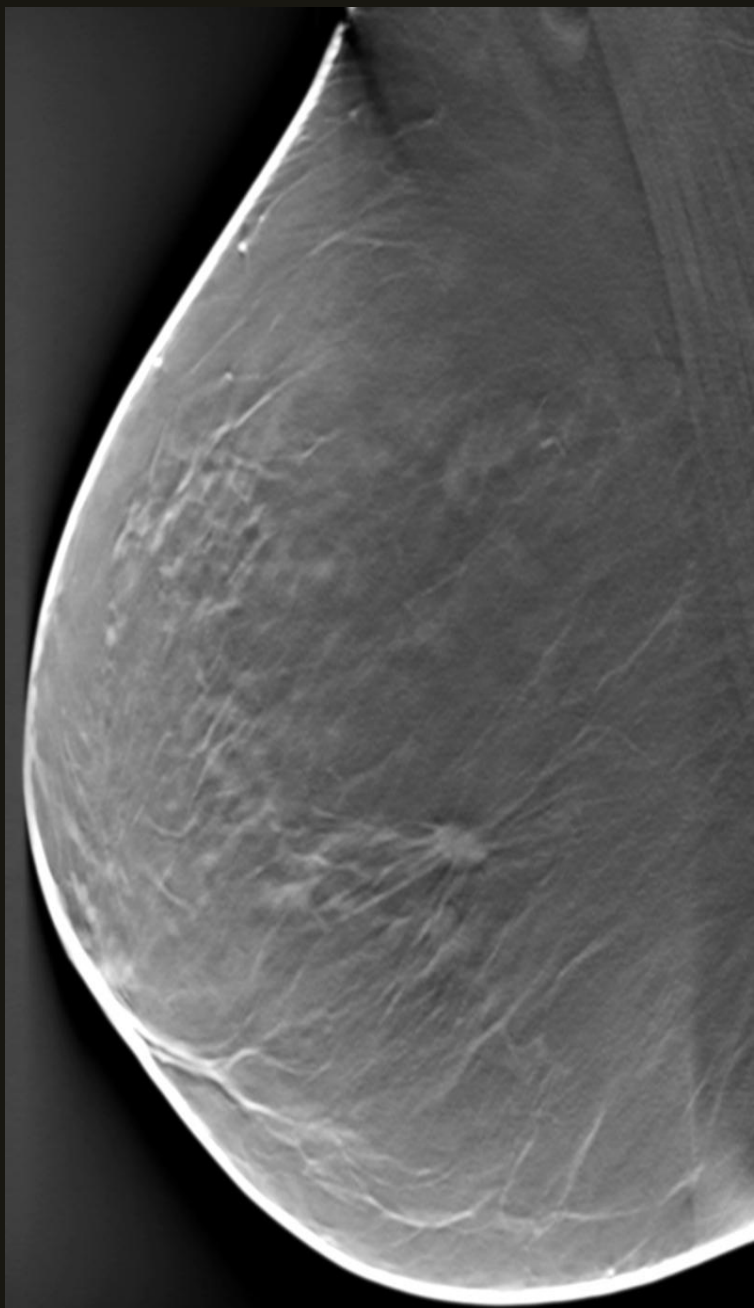
- slightly younger age
- 17 invasive cancers, 3 DCIS, 1 LCIS
- slightly smaller tumours
- lower grade, more node neg

BREAST DENSITY- BT ONLY

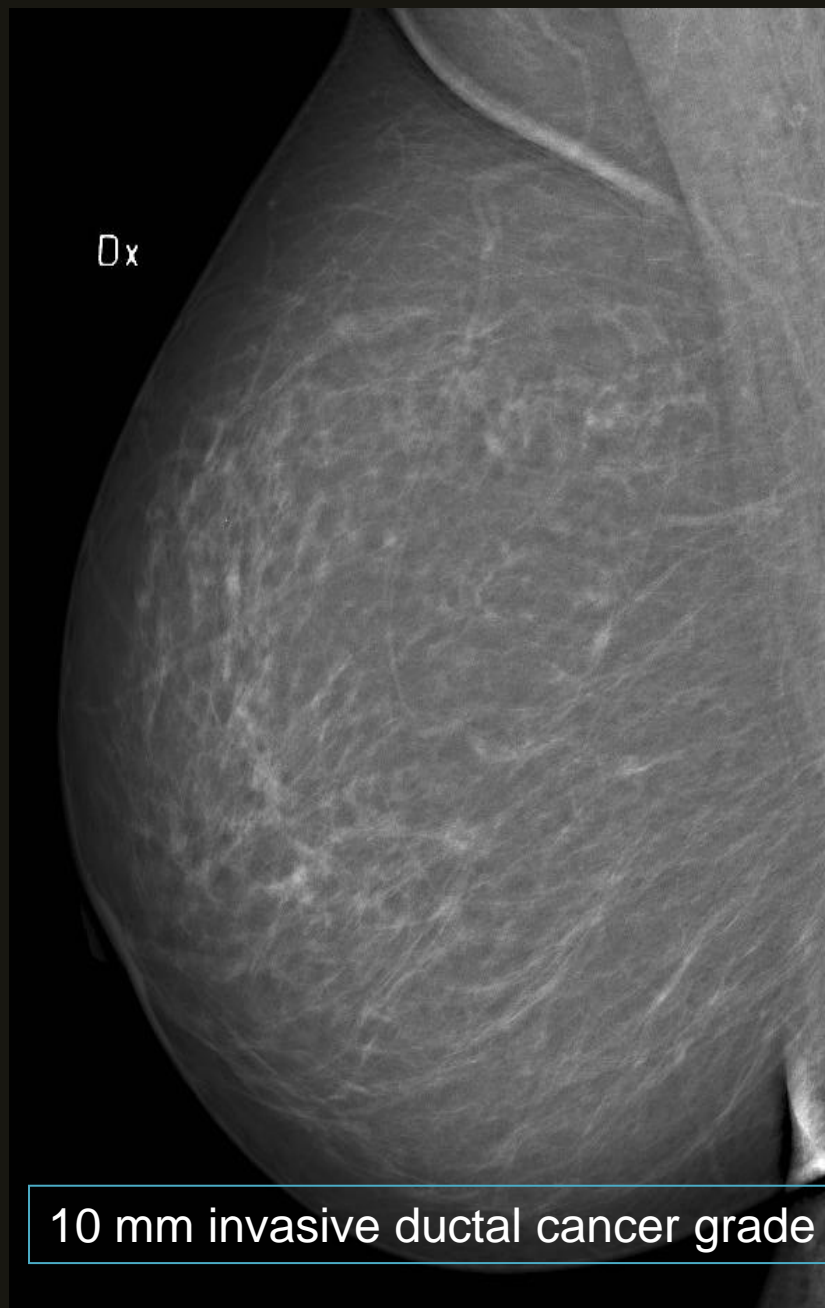
	BREAST DENSITY CATEGORIES	
	1+2	3+4
DM TOTAL (N=47)	35 %	66 %
BT TOTAL (N=67)	35 %	64 %
BT ONLY (N=21)	38 %	62 %



TOMOSYNTHESIS



MAMMOGRAPHY



10 mm invasive ductal cancer grade 1

SCREENING PERFORMANCE IN POPULATION BASED TRIALS

Cancer detection rates

	DETECTION RATE		INCREASED DETECTION
	DM	COMBO	
OSLO	6.1/1000	8/1000	27 %
STORM	5.3/1000	8.1/1000	34 %
		1-view BT	
MALMÖ	6.3/1000	8.9/1000	43 %

Skaane et al. Radiology. 2013
Ciatto et al. Lancet Oncol. 2013
Lång et al. Submitted

SCREENING PERFORMANCE IN POPULATION BASED TRIALS

Recall rates

	RECALL RATES		CHANGE IN RECALLS
	DM	COMBO	
OSLO	2 %	2.8%	+32 %
STORM	4.4%	3.5%	-27 %
	DM	1-view BT	
MALMÖ	2.6%	3.8%	+ 43 %

Skaane et al. Radiology. 2013
Ciatto et al. Lancet Oncol. 2013
Lång et al. Submitted

Summary of results MBTST

- Higher detection rate with BT only
- Increased but acceptable recall rate, with BT only
- Trend towards tumor detection at earlier stage with BT?

Discussion

- Prevalence effect
- Learning curve
- Analysis of false positives BT

Conclusion

- Our results suggest that one-view DBT might be feasible as a stand-alone screening modality

BT – a feasible screening tool?

- 30-40% increased cancer detection
- Acceptable or lower recall rates
- Different study designs and image combinations



Work flow

- Longer scanning time (7-25 sec)
- Greater need for computer power and storage (x10)
- Longer reading time (x1.5-2)
- No effective CAD so far

A potential mass screening modality

To be clarified in the near future:

- Repeated screening with BT
- One-view or two-view tomosynthesis?
- Alone or combined with DM/synthetic DM?
- Development of CAD?
- Cost-benefit analysis

DBT ready for routine screening?

YES

NO

SOON!



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THANK YOU!

Histologic grade

	Grade 1	Grade 2+3	n/a	Total
DM total (n=47)	30%	68%	2%	100%
BT total (n=67)	36%	61%	3%	100%
BT only (n=21)	48%	48%	4%	100%



Lymph node status

	Node neg	Node pos	N/A
DM total (n=47)	68%	26%	6%
BT total (n=67)	75%	21%	4%
BT only (n=21)	90%	10%	0%

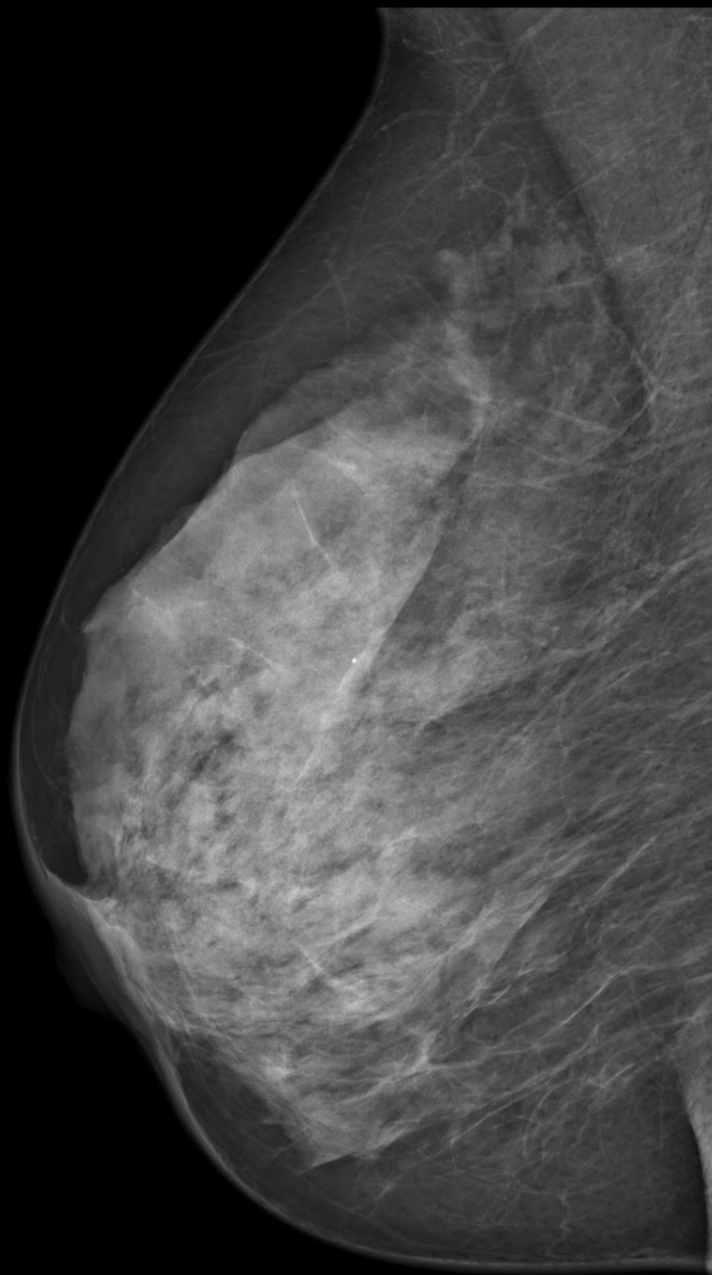
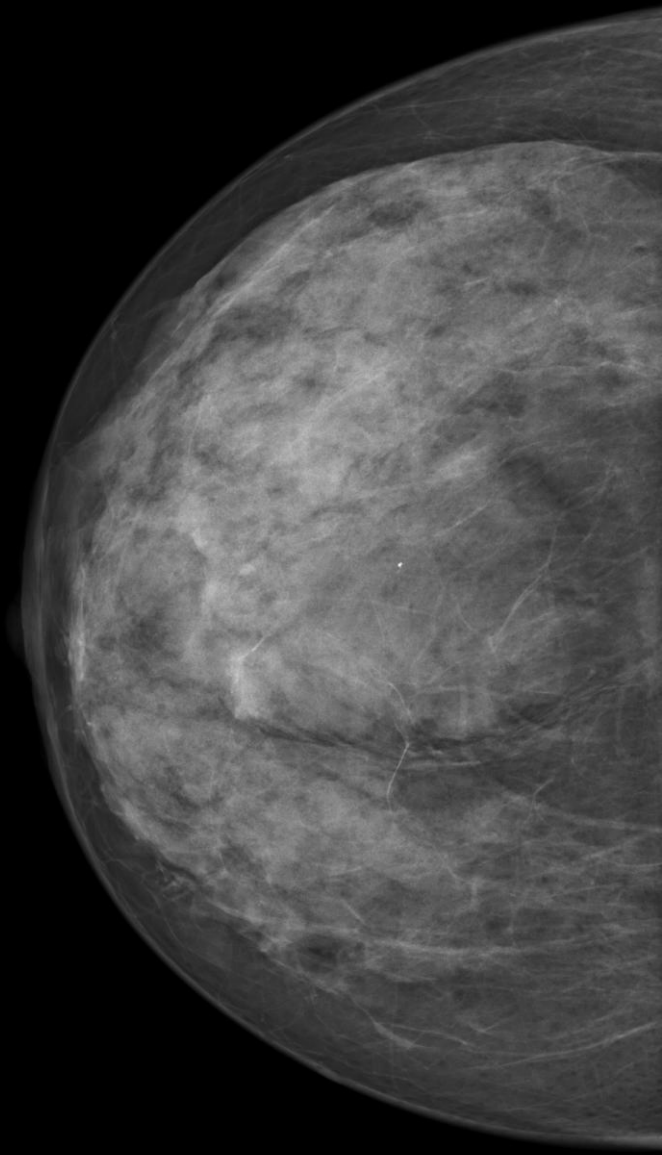


CASE 1.



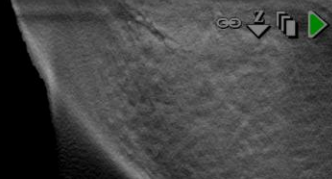
65 year old woman

Screening

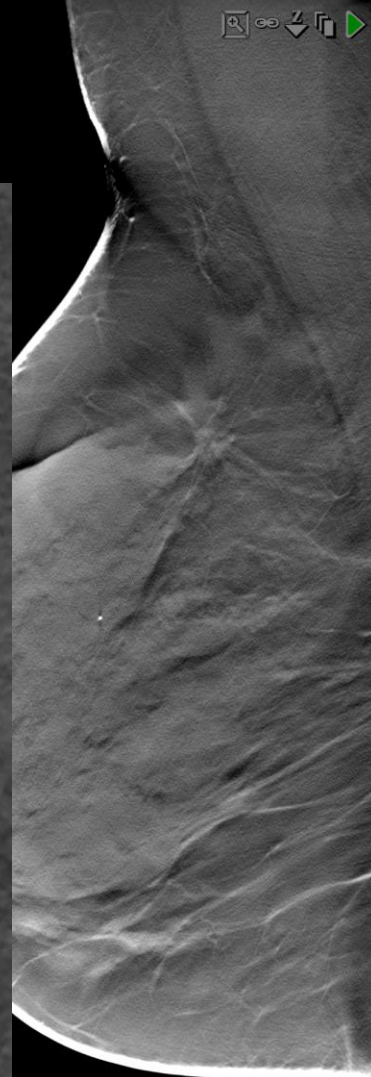
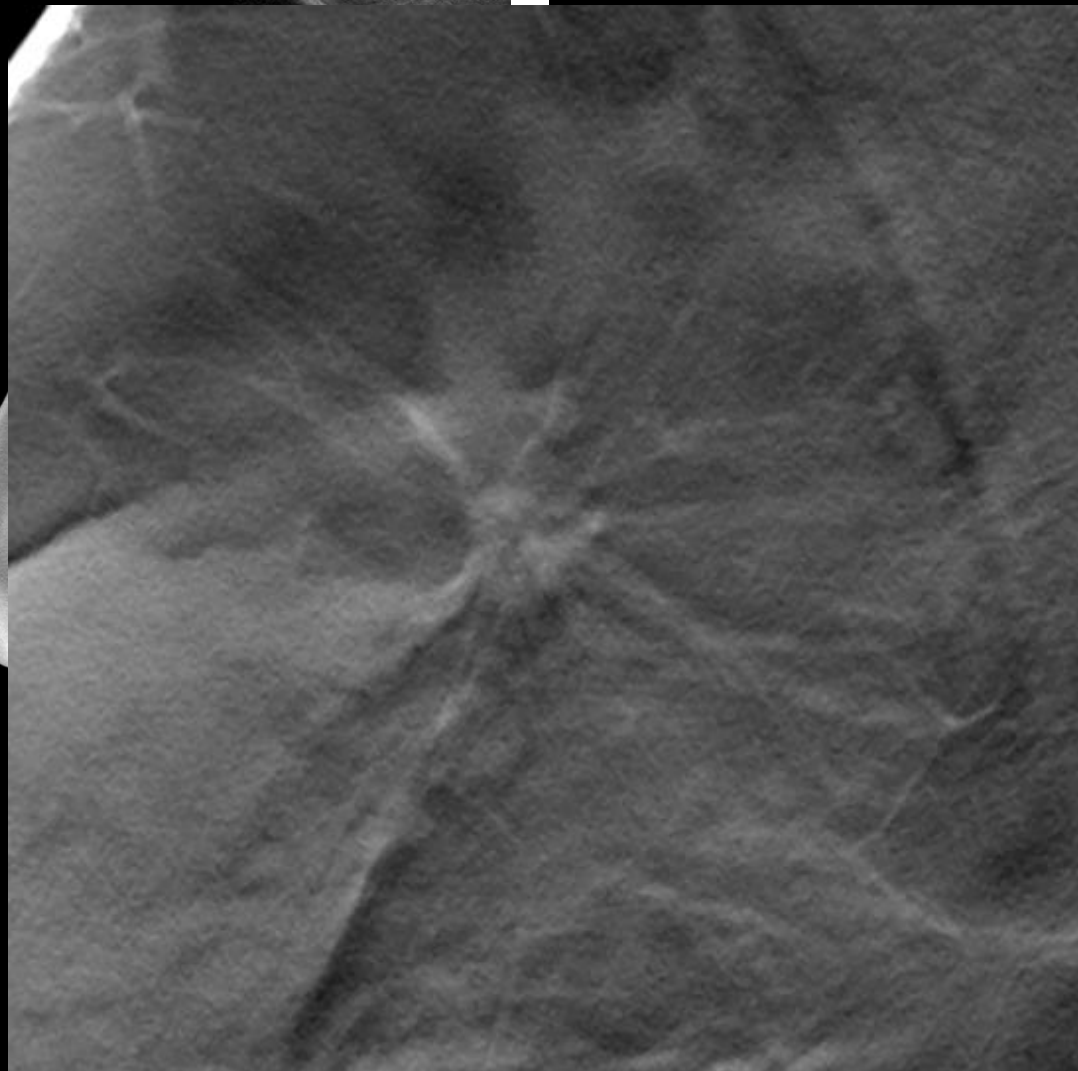




C: 2044,0, W: 811,0
Slice: 1 mm



C: 2044,0, W: 811,0
Slice: 1 mm



233 mAs
28 kV
Bild 1 av 46
2011-01-12

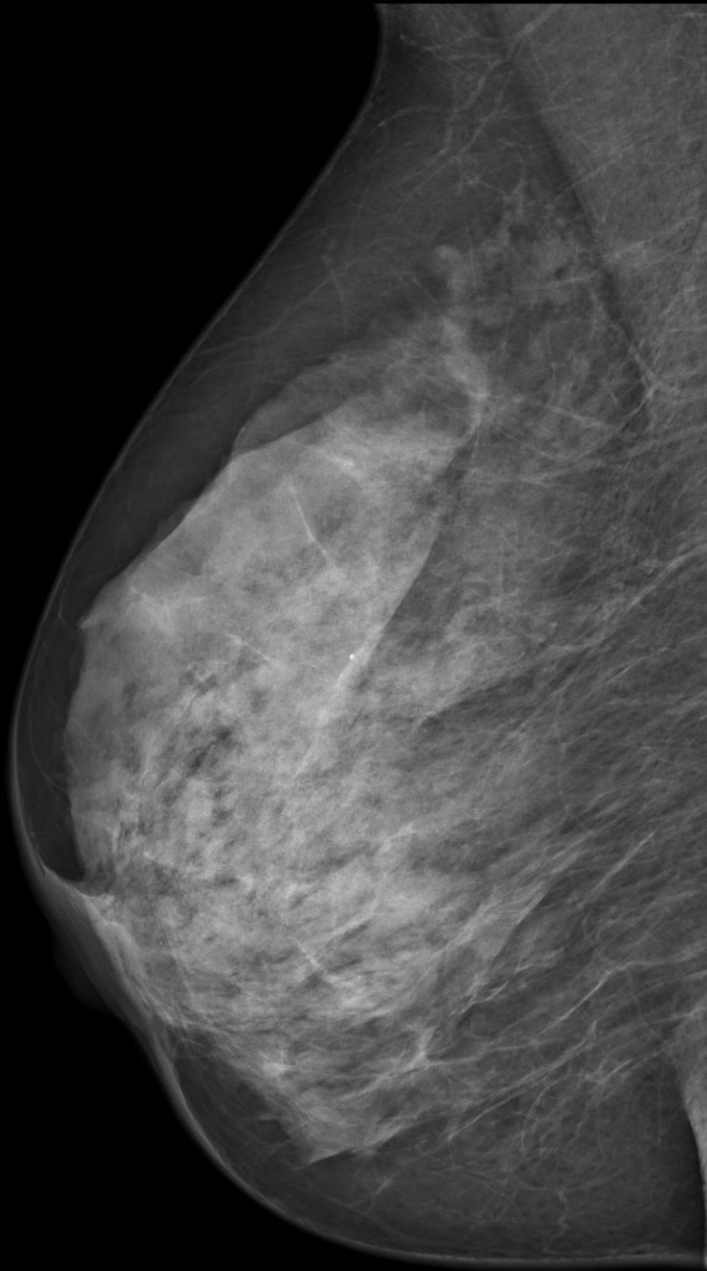
233 mAs
28 kV
Bild 31 av 46
2011-01-12



RMLO

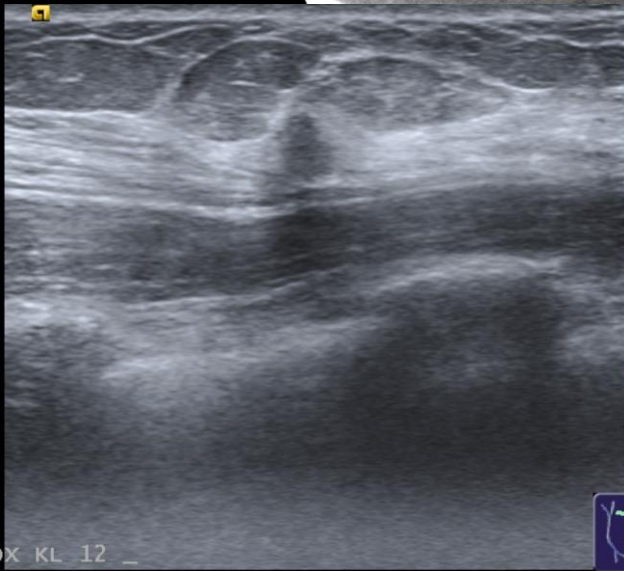
MLO

C: 2044,0, W: 811,0
Slice: 1 mm



2011-01-12, 10:25:14
-55°, Dos: 0,014053 mGy, 28 kV, 105 mAs

11: 0,4



SIEMENS
18L6 HD / *Bröst
Detail
2D
GEN / 15,00 MHz
4 dB / DR 65
ASC 5 / DTCE H

20
28
Bi
20

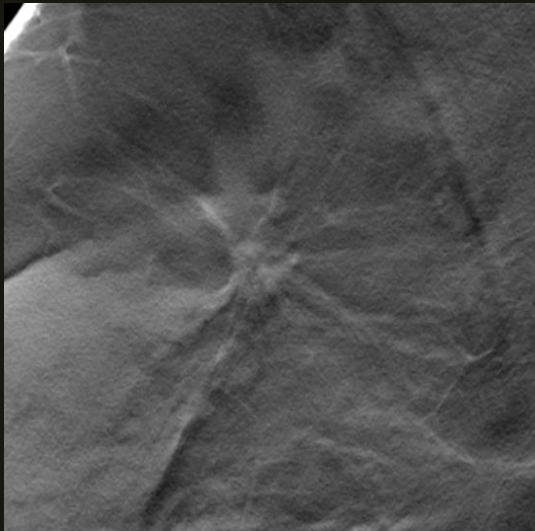
DX KL 12 _
FTI

51fps 5cm



Fr509

CASE 1. PAD



65 year old woman

Screening

15 mm intraductal
cancer grade 1,
NO

CASE 2.

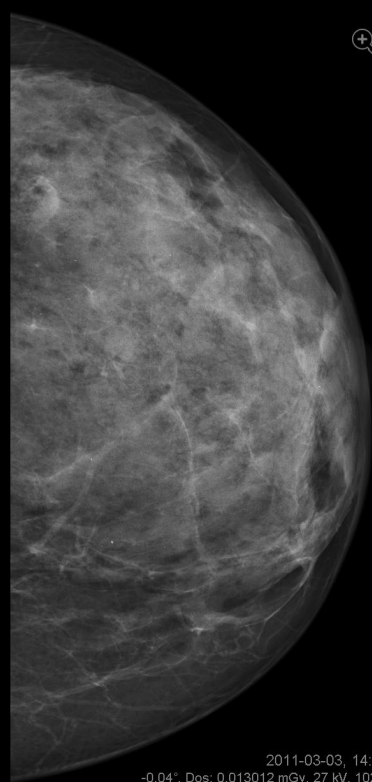
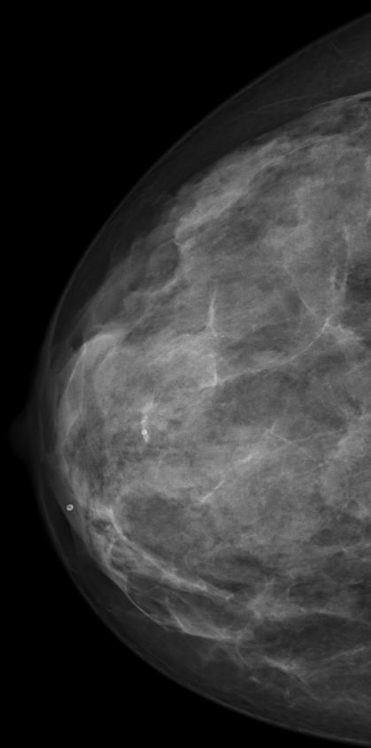


56 year old woman

Screening trial



R-CC

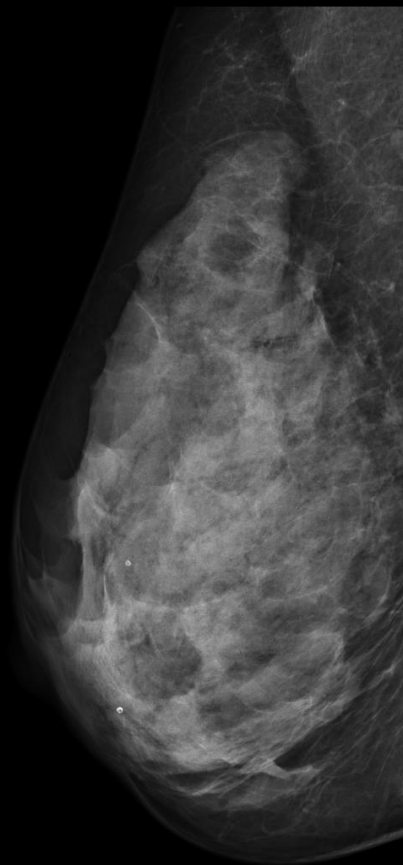


2011-03-03, 14:46:33
-0,04°, Dos: 0,01327 mGy, 28 kV, 103 mAs

2011-03-03, 14:47:07
-0,04°, Dos: 0,013012 mGy, 27 kV, 102 mAs

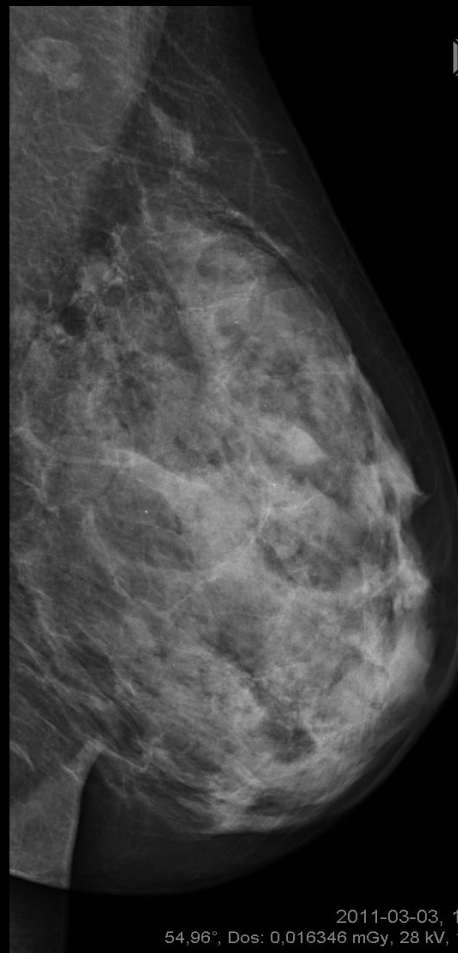


R-MLO



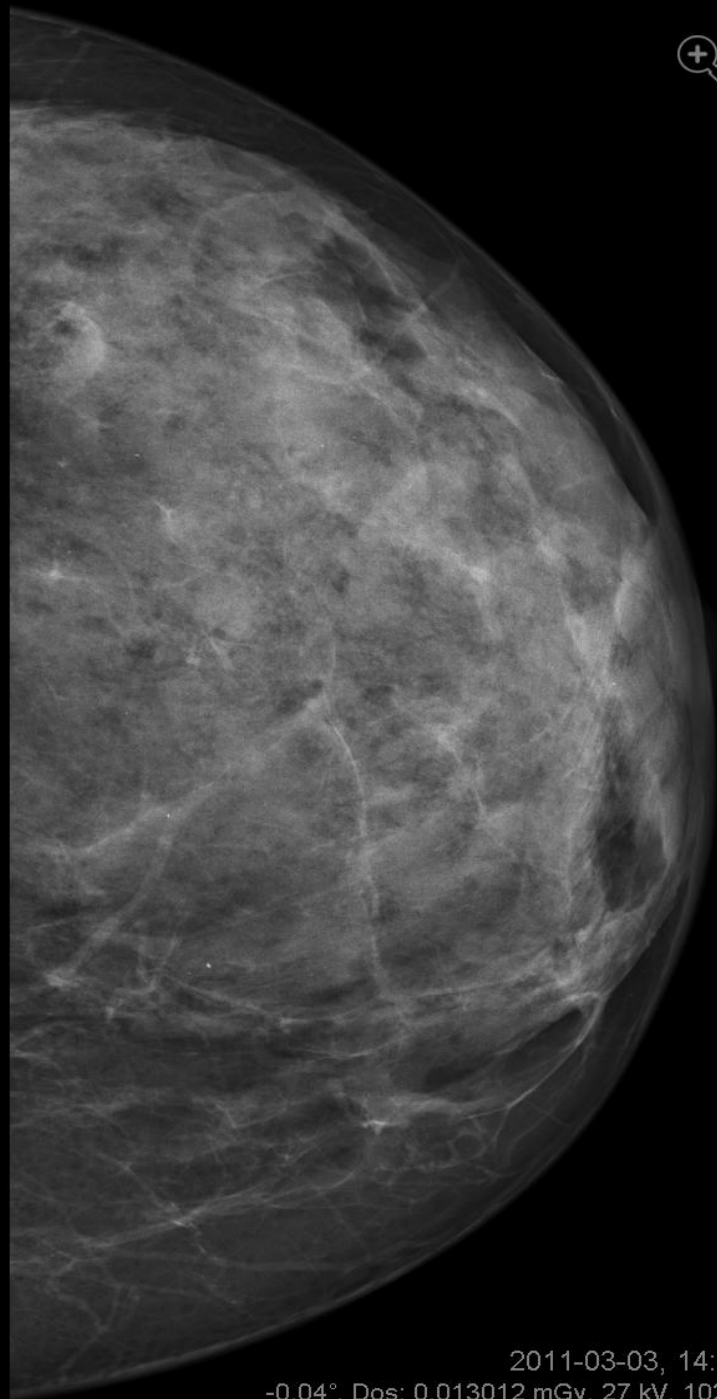
2011-03-03, 14:47:48

-54,99°, Dos: 0,017637 mGy, 28 kV, 145 mAs

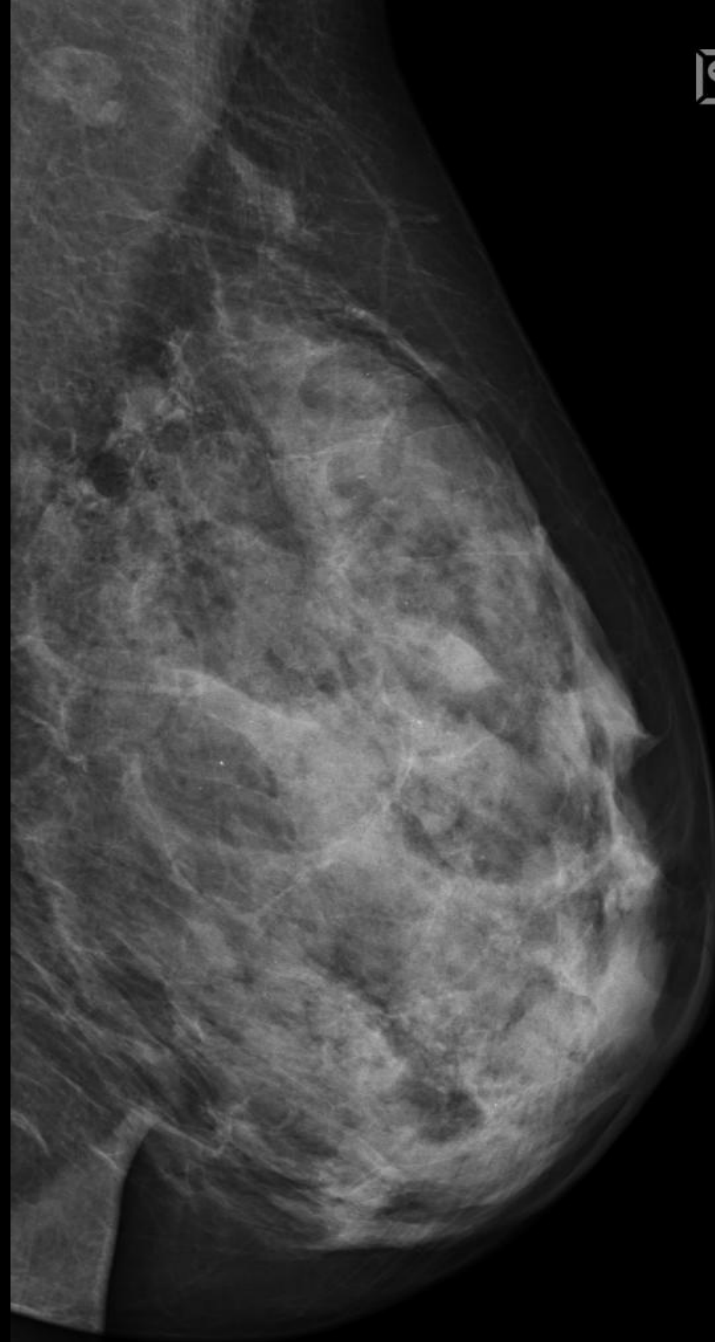


2011-03-03, 14:48:36

54,96°, Dos: 0,016346 mGy, 28 kV, 137 mAs



2011-03-03, 14:47:07
-0,04°, Dos: 0,013012 mGy, 27 kV, 102 mAs

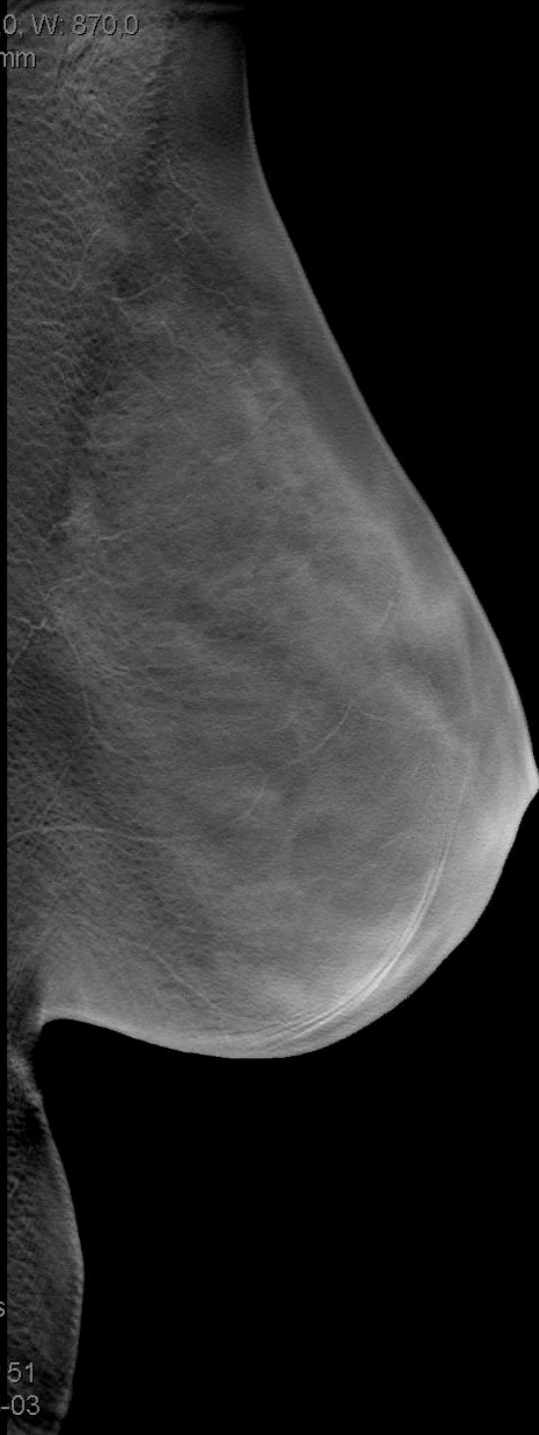


2011-03-03, 14:48:36
54,96°, Dos: 0,016346 mGy, 28 kV, 137 mAs

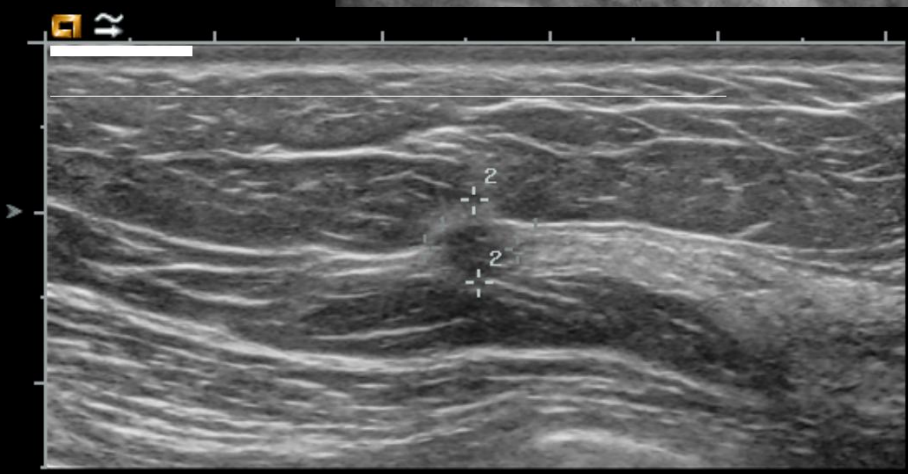
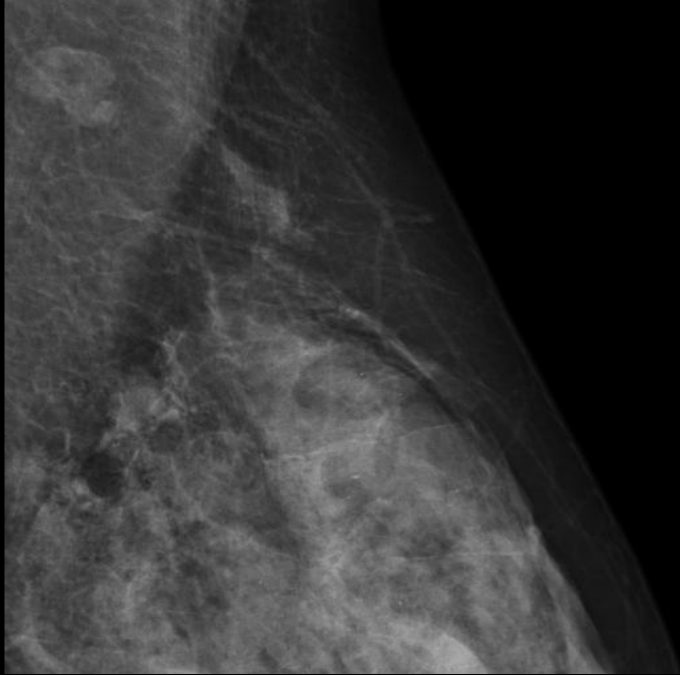
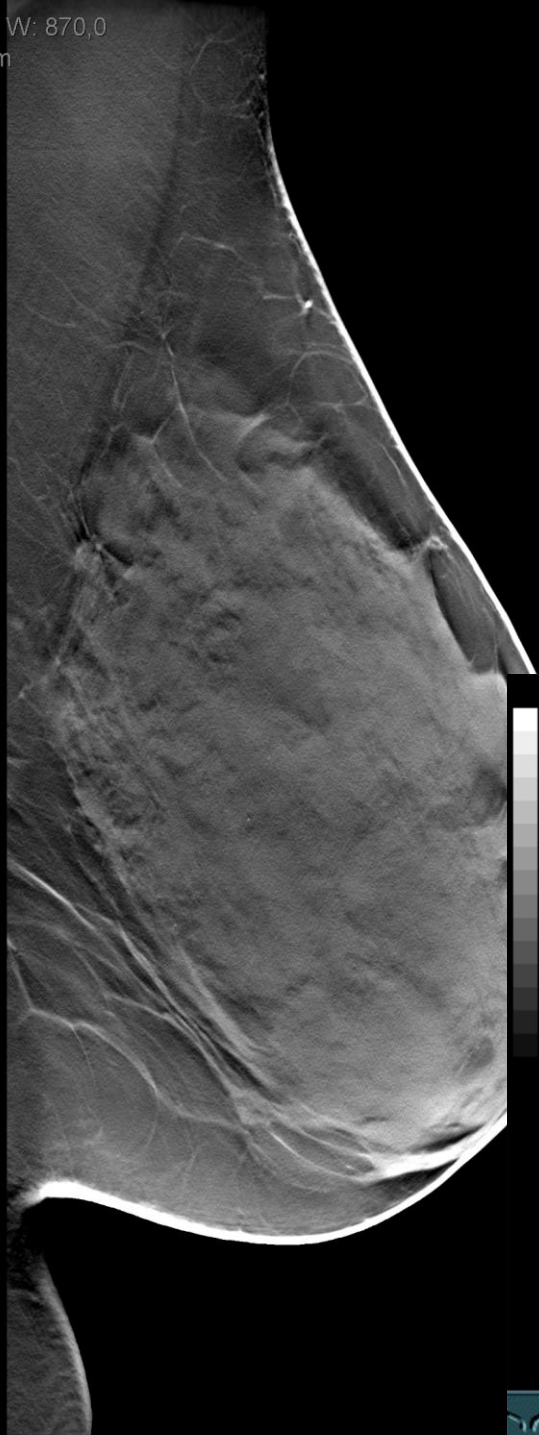
C: 2016,0, W: 870,0
Slice: 1 mm



263 mAs
29 kV
Bild 1 av 51
2011-03-03



C: 2016,0, W: 870,0
Slice: 1 mm

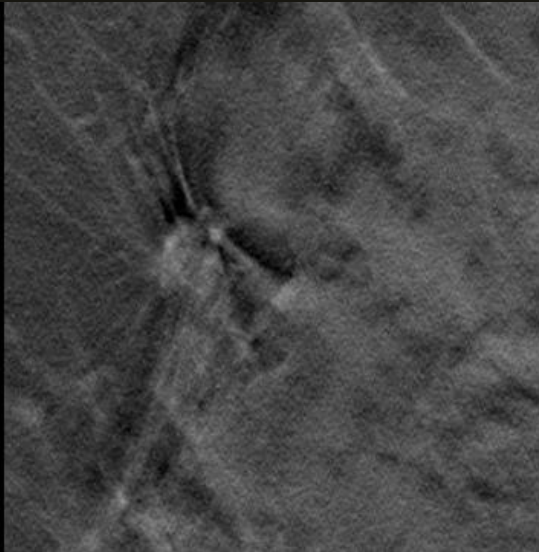


sin kl 11 7 cm

12:27:20
17L5 HD
15.0MHz 25mm
Breast
General
65dB SC2/+2/3/2
Gain= 12dB Δ=2
Store in progress

-----1-----
Dist = 0.553cm

CASE 2. PAD



56 year old woman

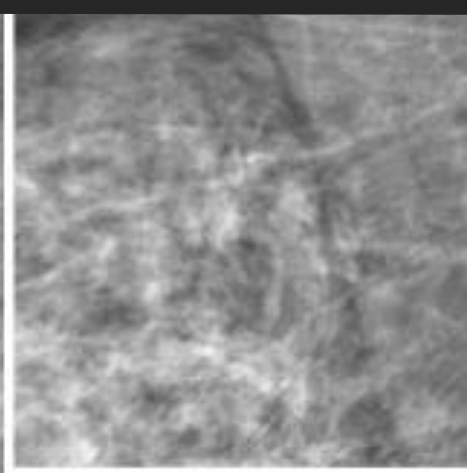
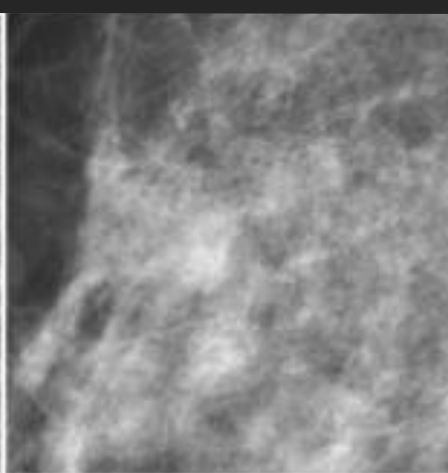
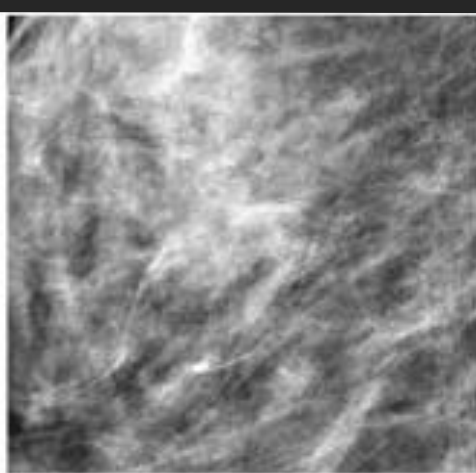
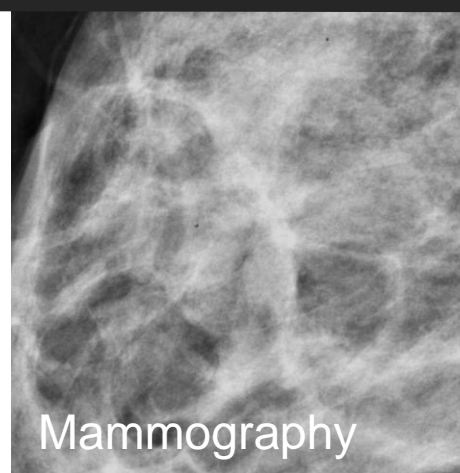
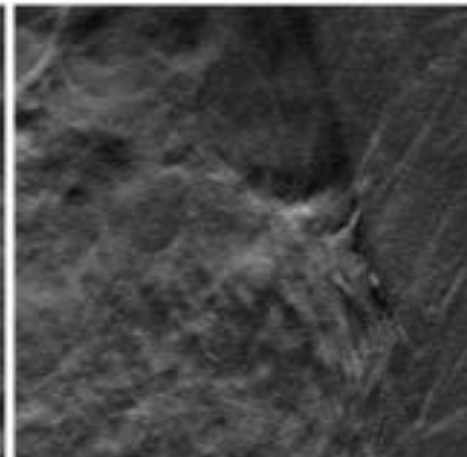
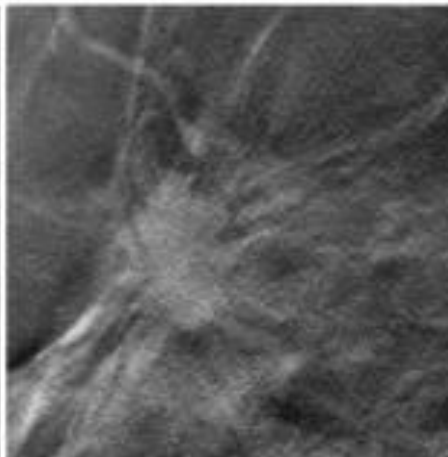
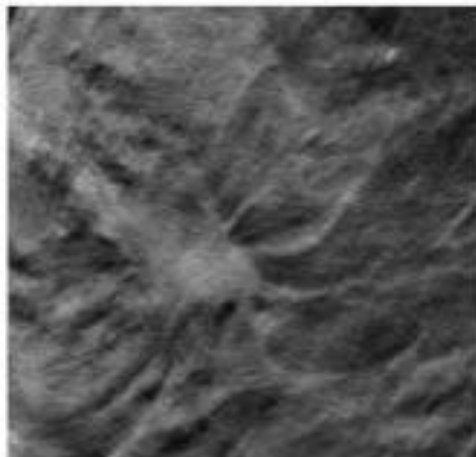
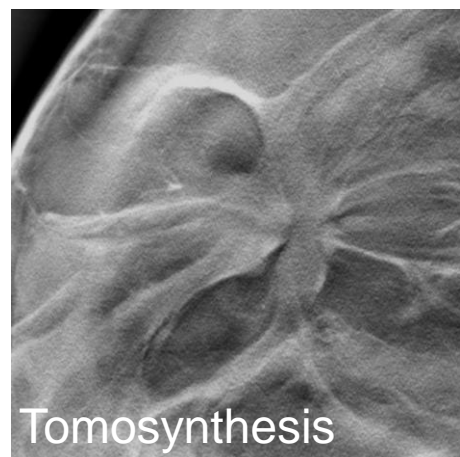
Screening trial

7 mm, tubular cancer
+ DCIS, grade 1, N0

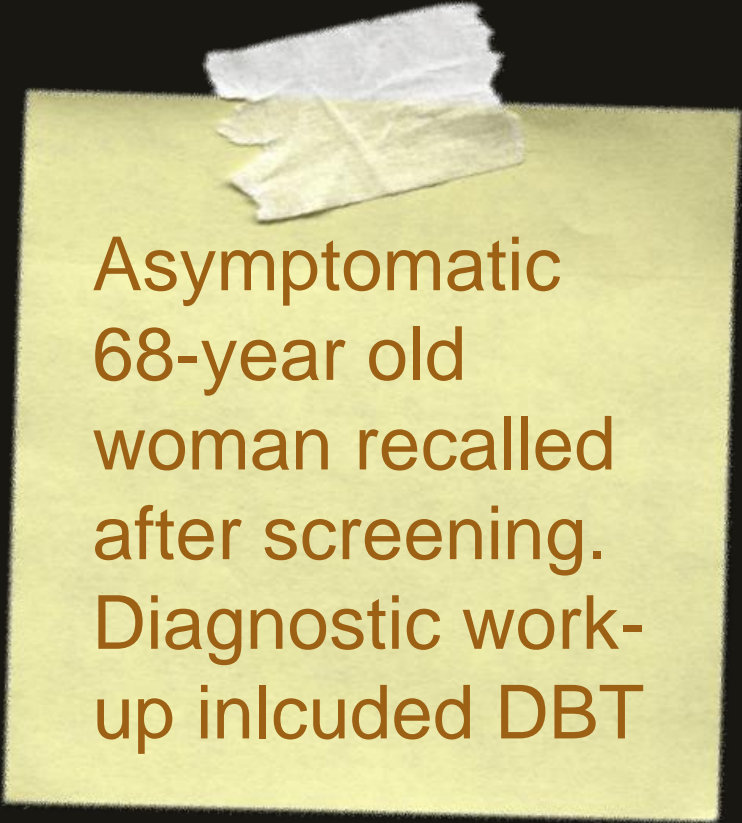
DBT and spiculated lesions

- Reduces effect of overlapping tissue
- Especially useful for detection of masses, e.g. spiculated lesions

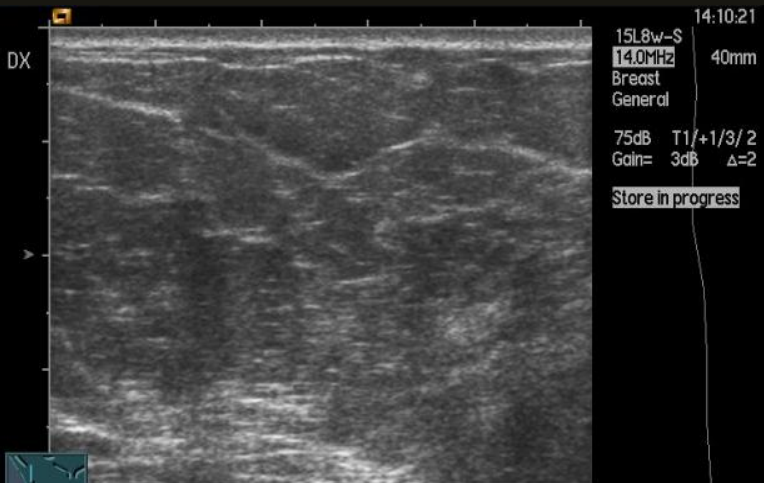




CASE 3.



Asymptomatic
68-year old
woman recalled
after screening.
Diagnostic work-
up included DBT

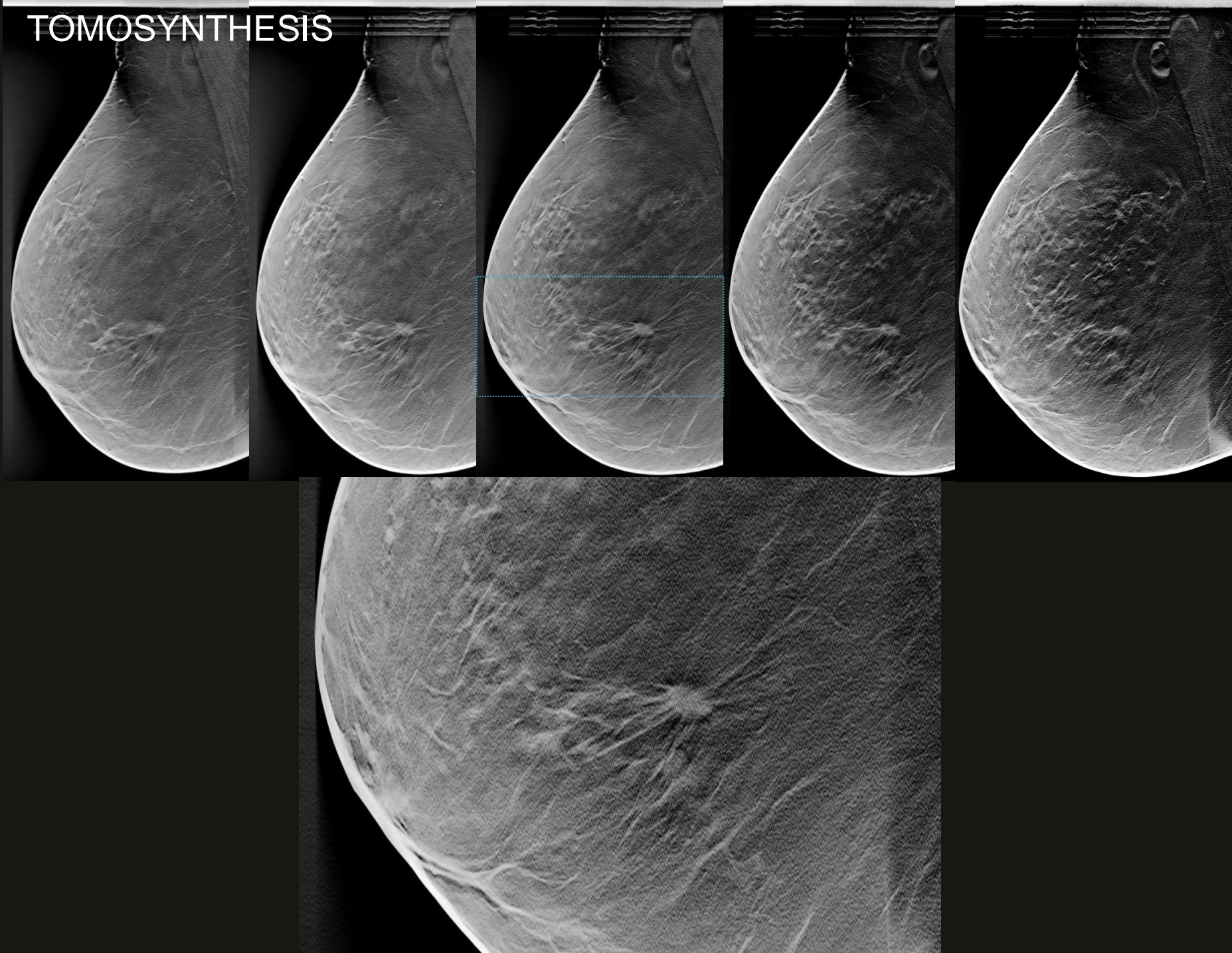


CC

MLO

Dx

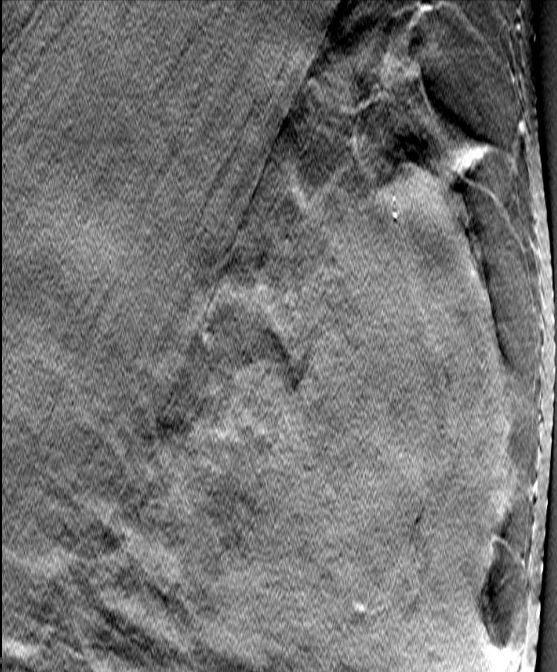
TOMOSYNTHESIS



DBT and breast density

- Cancers detected in all BIRADS groups in trials
- Not only useful in dense breasts

10 mm invasive carcinoma



False negative DBT

