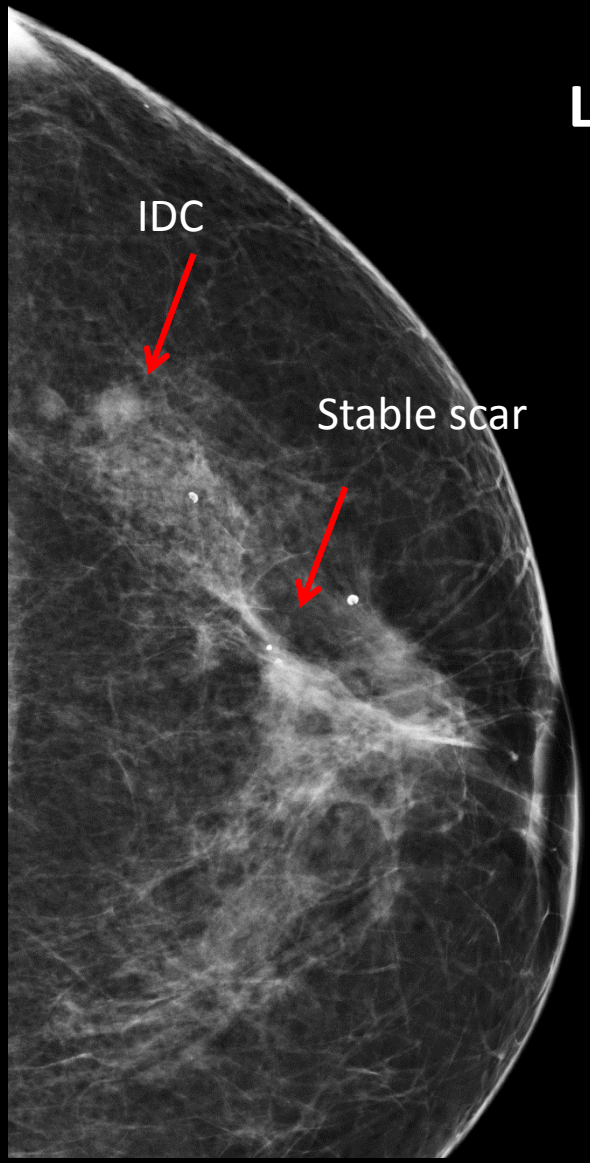
Breast tomosynthesis
Clinical cases:
benefits and practical considerations

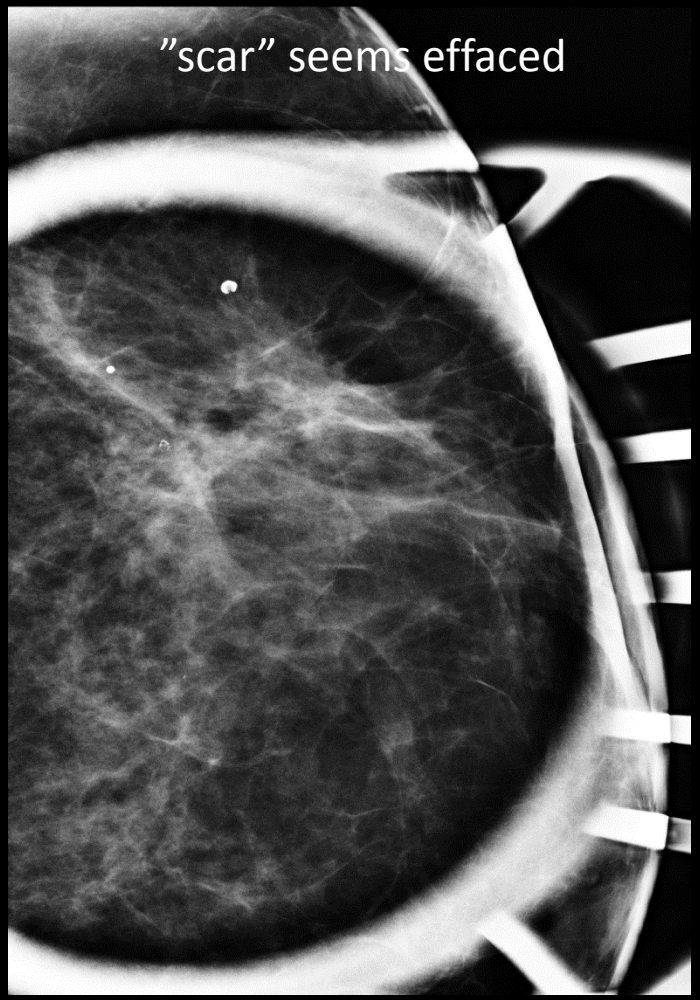
Dr Martine Boisserie-Lacroix
Institut Bergonié
Comprehensive Cancer Center
BORDEAUX-FRANCE

- 60 year-old-woman
- Left conservative treatment 10 years ago
- Annual follow-up

LCC

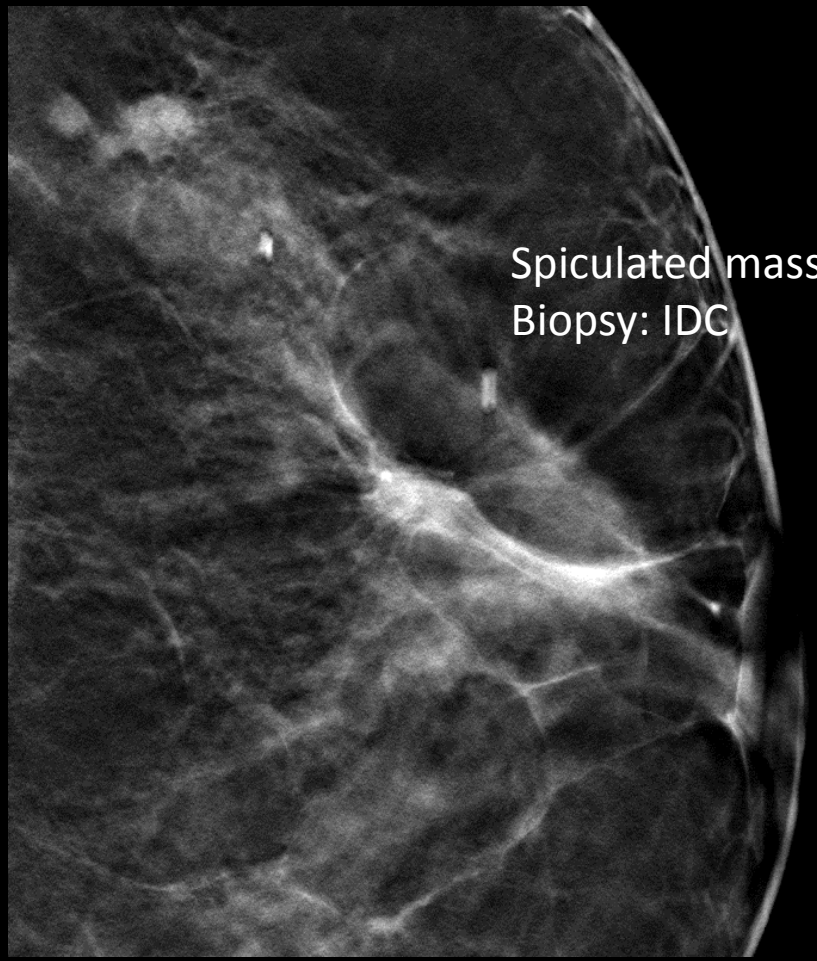


Cranio-caudal digital mammography 2D



Cranio-caudal spot compression

3D



Spiculated mass
Biopsy: IDC

Cranio-caudal tomosynthesis 3D

Conclusions (1): 3D versus 2D

- Some cancers are effaced on conventional spot compression (*Roth R. Radiographics 2014)*

- Detection rates were :

  6.1 per 1000 examinations for mammography 2D alone

  8.0 per 1000 examinations for 2D plus tomosynthesis

  27% increase, *P* =.001 (*Skaane P. Radiology 2013)*

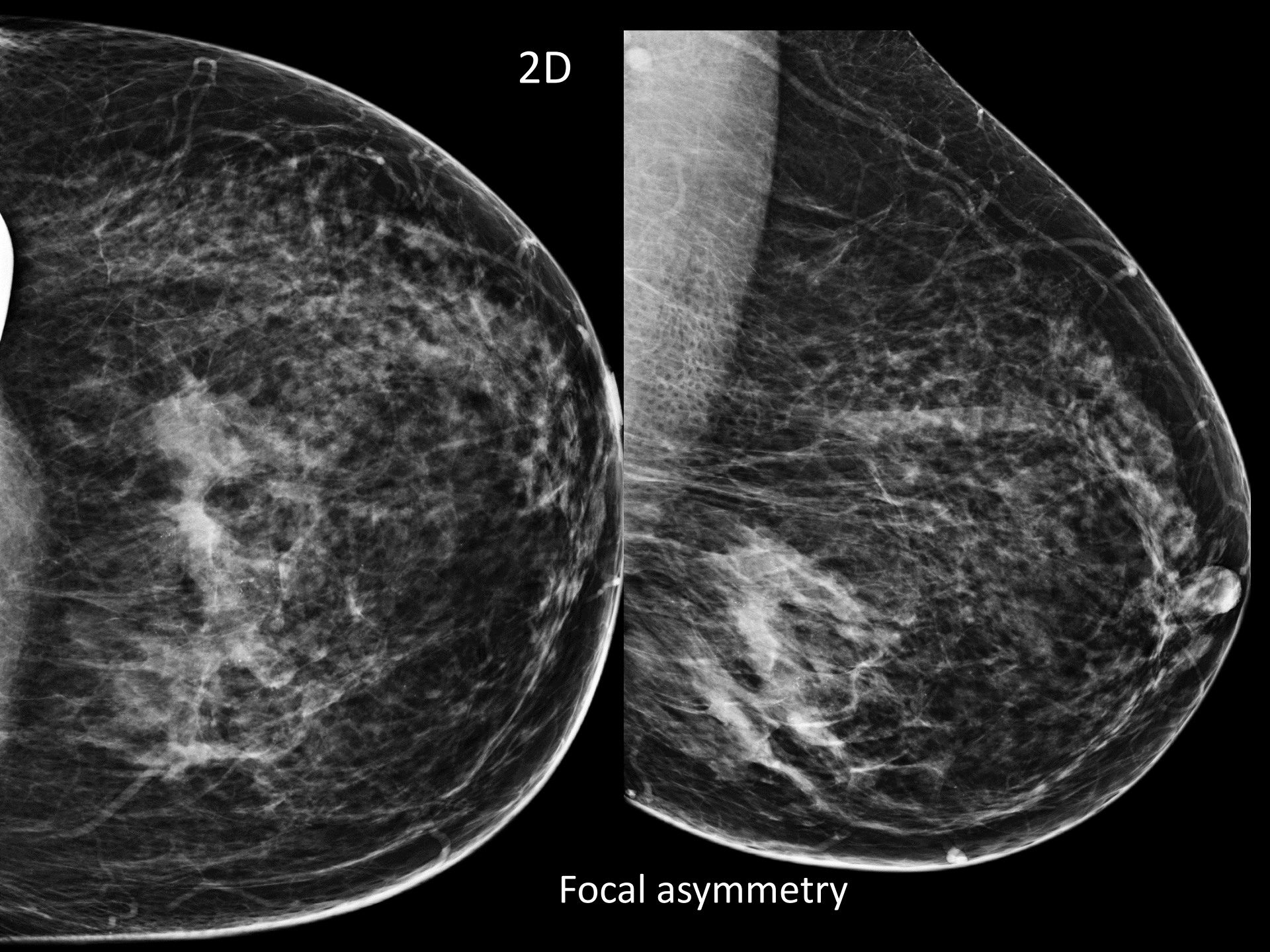
- Twenty-four of the 29 additional cancers detected under the 2D+3D mode were node-negative invasive cancers, 21 of which were depicted as spiculated masses and/or distortions.

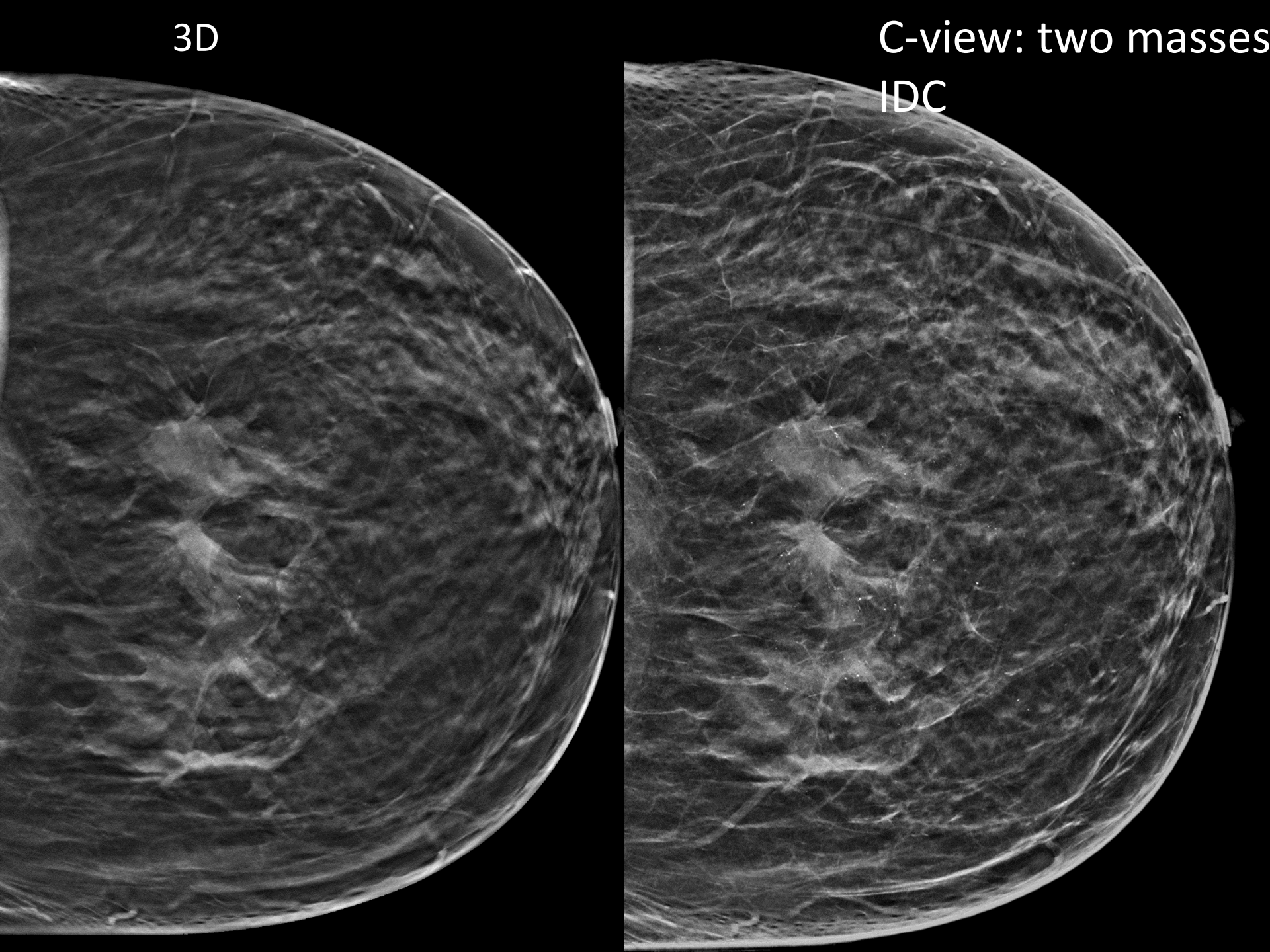
  (*Skaane P. Eur Radiol 2013)*

Conclusion (2): 3D versus supplemental views for evaluation of noncalcified breast lesions

- 33% of cancers are rated ACR5 with 2D vs 39% with 3D (p=0.017) *(Zuley M. Radiology 2013*)
- 3D can replace additional mammographic views in clinical practice *(Lourenco A. Radiology 2015)*
- 3 D can replace spot compression (NP4 grade3)
  (Lavoué V, Fritel X, Antoine M, Beltjens F, Bendifallah S, Boisserie-Lacroix M et al. Recommendations of College National des Gynéco-Obstétriciens Français (CNGOF). J Gynecol Obstet Biol Reprod 2015)

- 48 year-old-woman
- Screening mammography


2D
Focal asymmetry


3D
C-view: two masses
IDC

- Mammography 2D

→ Asymmetry

→ Recall for spot compression

→ Ultrasound and biopsy

- Tomosynthesis

→ Masses

→ No recall for supplementary views

→ Ultrasound and biopsy

Conclusion : 3D and recall

Comparison of Types of Abnormalities Recalled from Screening with DM and DBT

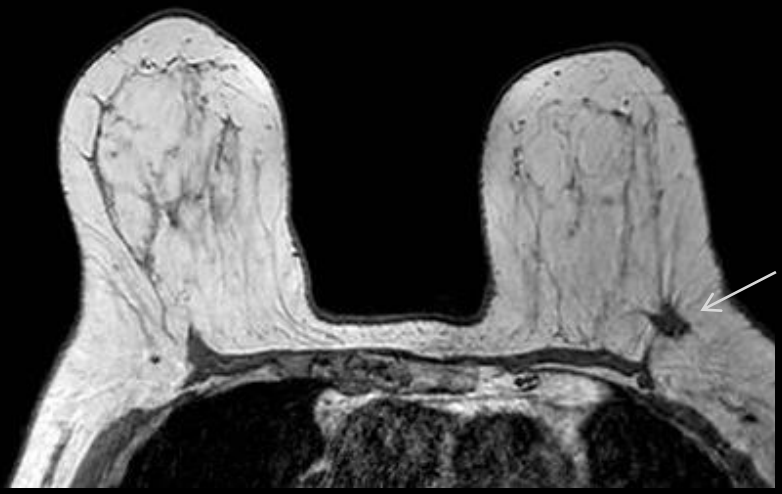
Abnormality Type	DM ($n = 1175$) 2D	DBT ($n = 827$) 3D	*P* Value
Asymmetry	379 (32.3) [29.6, 35.0]	110 (13.3) [11.1, 15.9]	<.0001* [15.3, 22.6]
Focal asymmetry	378 (32.2) [29.5, 34.9]	151 (18.3) [15.7, 21.1]	<.0001* [10.1, 17.8]
Calcification	158 (13.4) [11.6, 15.6]	168 (20.3) [17.7, 23.3]	<.0001* [−10.3, −3.4]
Distortion	7 (0.6) [0.2, 1.3]	44 (5.3) [3.9, 7.1]	<.0001* [−6.4, −3.0]
Mass	105 (8.9) [7.4, 10.7]	222 (26.8) [23.9, 30.0]	<.0001* [−21.4, −14.4]
Multiple	146 (12.4) [10.6, 14.5]	132 (16.0) [13.6, 18.7]	.0287 [−6.8, −0.3]
Other	2 (0.2)	0	Not applicable

Note.—Data are numbers of abnormalities. Numbers in parentheses are percentages. Numbers in brackets are 95% CIs (in percentages).

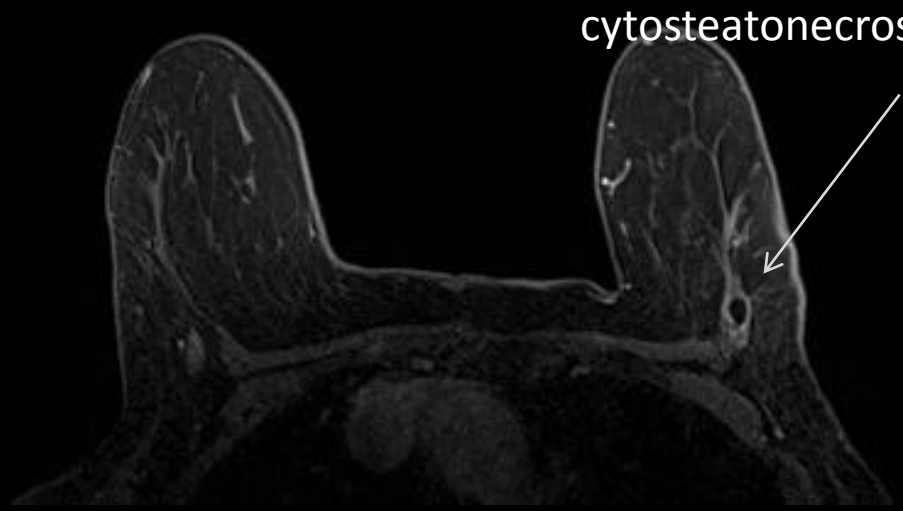
* Significant, where $\alpha = 0.001$.

Lourenco et al. Radiology 2015

- 86-year-old women
- Radiofrequency ablation of left IDC in 2008
- Follow-up by mammography/ US/ MRI



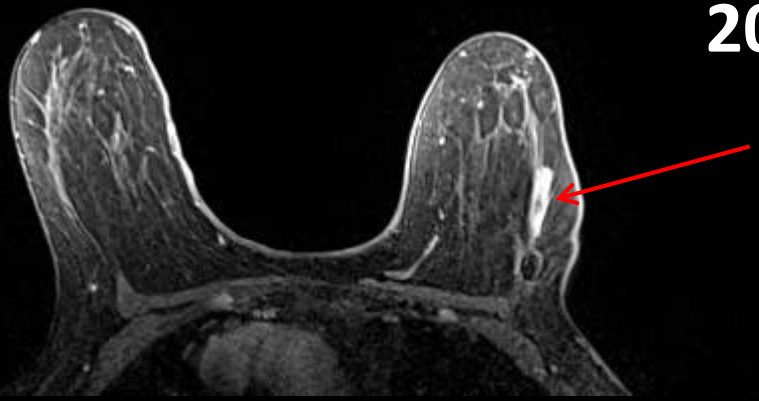
Pre-treatment (2008)

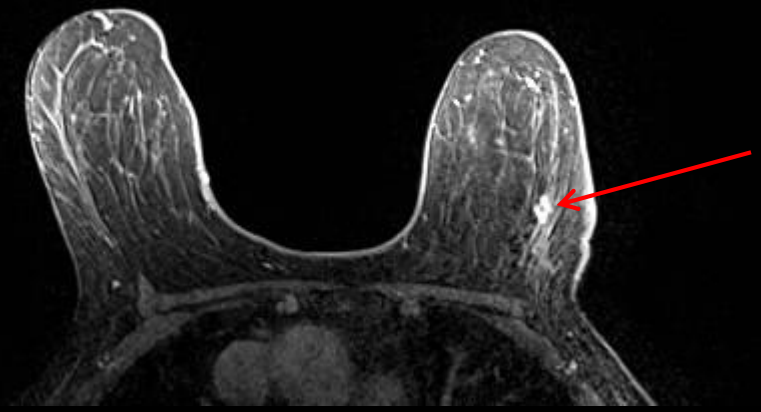


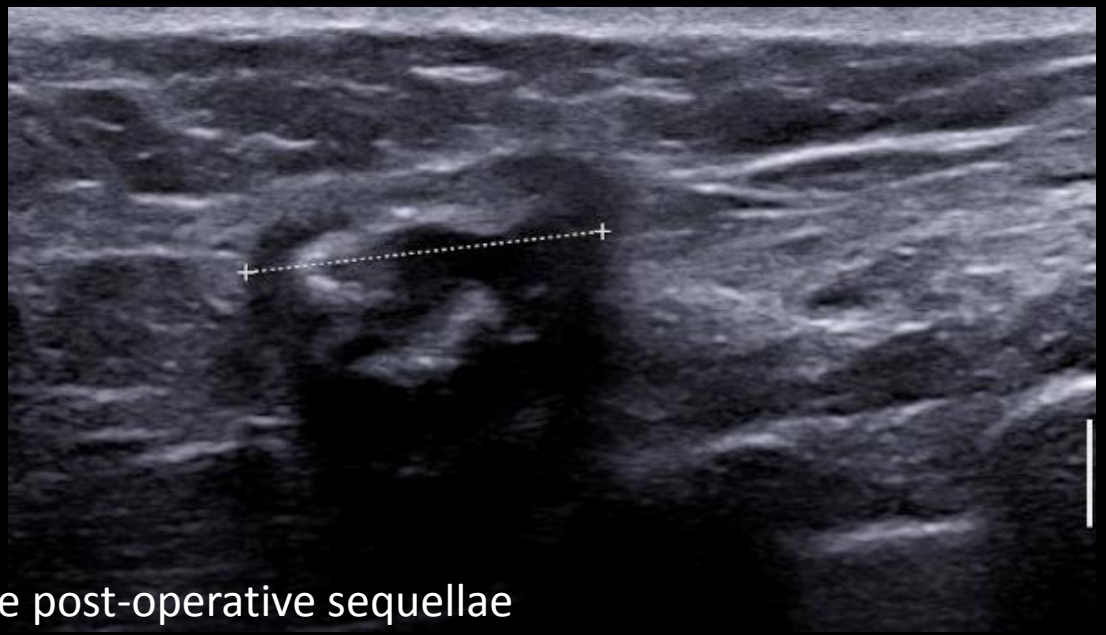
Follow-up (2009→2013)

- 200772748

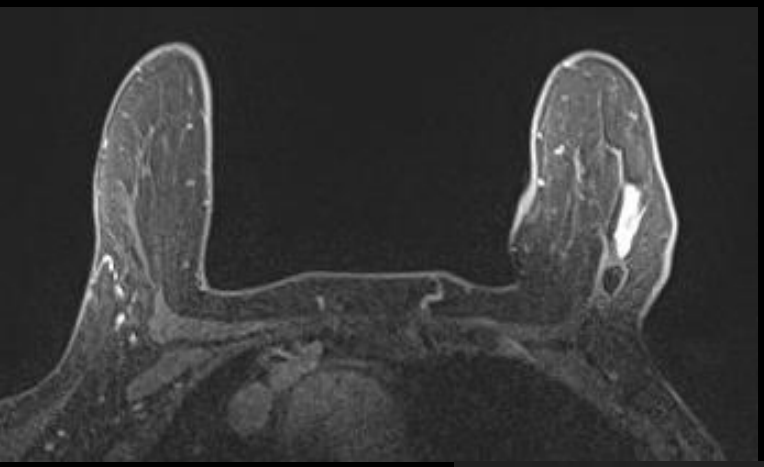
2014



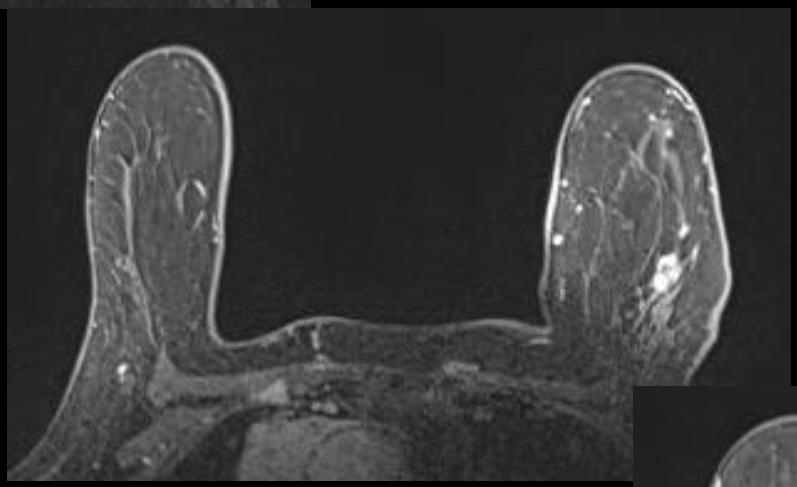


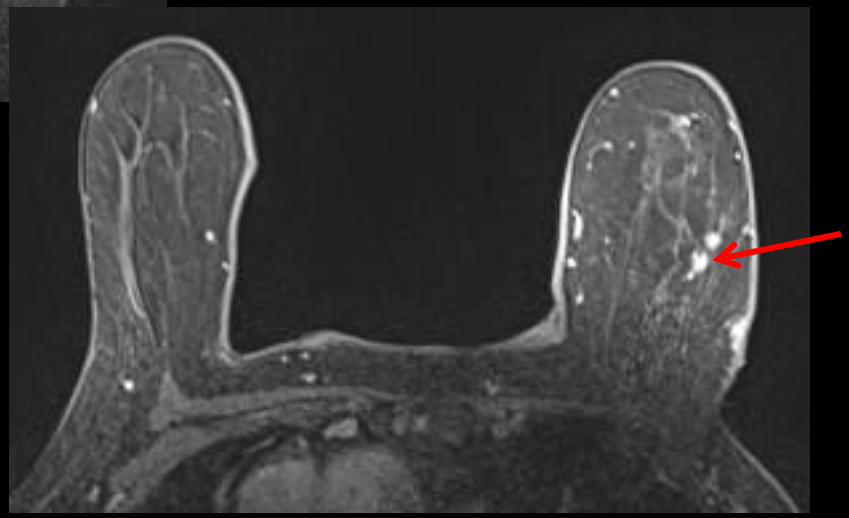


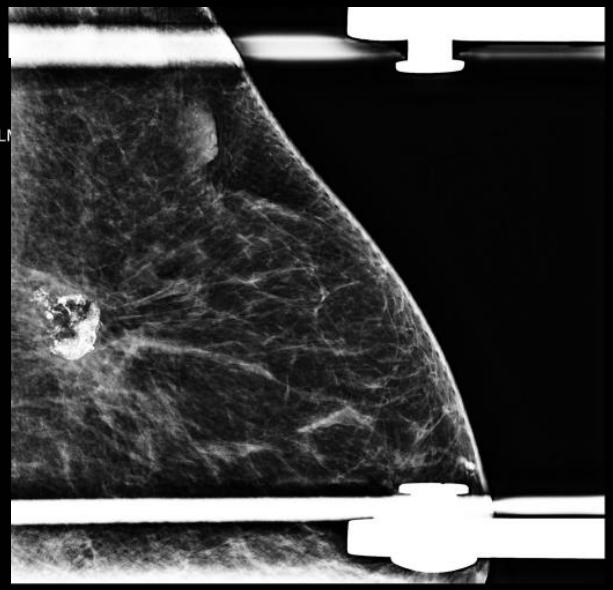
Stable post-operative sequellae



2015

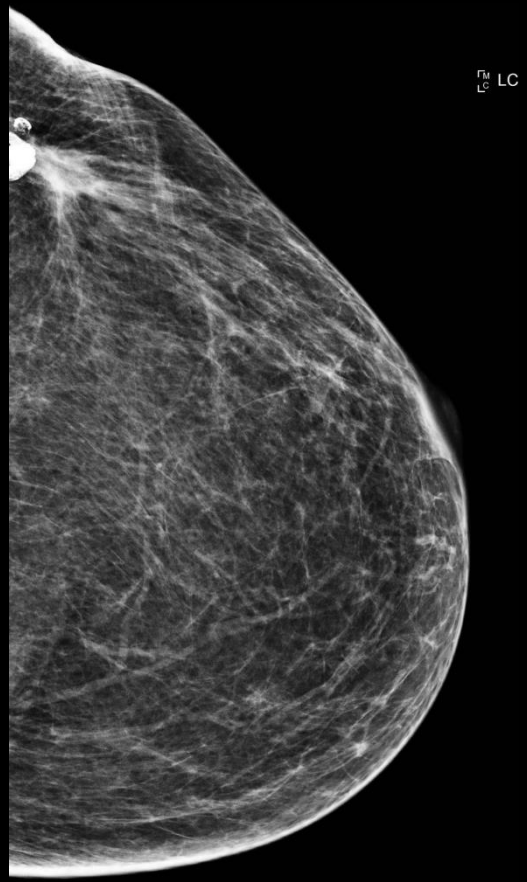


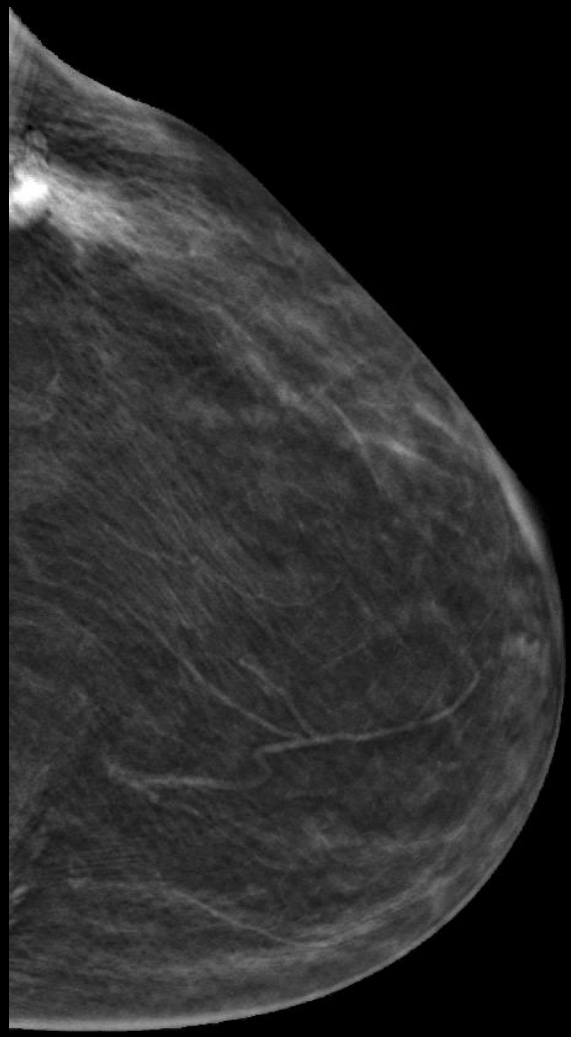


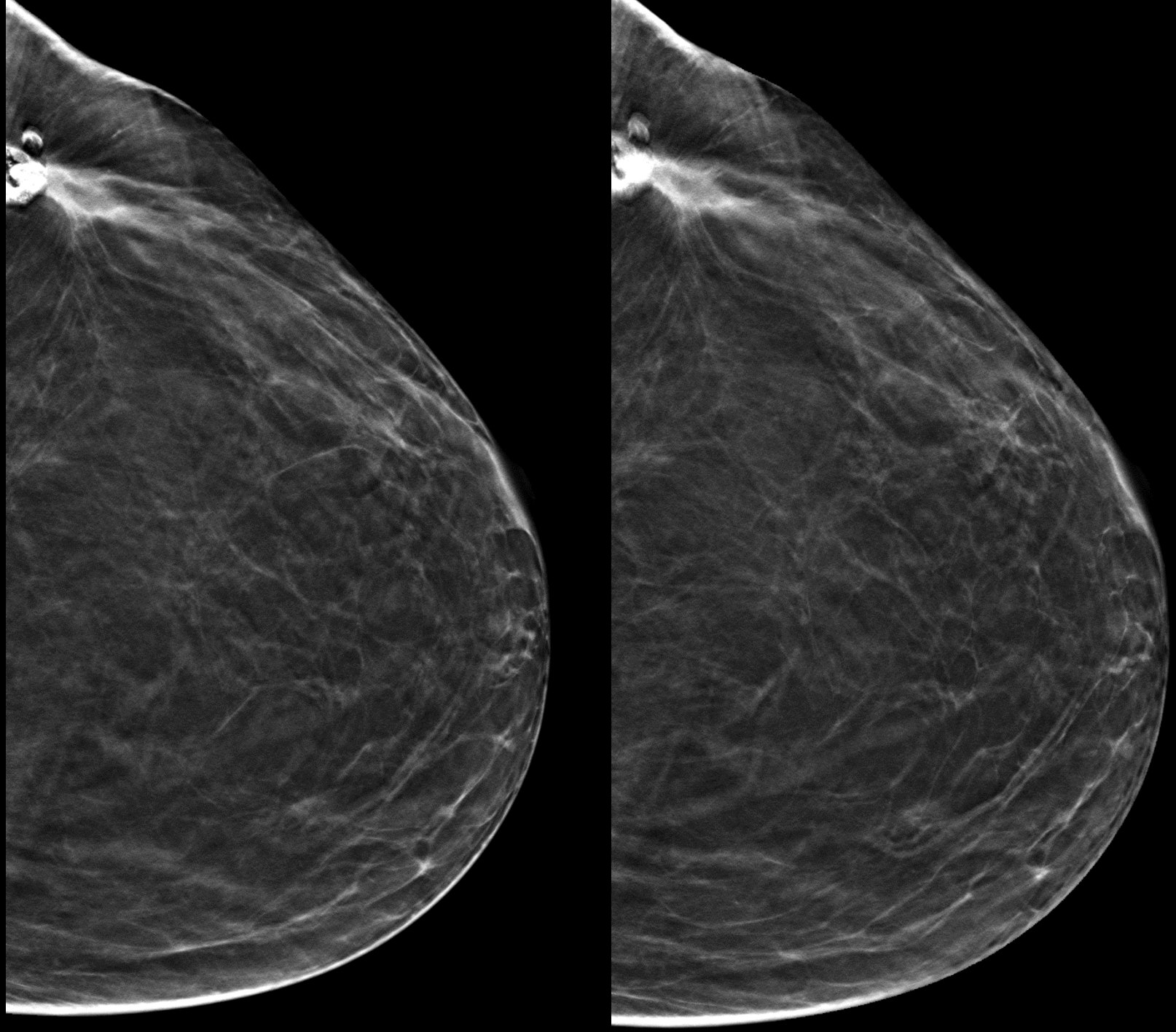


Spot compression

Digital full-field mammography
2D







Biopsy 14G : invasive ductal carcinoma

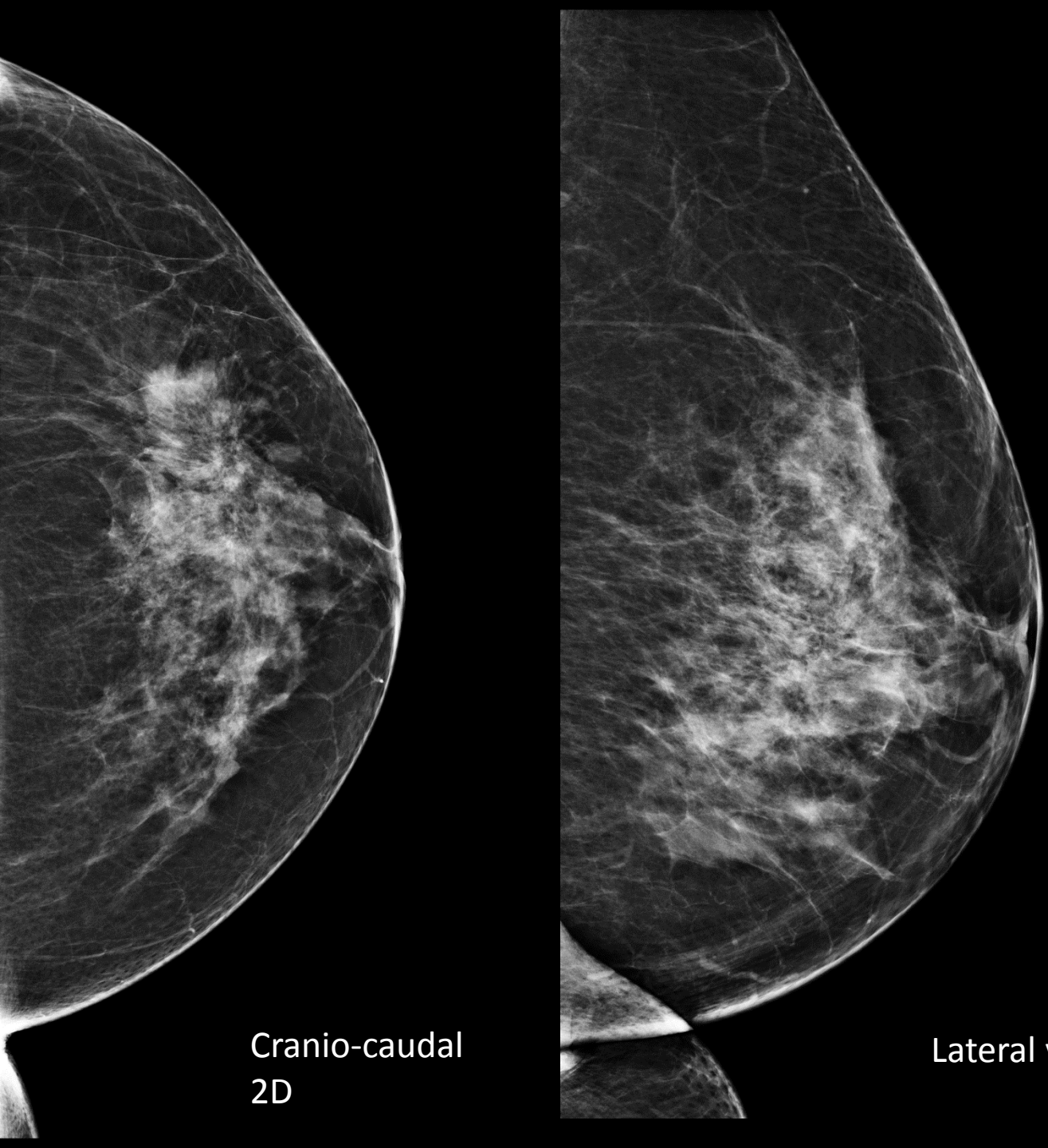
Conclusion: second-look 3D

- 3D improves the characterization of additional MR findings not identified at targeted breast (standard) US

- After preoperative breast MRI, 3D identified a further 32 of the 50 lesions unidentified on targeted US

  (Mariscotti G. Eur Radiol 2015)

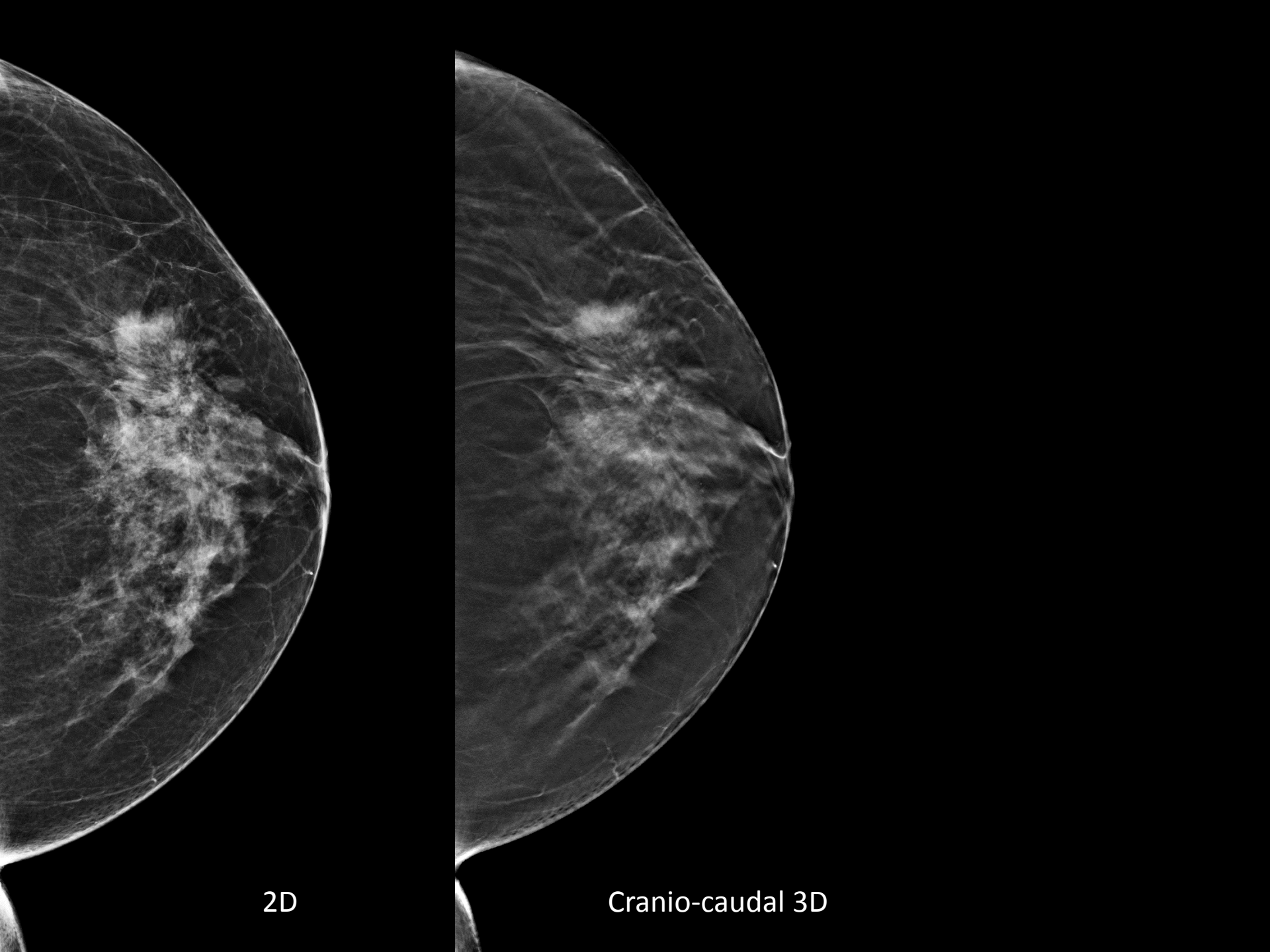
- 64 year-old woman
- No personal history
- No family history
- Doubt about left architectural distortion on mammography/ negative ultrasound

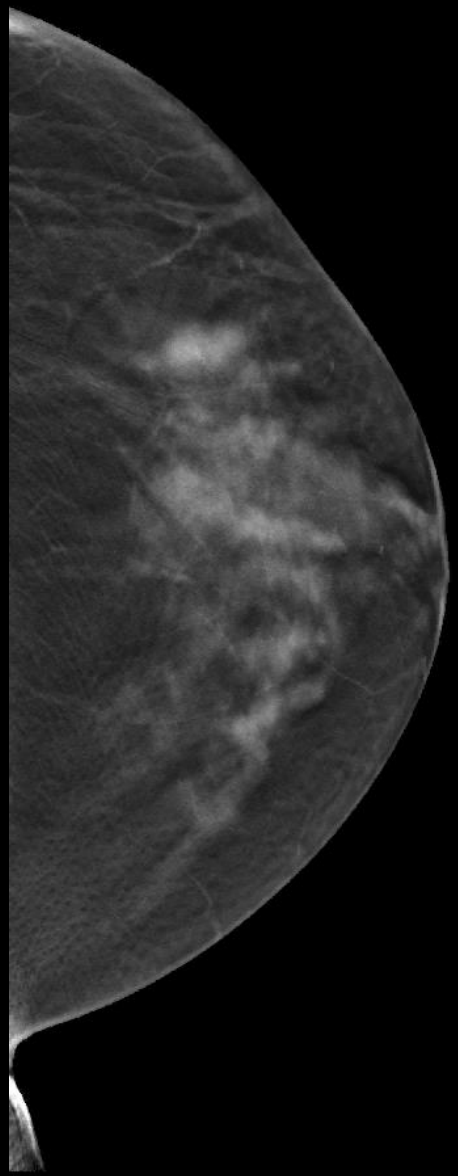


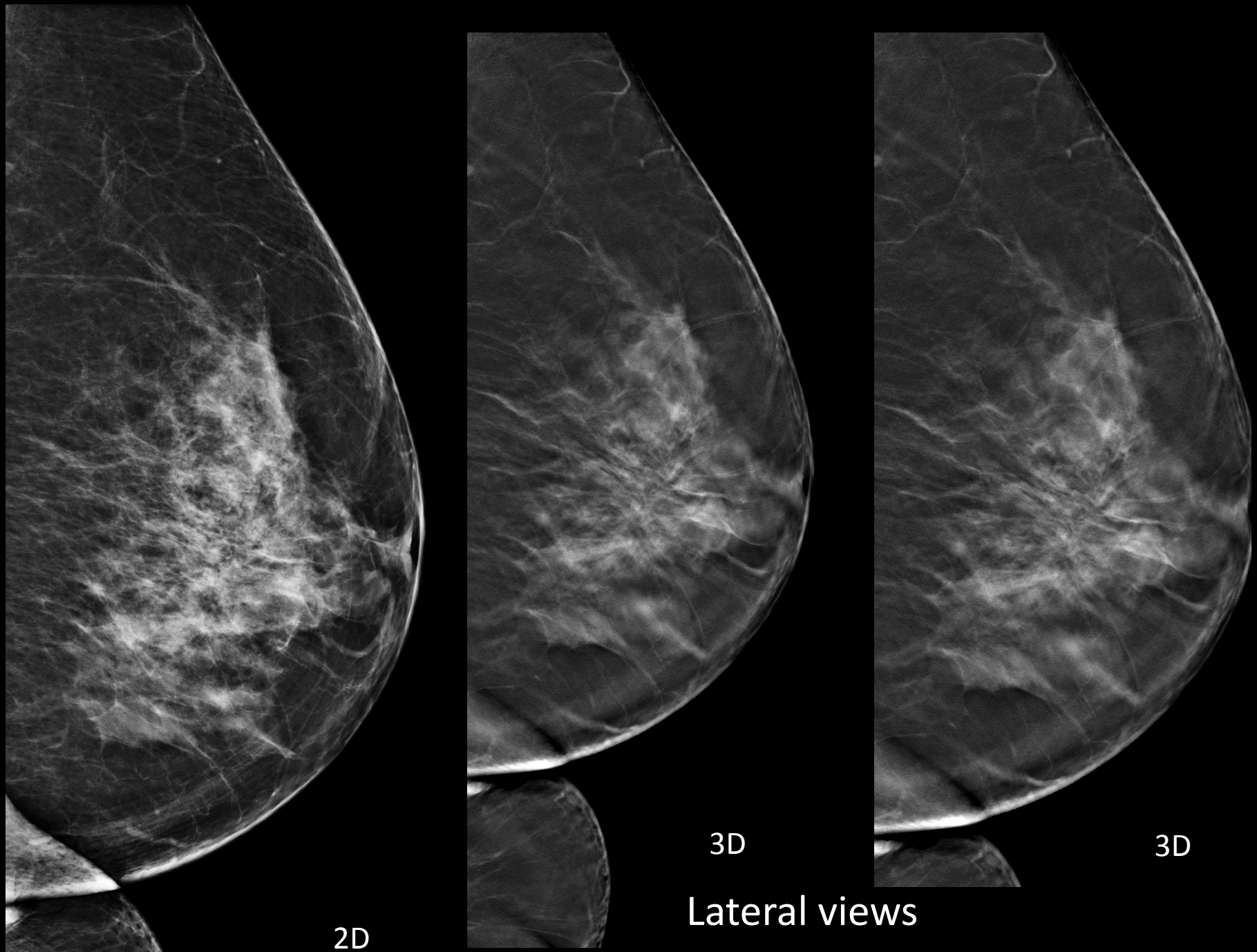
Cranio-caudal
2D

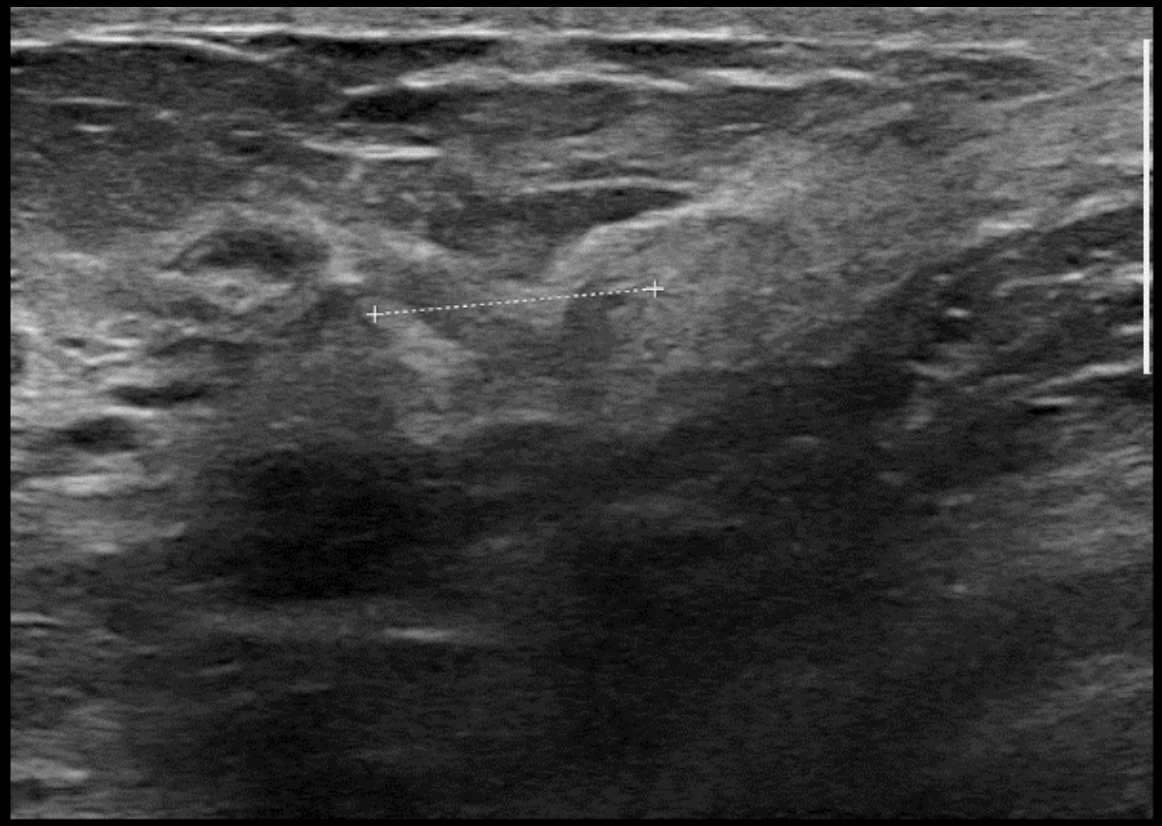
Lateral view

Ultrasound:
No abnomality


2D
Cranio-caudal 3D



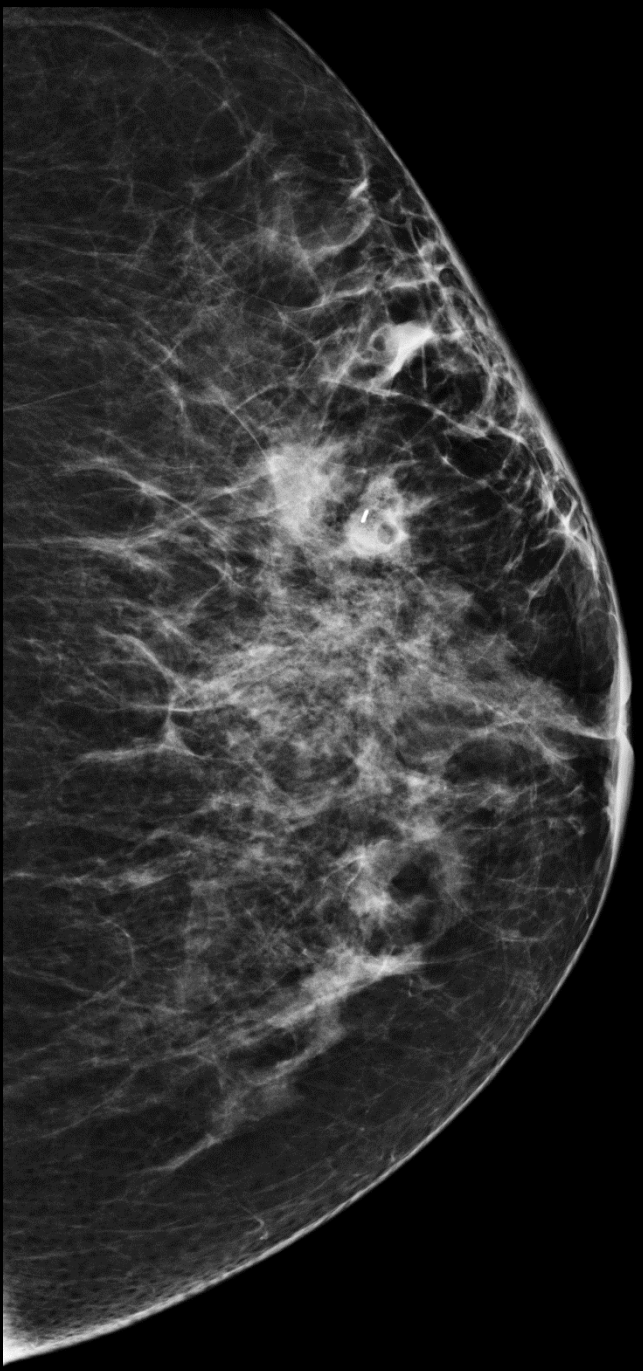

2D
3D
3D
Lateral views



Targeted ultrasound:

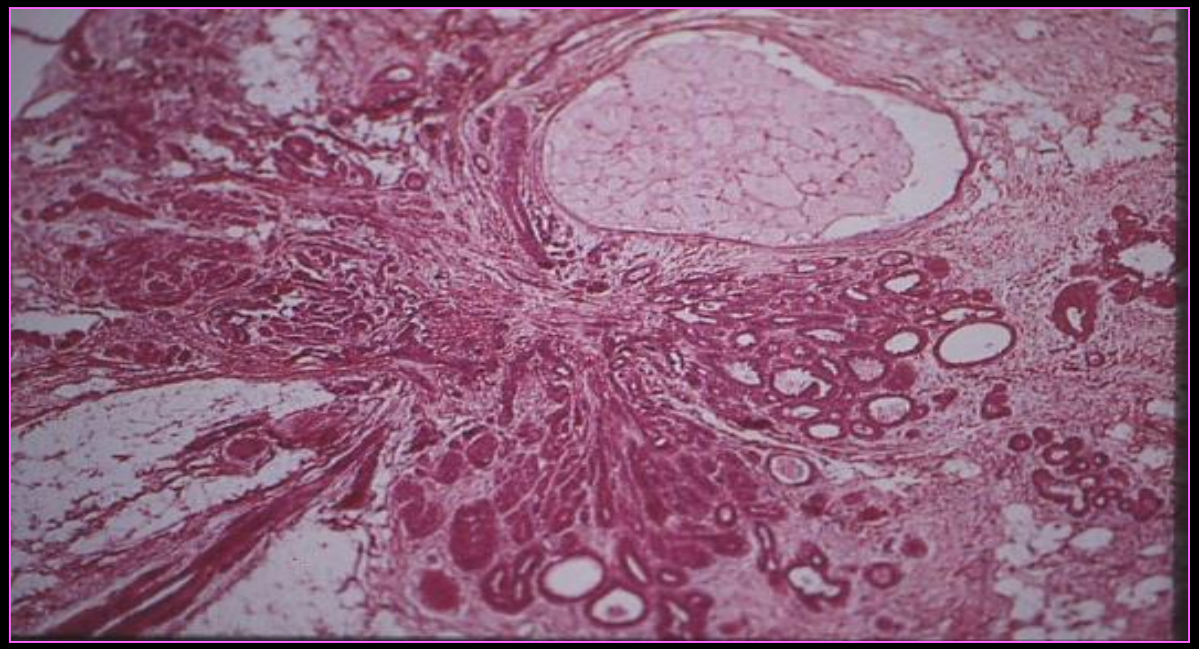
- Subtle architectural distorsion: ACR4
- Vacuum-assisted biopsy indicated

Biopsy 10 G under tomosynthesis guidance



Biopsy 10 G under tomosynthesis guidance
Deployment of a clip marker

Radial scar



- Concordant

but known underestimation (4%)

- Open surgery
- Final histological results:

complex sclerosing lesion

papilloma

atypical epithelial atypia

Conclusion (1)

- 3D enables better visualization of architectural distortion (AD) and its associated spiculations *(Partyka L AJR 2014)*
- 3D more informative than 2D in 94.4% of AD *(Yang Biomed Res Int 2013)*
- Increase sensitiviy of 3D in cancers manifesting as spiculated masses and AD *(Skaane Acta Radiol 2012)*

Conclusion (2)

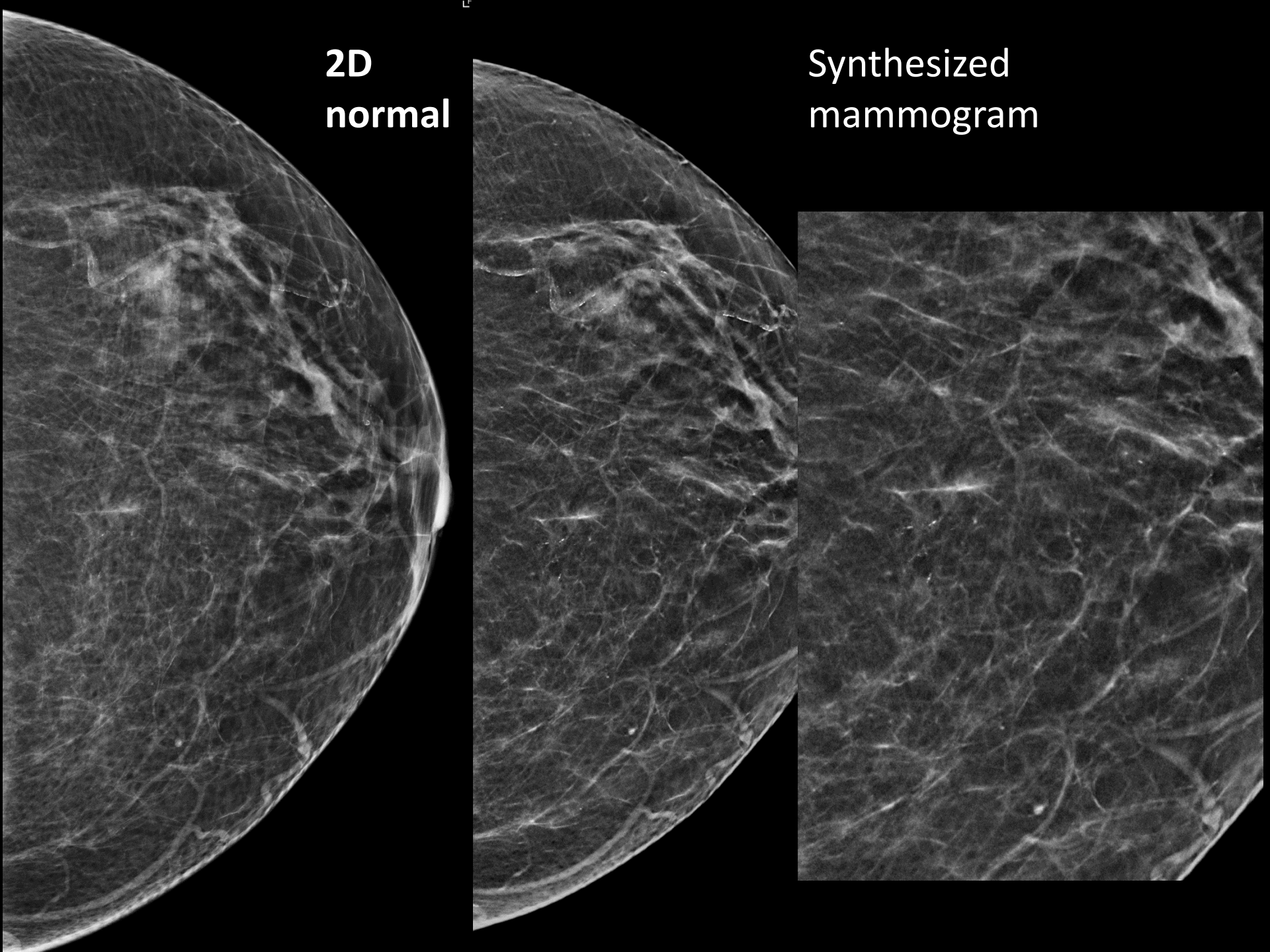
- Follow-up or biopsy under 3D of subtle distorsion detected only with 3D?

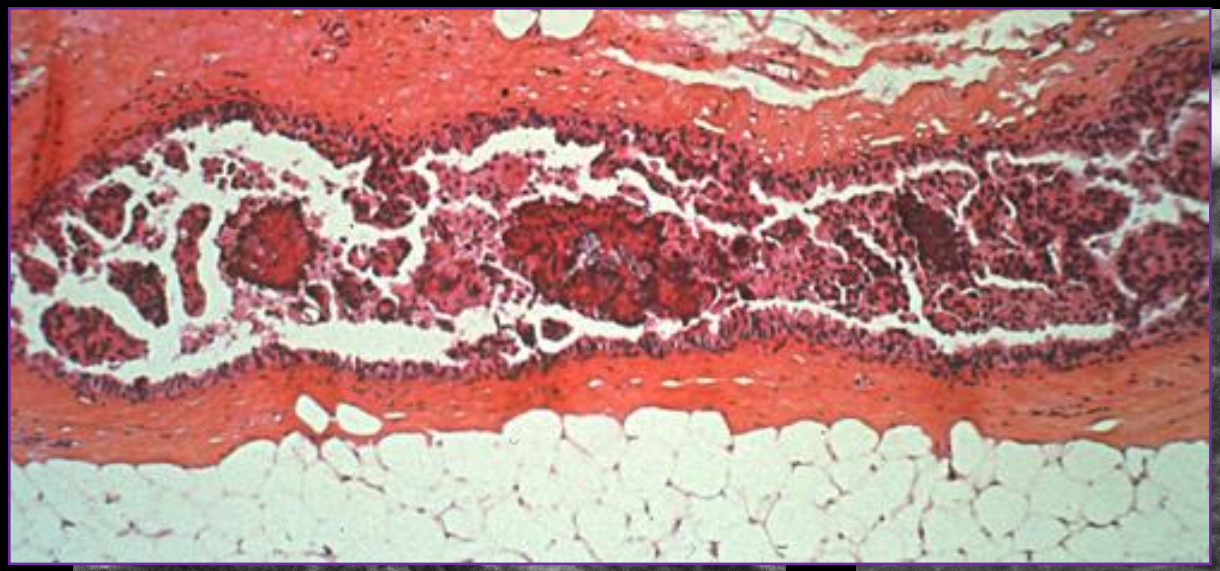
- Tomosynthesis improved ($p < 0.05$) the identification of radial scar (overdiagnosis)

  Dominguez et al. Radiol Med 2014

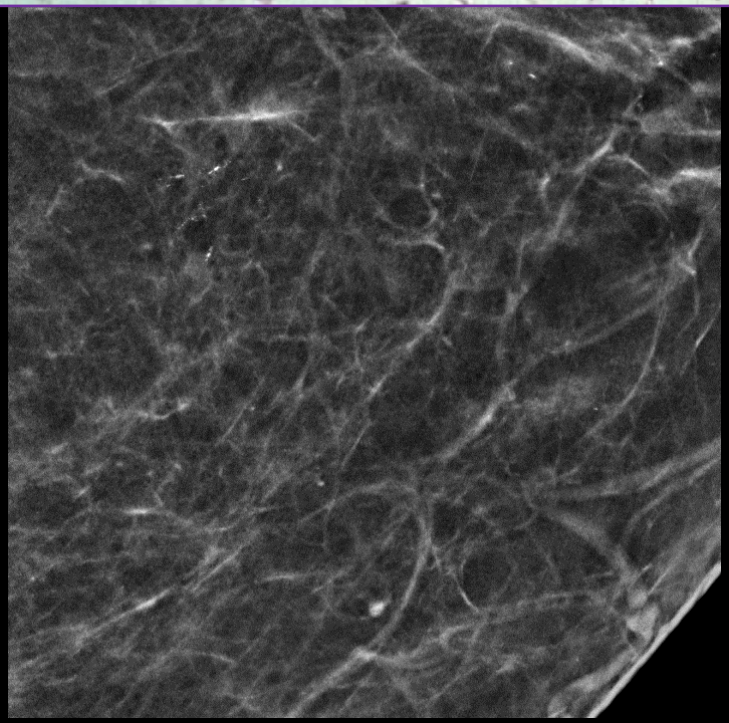
- New management? Percutaneous ultrasound-guided vacuum-assisted removal versus surgery for small lesions < 1 cm?

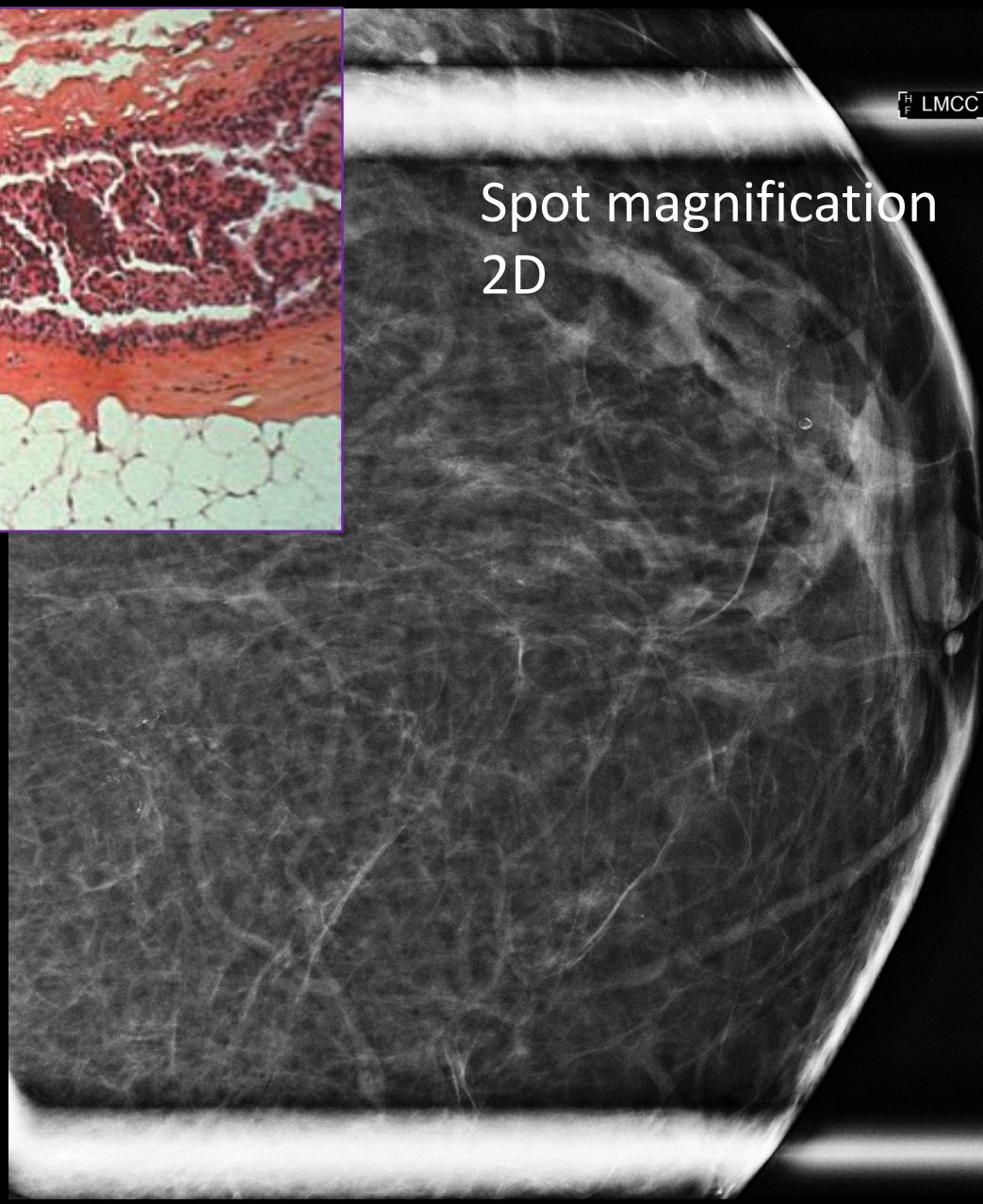
- Screening mammography
- Normal previous examination


2D
normal
Synthesized
mammogram



Spot magnification
2D





Intermediate grade ductal carcinoma in situ

Conclusions (1): synthesized mammogram

- = Synthetically reconstructed 2D mammogram from the multiple projection views
- Acceptable for routine in USA (1 firm)
- Reduces the radiation exposure
- Enhances small details (microcalcifications)
- Still a work-in-progress

Conclusions (2): 3 D and microcalcifications

- Clinical experience : some potential pitfalls
- Calcifications may be different (less visible on 3D) and classified differently (underestimated) *(Tagliafico Eur radiol 2015)*
- 3D images reviewed as individual slices, or slabs and optimal slabbing may be cluster dependant

Kopans AJR 2014

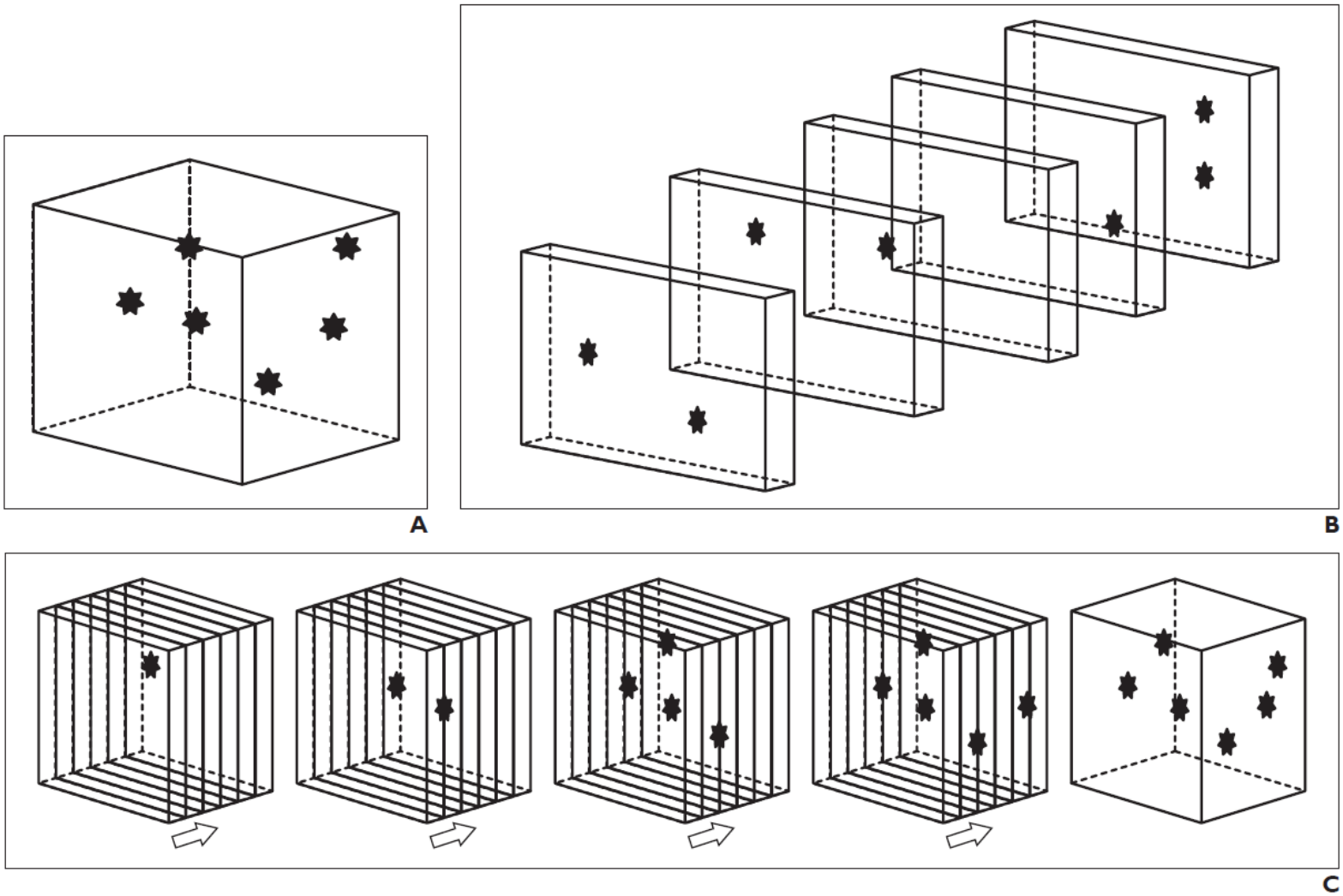


Fig. 3—Diagrams show how calcifications can be difficult to perceive on planes through volume but are more easily appreciated on slab images. Adapted with permission from [50]

A, Cluster of calcifications is perceived because on 2D mammogram distribution catches reader's attention.

B, Clustering can be difficult to perceive as a reader pages through volumes because brain does not appreciate cluster.

C, Cluster becomes evident when planes are put together to make slab and slab is moved through volume by use of maximum intensity projection within slab.

Conclusions (2): 3D and microcalcifications

- No change in detection of DCIS with 3D (microcalcifications easily seen in 2D) *(Gilbert 2013)*
- Studies on synthesized image and microcalcifications are necessary
- 3D doesn’t replace 2D magnification for microcalcifications

Take-home messages: 3D

- Increases sensitivity and decreases false-positive recall rates
- Has approval for diagnostics
- Hasn’t approval for screening in France
- However there are issues with 3D as a screening tool including additional reading time, storage, … *(Gilbert F. Clinical Radiology 2016)*