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Tomosynthesis in screening (stratified screening?)

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Conflicts of interest

- Speaker's fees from Siemens Healthineers, Pfizer, Bayer AG
- Patent (US patent no PCT/EP2014/057372)

Lund University breast Cancer Imaging Group, LUCI

Department of Translational Medicine



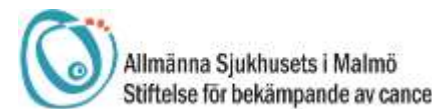
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Hanna Tomic, MSc, PhD candidate

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Li Sturesdotter, MD, PhD candidate
Nadia Chaudry, MD, PhD candidate
Jakob Olinder, MD, PhD candidate



Knut och Alice Wallenbergs

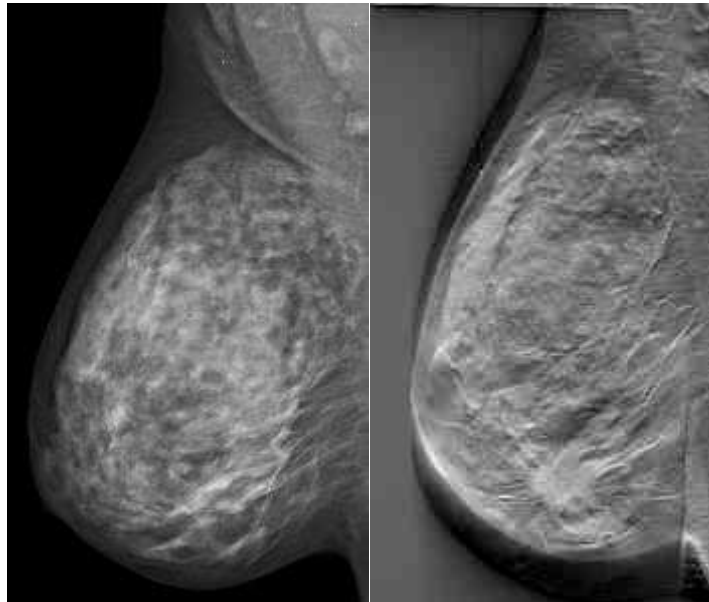


Stiftelser för cancerforskning vid Onkologiska kliniken vid Karolinska Institutet i SÖS

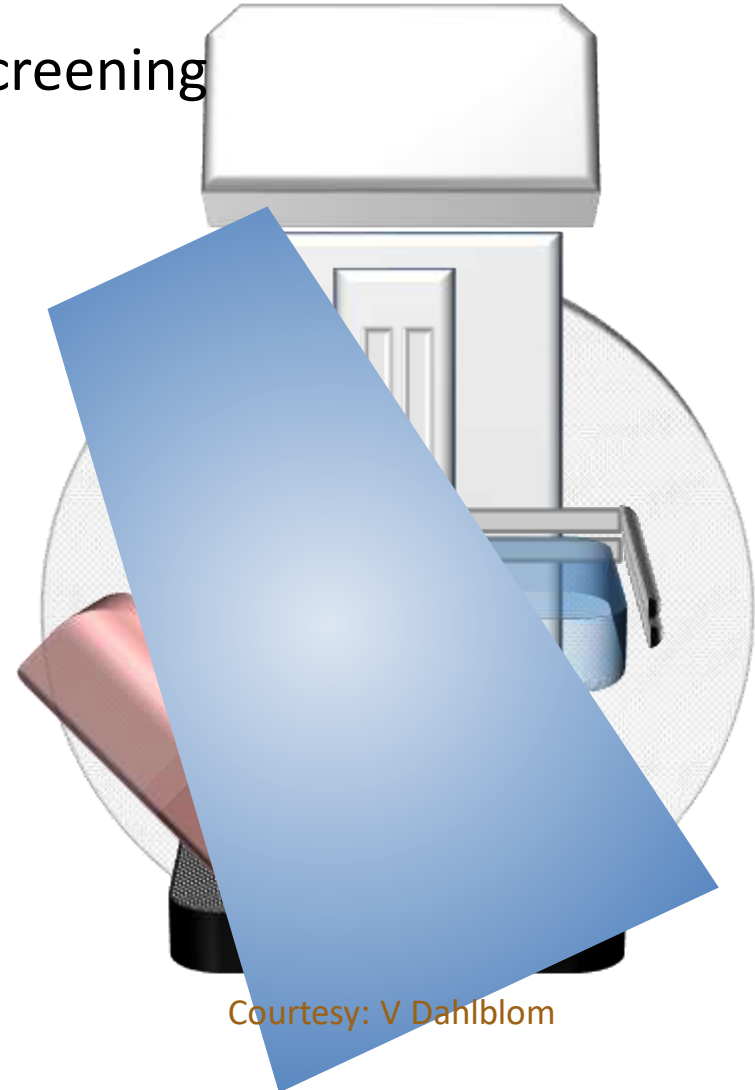


Why DBT is better than DM in screening

- Limited sensitivity of digital mammography (DM) in screening
- DBT = pseudo-3D mammography
- Less overlapping tissue
- Increased lesion detection and conspicuity



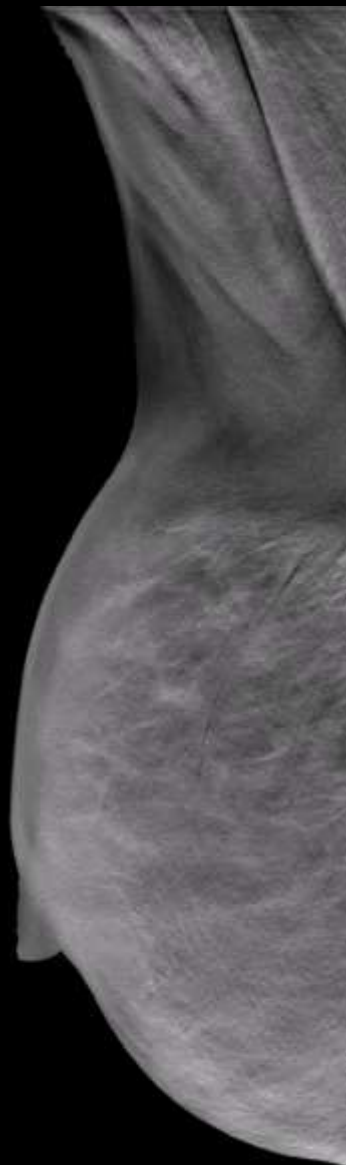
Niklason L et al. Radiology 1997
Törnberg *et al* Eur J Cancer Prev 2010
Kemp Jacobsen *et al* Int J Cancer 2015
Andersson *et al.* Eur Radiol 2008



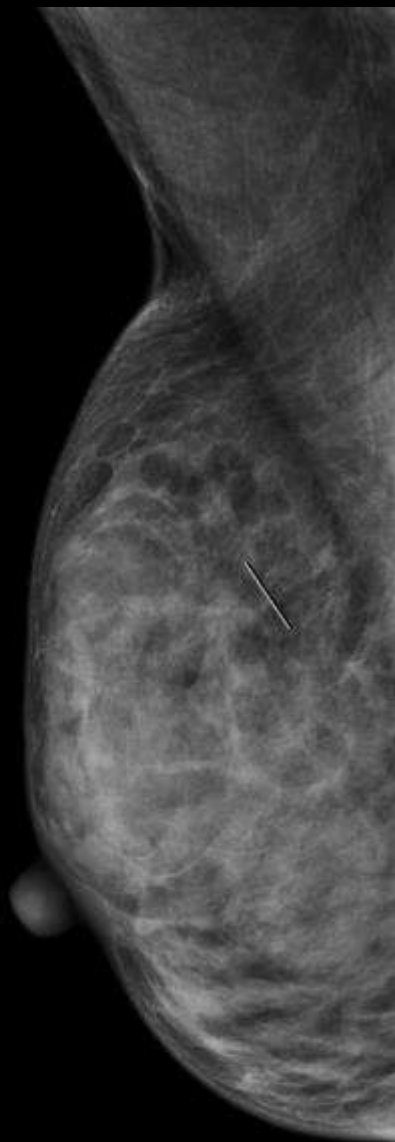
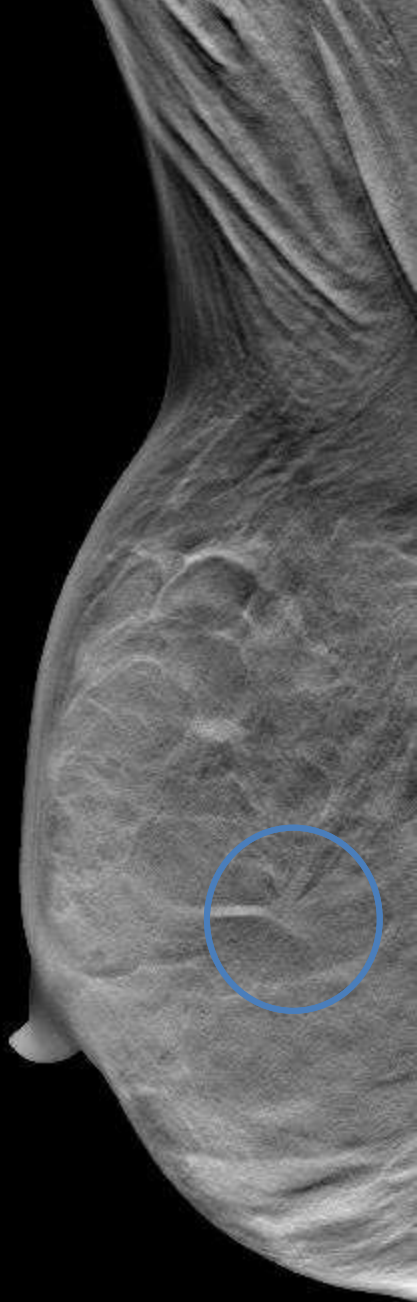
Courtesy: V Dahlblom



RMLO



2018-09-19, 10:18:38
32 mm, 0.016 dGy, 27 kV, 118 mAs



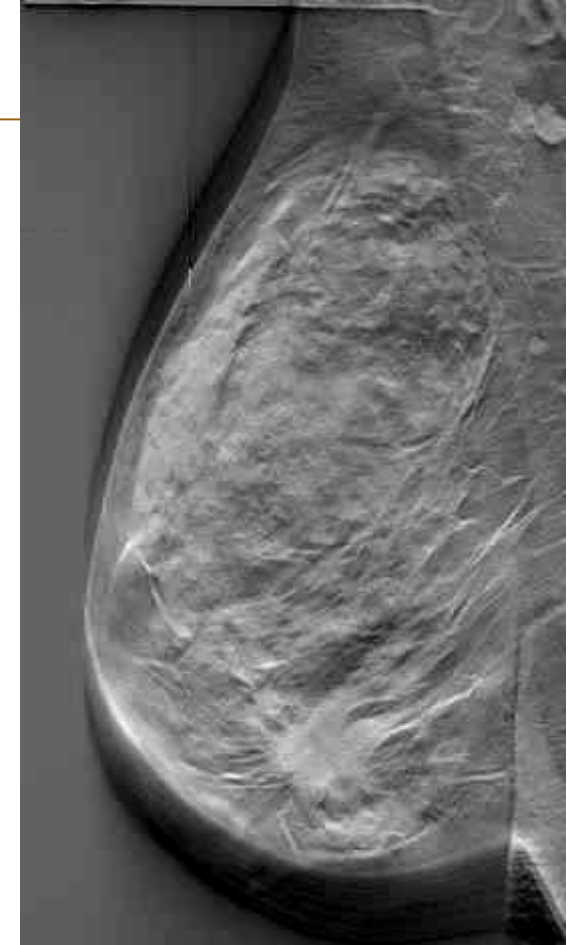
EU recommendation DBT

Use of digital breast tomosynthesis (DBT)

In the context of an organised screening programme, for asymptomatic women with an average risk of breast cancer, the ECIBC's Guidelines Development Group (GDG) suggests:

- **using either DBT or digital mammography**
(conditional recommendation, very low certainty of the evidence)
- **not using both DBT and digital mammography**
(conditional recommendation, very low certainty of the evidence)

Since the GDG made a strong recommendation for screening at ages 50-69, these apply specifically to this age group.

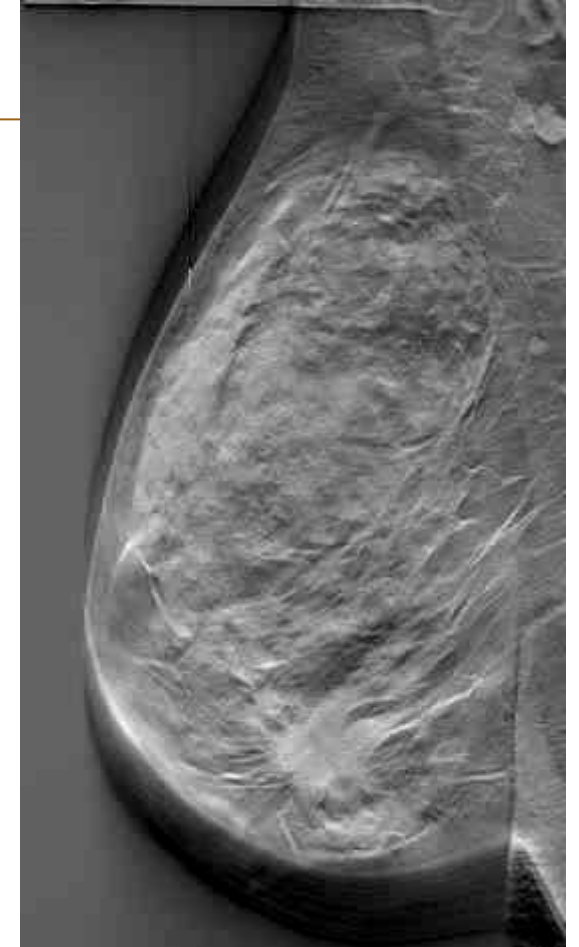


EU recommendation DBT dense breasts

Digital breast tomosynthesis (DBT)

In the context of an organised screening programme, the ECIBC's Guidelines Development Group (GDG) **suggests:**

- **not implementing tailored screening with both DBT and digital mammography for women with high mammographic breast density detected for the first time with digital mammography**
(conditional recommendation, very low certainty of the evidence)
- **using DBT for women with high mammographic breast density detected in previous screening exams**
(conditional recommendation, very low certainty of the evidence)



Current scientific evidence

- Large body of evidence
- Increased cancer detection (+30%)
- Acceptable recall rates – variations due to baseline rates, study design and setting
- DBT + synthetic DM

Undesirable effects of DBT in screening

Undesirable Effects

How substantial are the undesirable anticipated effects?

JUDGEMENT

- Large
- Moderate
- Small
- Trivial
- Varies
- Don't know

- Interval breast cancer
- Overdiagnosis
- Radiation exposure

ARTICLES | [VOLUME 19, ISSUE 11, P1493-1503, NOVEMBER 01, 2018](#)



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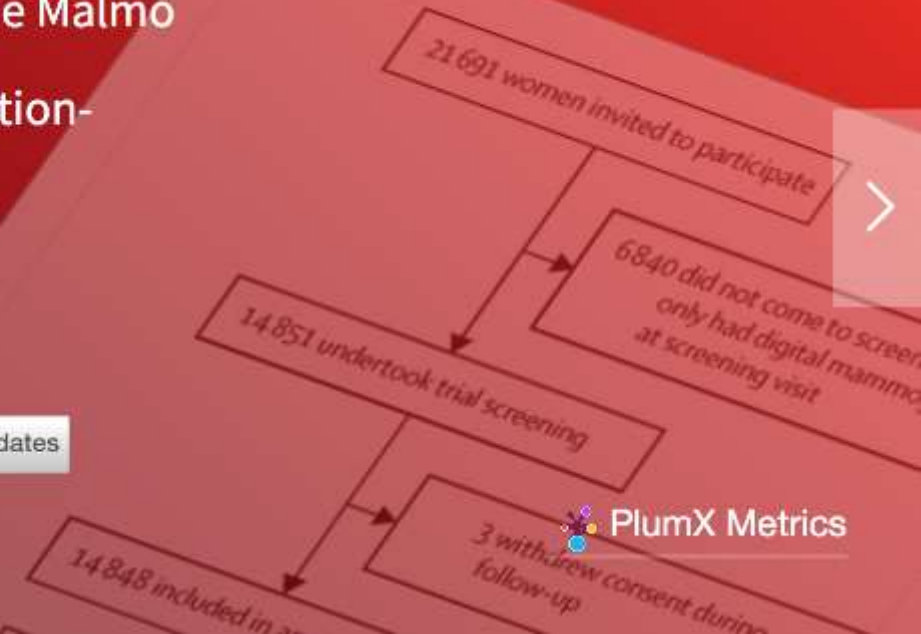


Request

One-view breast tomosynthesis versus two-view mammography in the Malmö Breast Tomosynthesis Screening Trial (MBTST): a prospective, population-based, diagnostic accuracy study

[Sophia Zackrisson, PhD](#) • [Kristina Lång, PhD](#) • [Aldana Rosso, PhD](#) • [Kristin Johnson, MD](#) • [Magnus Dustler, PhD](#) • [Daniel Förnvik, PhD](#) • et al. [Show all authors](#)

Published: October 12, 2018 • DOI: [https://doi.org/10.1016/S1470-2045\(18\)30521-7](https://doi.org/10.1016/S1470-2045(18)30521-7)



About MBTST

- Siemens Mammomat Inspiration (2D and 3D)
- 15 000 women in Malmö, Sweden
- Angular range 50°
- One view 3D (MLO) vs 2 view 2D
- Reduced breast compression with 3D*



*Förnvik *et al* Radiat Prot Dosim 2010

MBTST- most important results

- ✓ 34% higher detection with 3D (more or the same)
- ✓ 40% less compression force
- ✓ Acceptable recall rate (2.6->3.8%, low +prevalence round)
- ✓ 15% lower radiation dose
- ✓ 40% lower risk of interval cancers

3D

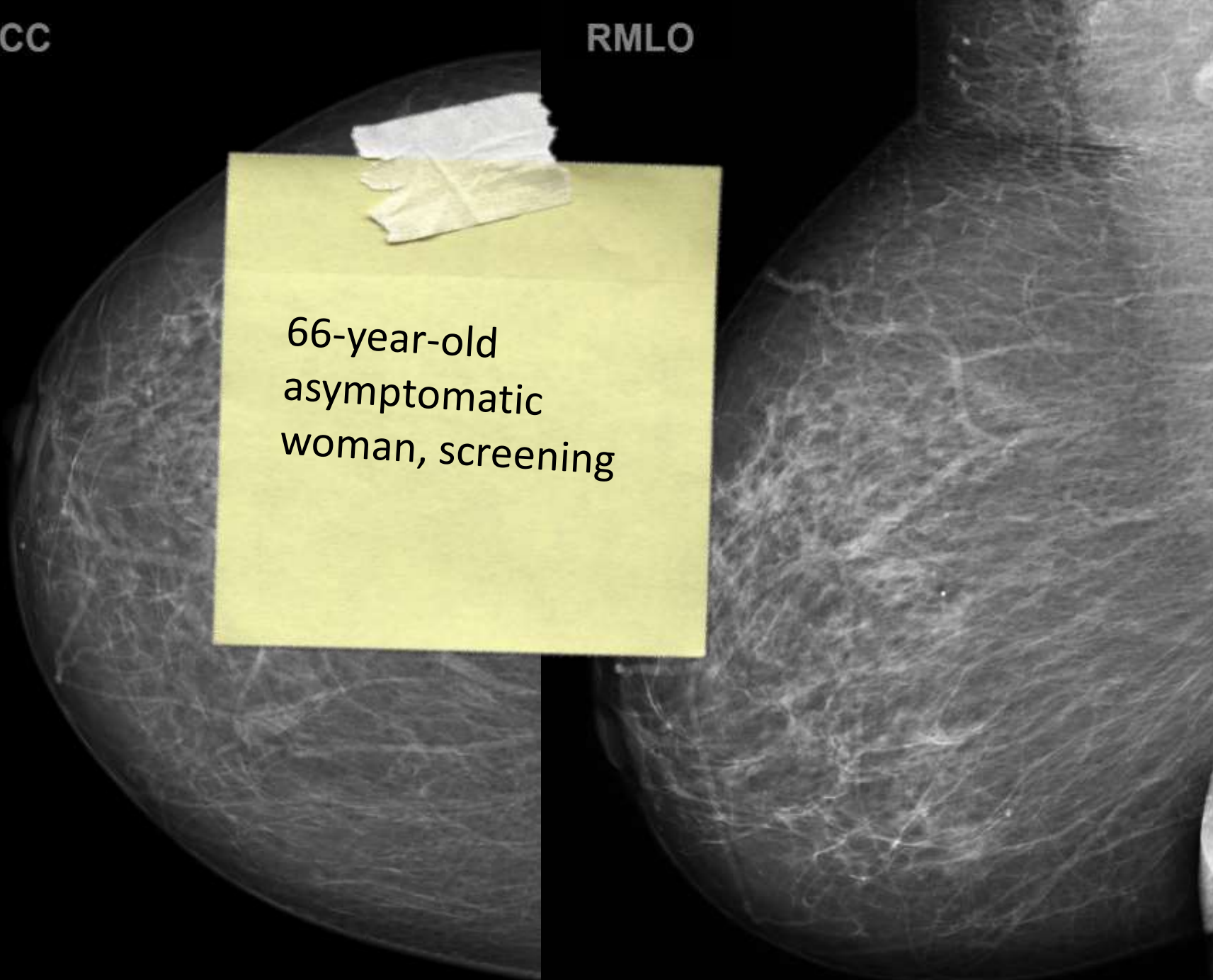


Zackrisson et al. Lancet Oncol 2018
Johnson et al. Radiology 2019
Johnson et al. Radiology 2021

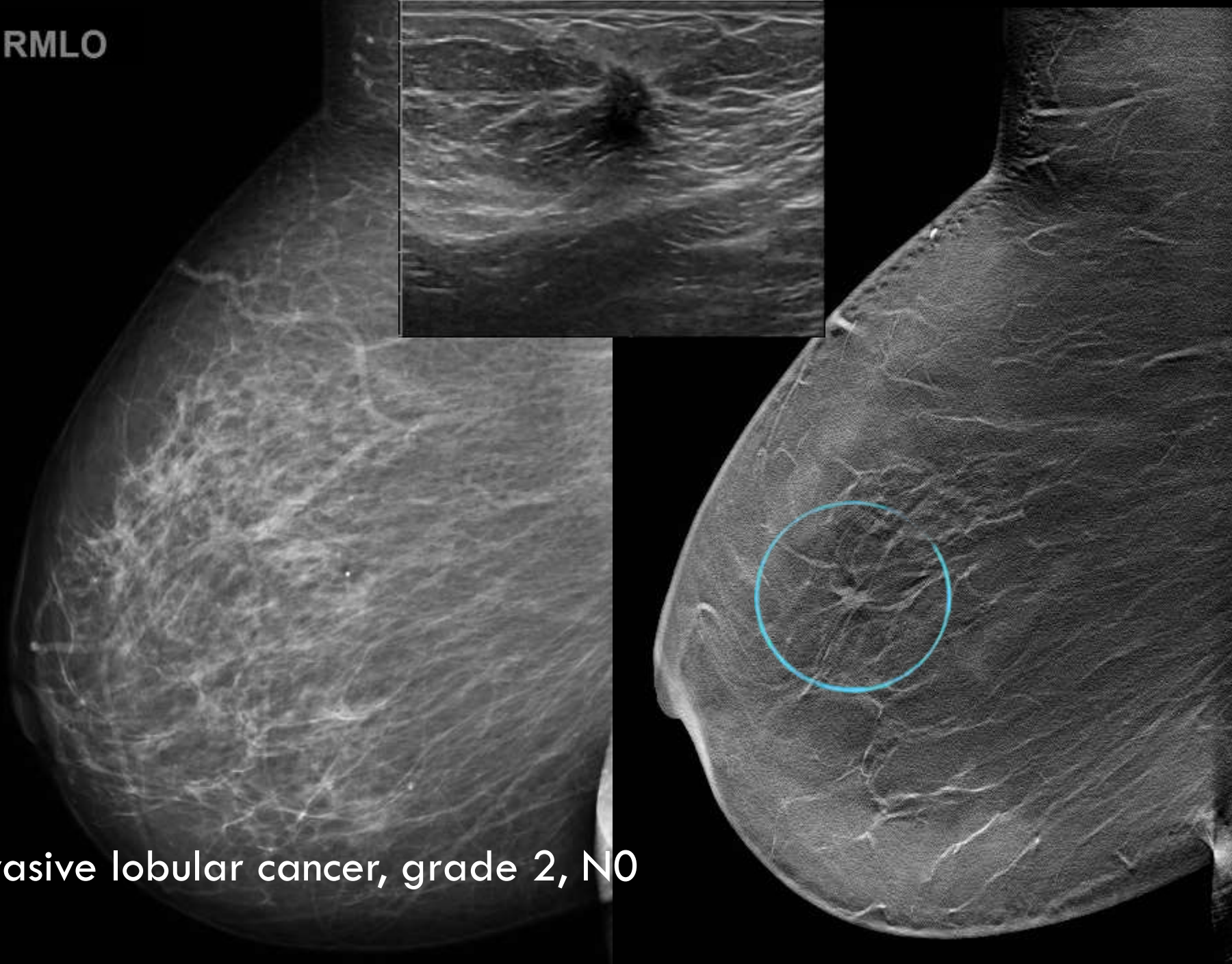
RCC

RMLO

66-year-old
asymptomatic
woman, screening



RMLO



11 mm Invasive lobular cancer, grade 2, N0



Results invasive cancers: luminal vs non-luminal

Kristin Johnson, MD, PhD

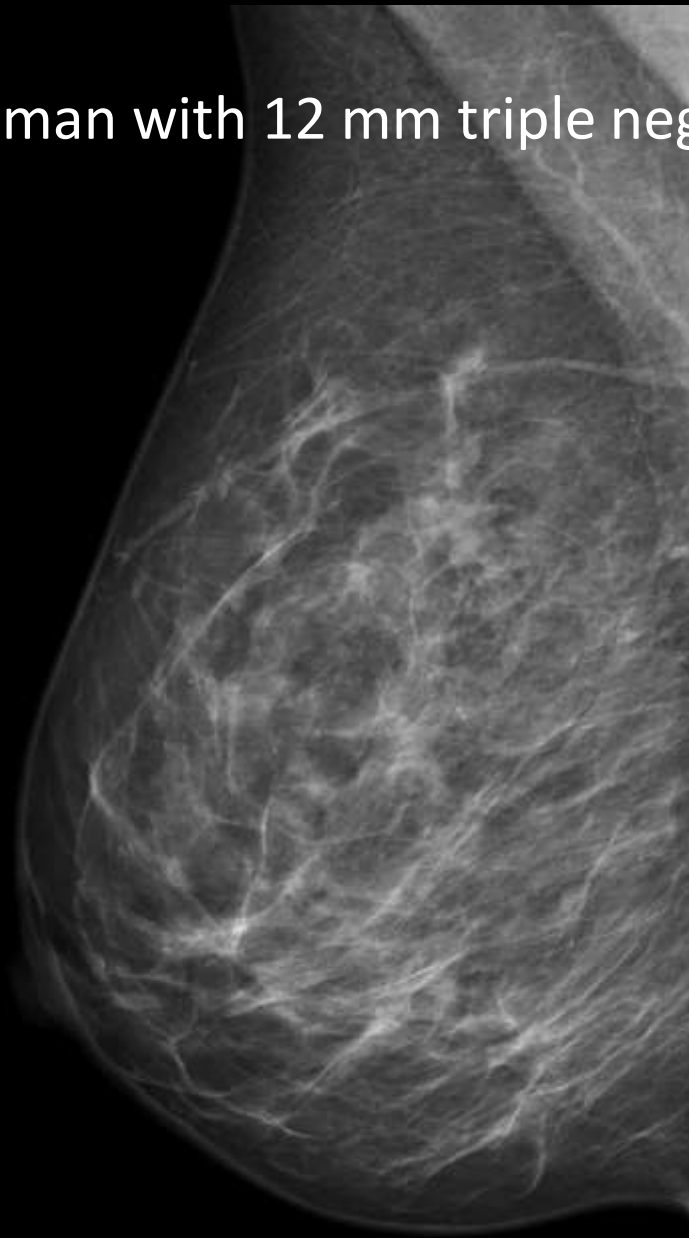
	DBT reading arm only	All DM detected cancers	All cancers
Luminal	33 (87 %)	72 (90 %)	105 (89 %)
Non-luminal	4 (10 %)	8 (10 %)	12 (10 %)
Missing	"MORE OF THE SAME"		(1 %)
Total	38 (100 %)	80 (100 %)	118 (100 %)

Goldhirsch et al, Ann Oncol 2013
Johnson et al. Radiology 2019

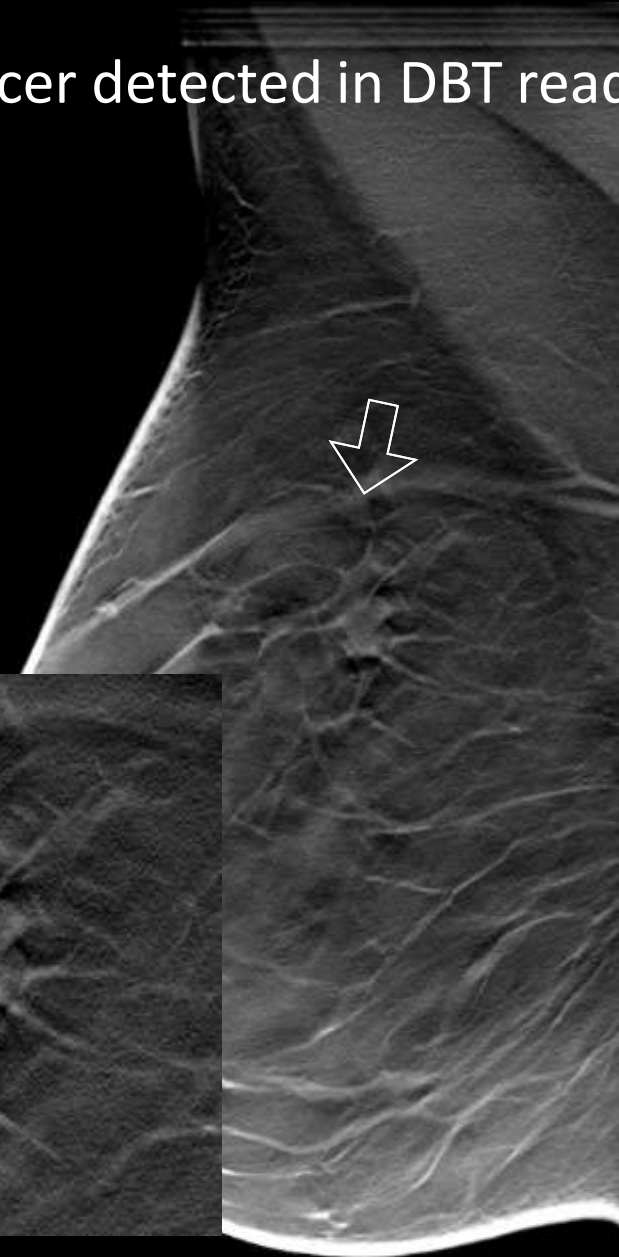
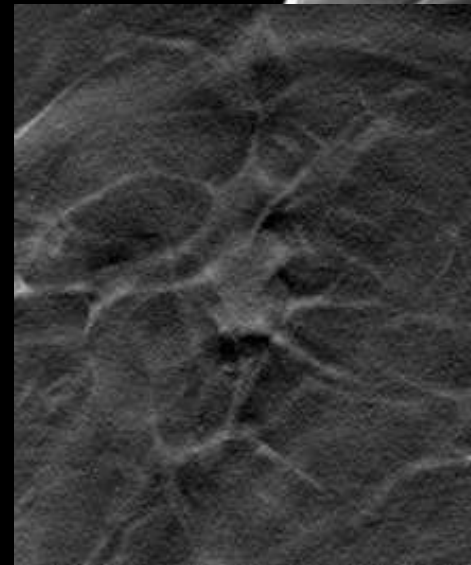
* Woman declined surgery



52-year-old woman with 12 mm triple negative breast cancer detected in DBT reading arm only



DM mediolateral oblique



One-view DBT



Interval cancers in the Malmö Breast Tomosynthesis Screening Trial (MBTST) compared to a contemporary control group

The MBTST screens matched with two controls, based on age and screening date

	Modality	Interval cancers	Screens	Rate (95% CI)	Odds ratio	P-value
MBTST	DBT + DM	21	13,369	1.6/1000 (1.0 – 2.4)	0.6 (0.3 – 0.9)	0.02
Control group	DM	76	26,738	2.8/1000 (2.2 – 3.6)		

- 40%
IC

DBT = digital breast tomosynthesis, DM = digital mammography

Johnson K, Lång K, Ikeda DM, Åkesson A, Andersson I, Zackrisson S. Interval cancer rates and tumor characteristics in the prospective population-based Malmö Breast Tomosynthesis Screening Trial (MBTST). *Radiology* 2021



Interval cancer rates after DBT?

- 40-50% lower risk of interval cancers ^{1,2}
- Ongoing trials^{3,4,5} Interval cancer rates, tumor characteristics

No evidence that
overdiagnosis is
increased with DBT!

1. MBTST. Johnson K *et al.* Radiology 2021

2. CBTST. Pulido-Carmona C *et al.* Eur Radiol 2024

3. TMIST: ClinicalTrials.gov Identifier: NCT03233191

4. TOSYMA: ClinicalTrials.gov Identifier: NCT03377036

5. STREAM study. ClinicalTrials.gov Identifier: NCT06059300



What more is known about DBT screening?

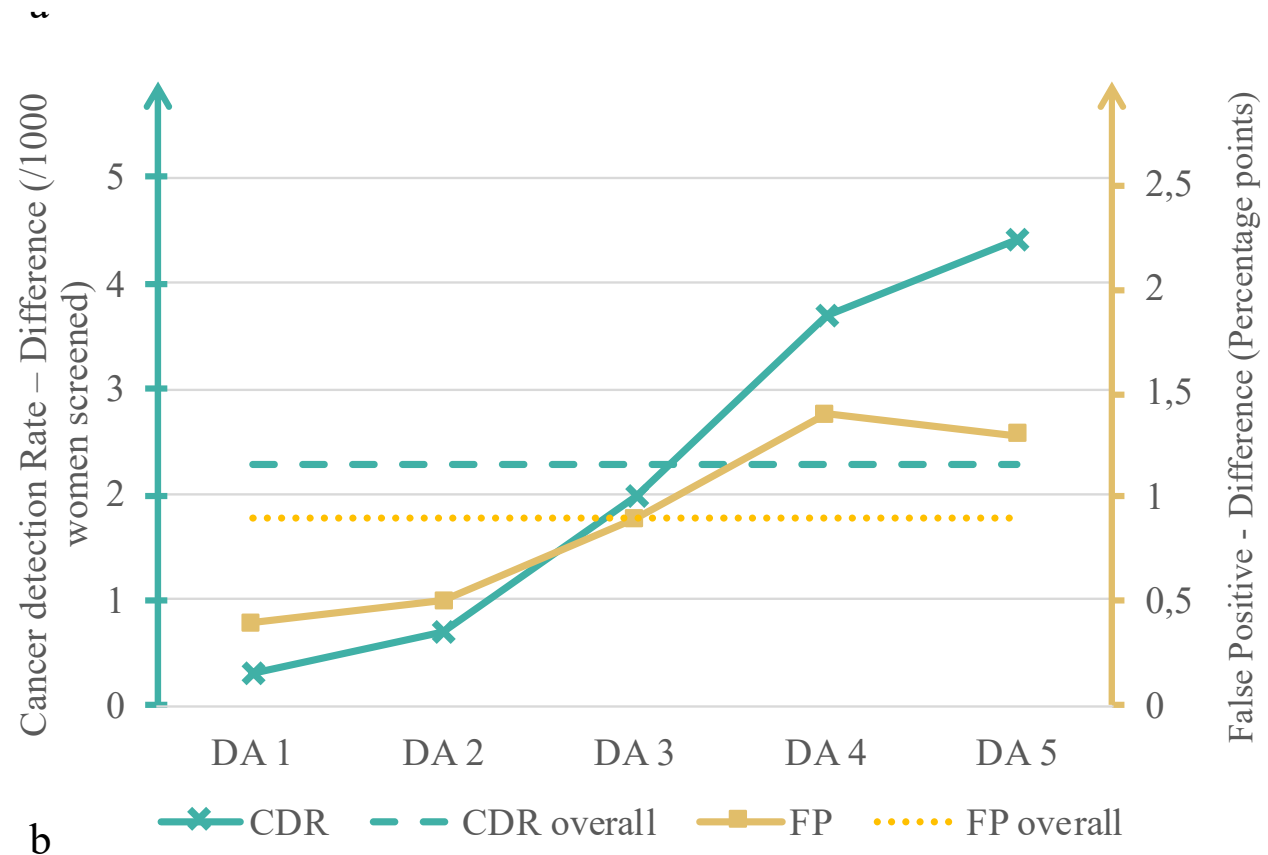
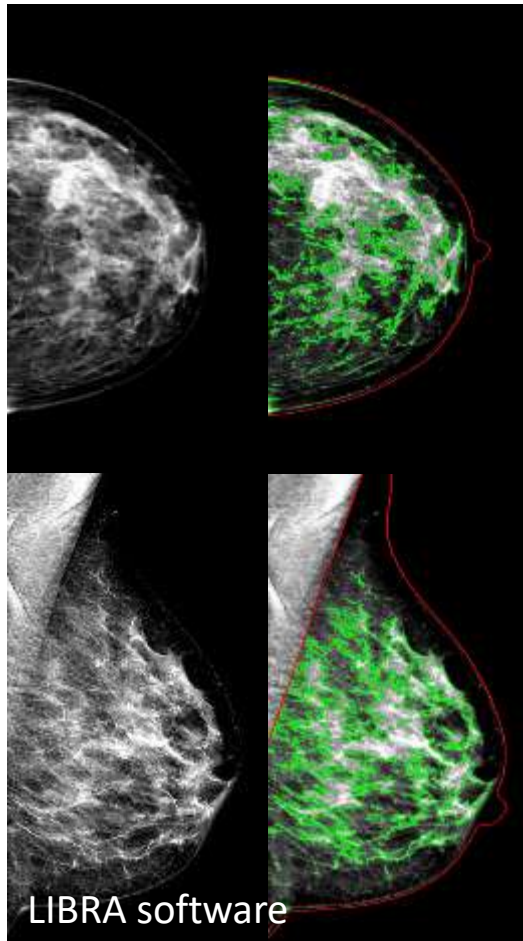
- ✓ Cancer types DBT detects more of the same¹⁻⁵
- ✓ Breast density DBT detects more cancers in dense breasts^{1,6-8}
- ✓ Radiation dose Vary with protocols/vendor^{9,10}, DBT + synth DM or DBT alone preferred
Within European recommended limits¹¹

1. MBTST: Zackrisson S *et al* Lancet Oncol 2018, Johnson K *et al*. Radiology 2019
2. OTST: Skaane P *et al*. Radiology 2019
3. STORM 1 and 2: Ciatto S *et al*. Lancet Oncol 2013, Bernardi D *et al*. Lancet Oncol 2013
4. US, large retrospective cohort: Bahl M *et al*. Radiology 2018
5. Verona, retrospective: Caumo F *et al*. Br Res Treat 2018
6. US, large retrospective cohort: Conant *et al*. JAMA Onc 2019
7. ToBe: Moschina N *et al*. Radiology 2020.
8. MBTST: Olinder J *et al*. Br Ca Res 2023, accepted
9. Review: Svahn T *et al*. Breast 2015
10. STORM-2: Gennaro G *et al*. Eur Radiol 2017
11. Perry N. European guidelines for quality assurance in breast cancer screening and diagnosis. European Community 2006

MBTST – highest gain in detection for women with dense breasts



Jakob Olinder, MD, PhD student



Olinder J, Johnson K, Åkesson A, Förnvik D, Zackrisson S. Impact of Breast Density on Diagnostic Accuracy in Screening: Digital Breast Tomosynthesis versus Digital Mammography. *Breast Cancer Research* 2023



What more is known about DBT screening? cont...

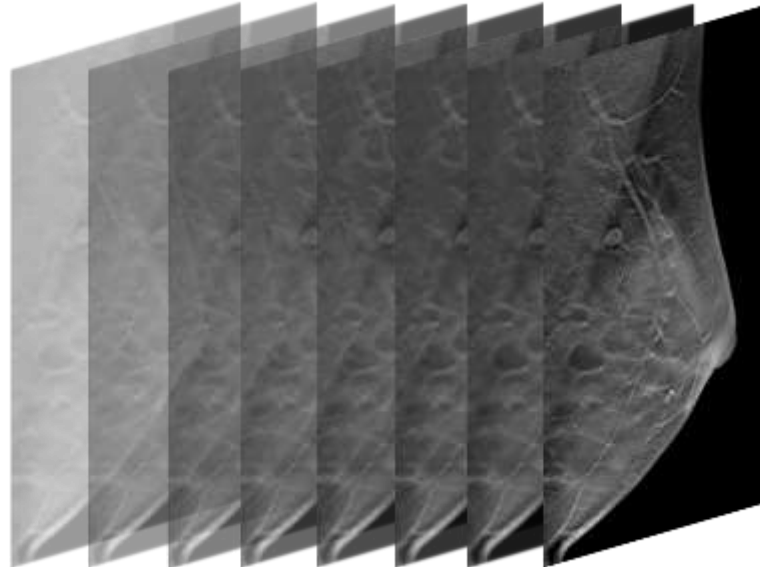
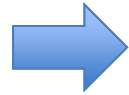
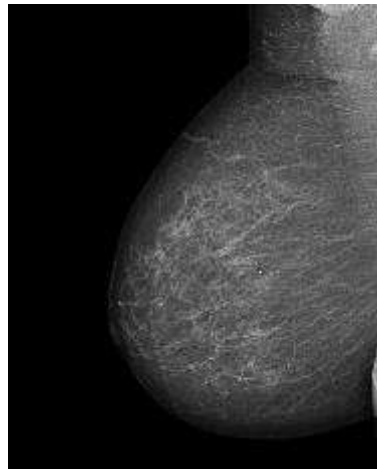
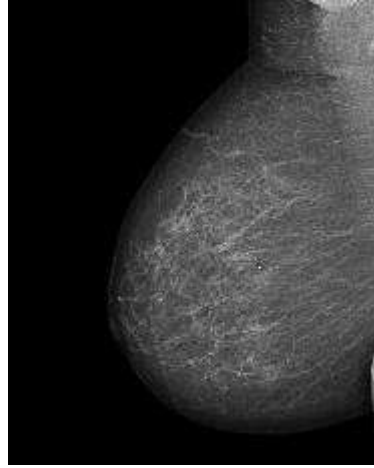
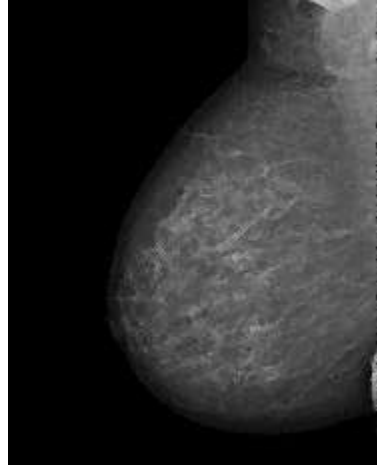
- ✓ Reading time Longer, depending on protocol – CAD/AI?^{1,2,}
- ✓ Consecutive round(s) Detection lower^{3,4}
- ✓ Single reading DBT+SM single read enough⁵
- ✓ Resources Vary⁶
- ✓ Cost effectiveness Vary^{7,8}

DBT reading time 36s vs 23s for DM.⁷
DBT reading time improves with
experience⁹

Costs expected to reduce
Vary by country context

1. Reader study: Balleyguier C *et al.* EJR 2017
2. ToBe trial: Hofvind S *et al.* Lancet Oncol 2019
3. OVVV study. Hovda *et al.* Radiology 2019
4. MBTST. Jögi A *et al.* Submitted
5. CBTST trial. Romero Martín S *et al.* Eur Radiol 2017
6. European Commission Initiative on Breast Cancer <https://healthcare-quality.jrc.ec.europa.eu/>
7. MBTST. Fridhammar A *et al.* Submitted
8. ToBe trial: Sørlien Holen *et al.* Eur J Radiol 2023
9. PROSPECTS trial. Chen Y *et al.* Radiology 2023

Image quality in screening



If...

- ...possible overdiagnosis stops DBT introduction...
- ...logically, it should have severe consequences on the clinical optimization work in screening

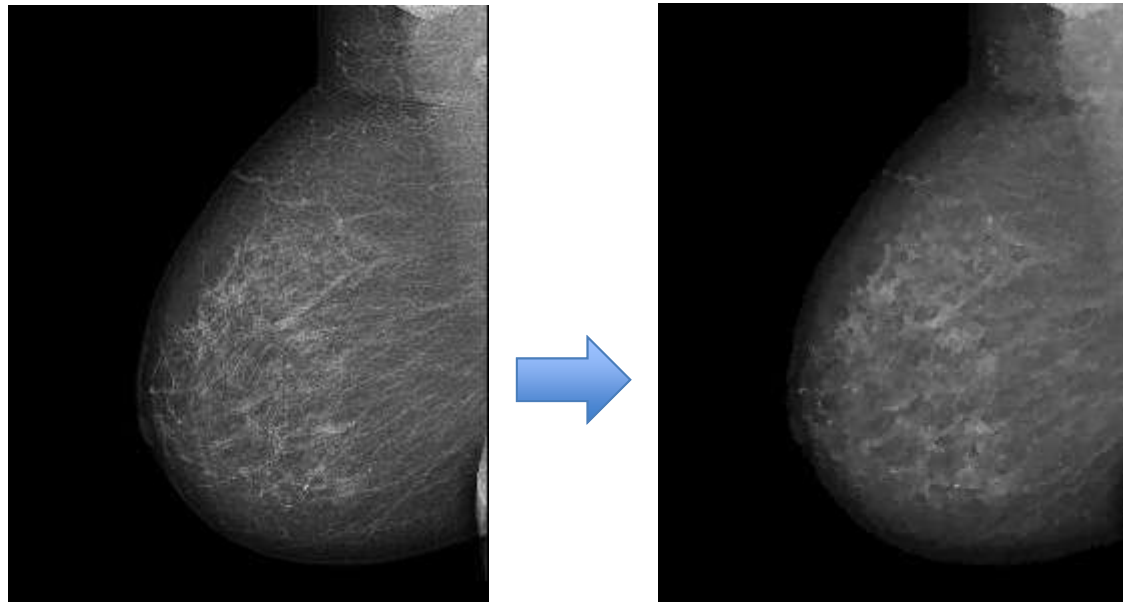
Consequence 1

- Stop improvement of image quality! Wait 20 years for mortality data!



Consequence 2

- Why is today's DM optimal? Detection/workload double reading
- Reduce image quality, reduce detection, reduce overdiagnosis?
- Status quo bias!



Status quo bias



The Status Quo Bias - We don't like to change.

Digital Breast Tomosynthesis in Breast Cancer Screening: An Ethical Perspective. *Submitted*

- Simon Rosenqvist, Department of Global Political Studies, Malmö University
- Johan Brännmark, Department of Philosophy, Stockholm University
- Magnus Dustler, Department of Radiology, Malmö, Lund University



Magnus Dustler, MSc, PhD
Associate professor

If...

- workload issues stops DBT introduction
- then let us solve that in a safe manner!



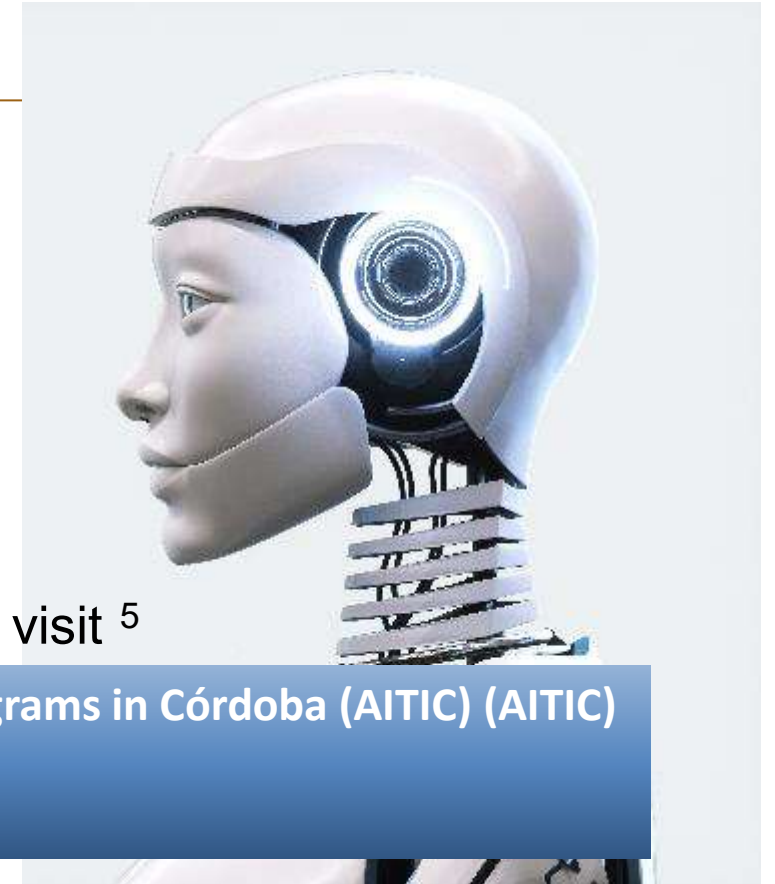
The Status Quo Bias - We don't like to change.

Possibilities with AI and DBT

- ❖ AI with DBT would result in up to 70% less workload ^{1,2}
- ❖ Single-view DBT and AI more efficient than DBT alone ³
- ❖ AI with DBT single reading as good as double reading ⁴
- ❖ AI on DM to identify high gain cases to add DBT during the same visit ⁵

Ongoing prospective trial: Artificial Intelligence in Breast Cancer Screening Programs in Córdoba (AITIC) (AITIC)
ClinicalTrials.gov Identifier: NCT04949776

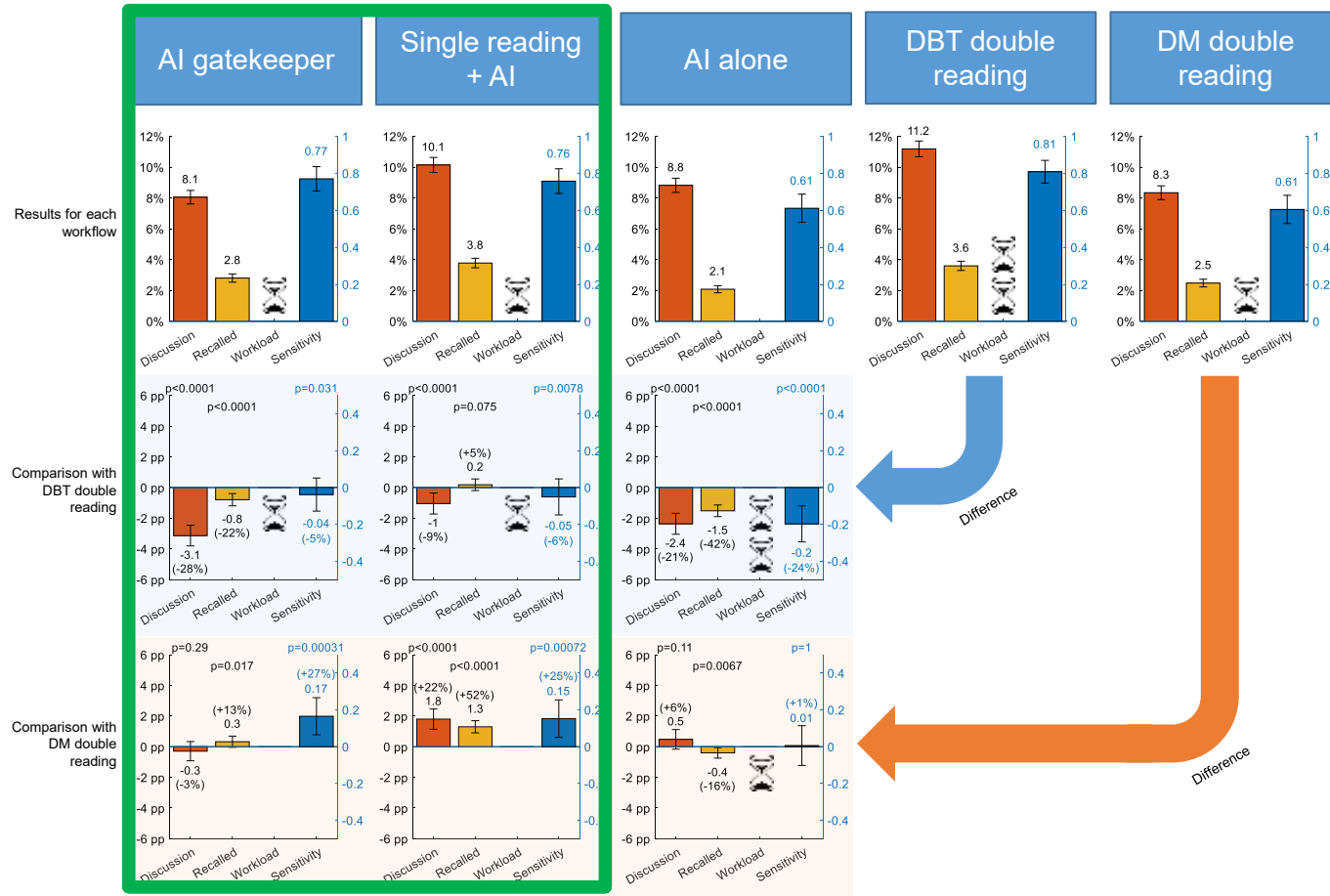
1. Cordoba trial. Raya-Povedano *et al.* Radiology 2021
2. Shoshan *et al.* Radiology 2022
3. Reader study. Pinto *et al.* Radiology 2021
4. MBTST. Dahlblom *et al.* Eur Radiol 2022
5. MBTST. Dahlblom *et al.* J Med Imaging 2023



Single-reading DBT+AI as effective as double reading

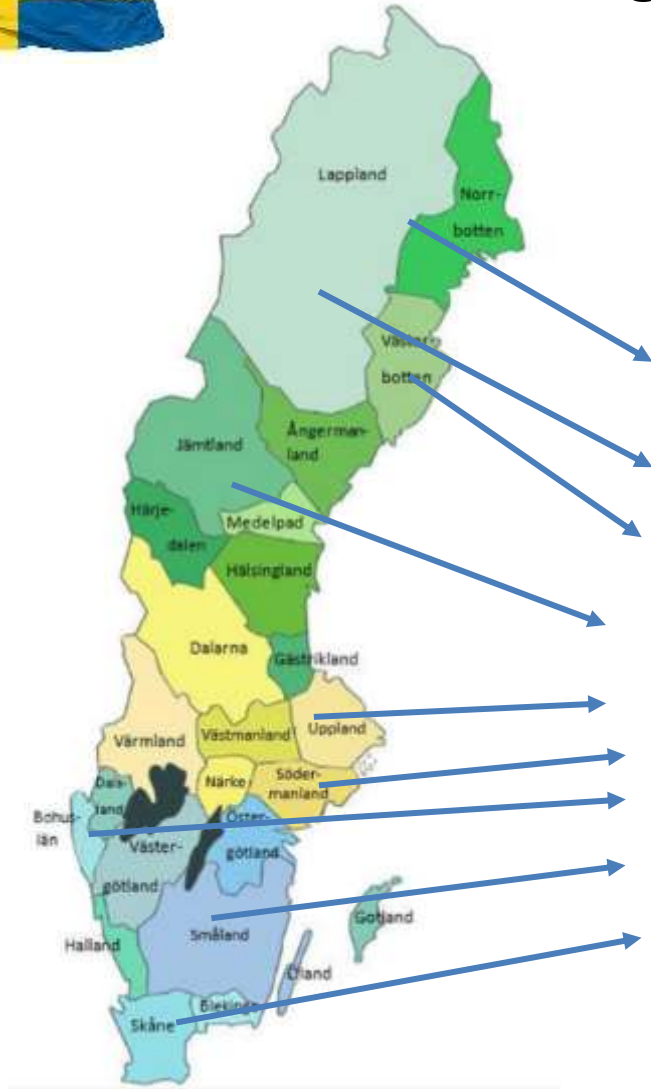


Victor Dahlblom, MD, PhD student





Regional testing of DM+AI or AI+DBT in Sweden



Knowledge transfer network

NUB
 Nationellt utvecklingsnätverk för bröstcancerscreening

VAI.B Validation Platform for AI in Breast Imaging

AIDA
 Analytic Imaging Diagnostics Arena

REGIONALA CANCERCENTRUM I SAMVERKAN

Information/interaction
Health authorities, profession and "end users"





Double reading

Single reading

Single
reading + AI

- cancer detection
- recalls
- consensus
- reading time
- workload

Take home message



- In terms of accuracy, DBT outperforms DM
- DBT good for all breasts and, particularly for denser breasts
- Not introducing DBT in screening should have consequences on optimization work in general
- Question the ground for status quo!
- Implementation projects for feasibility



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