

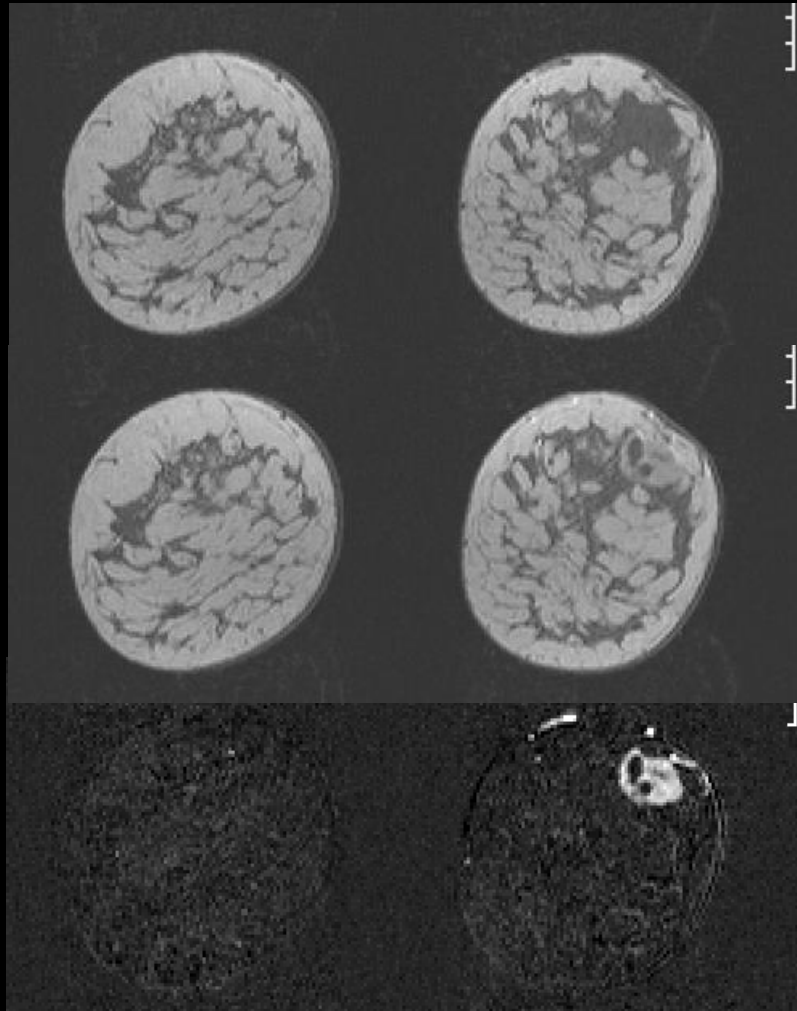


Stavanger Universitetssjukehus
Helse Stavanger HF

*MR sin plass i
brystkreftdiagnostikk, dagens
anbefalinger og
fremtidsperspektiver*

Kathinka Kurz, MD, PhD, seksjonsoverlege SUS, kathinka.dehli.kurz@sus.no

Technique - Subtraction



Without contrast agent

2 min after i.v. injection of
gadolinium containing
contrast agent

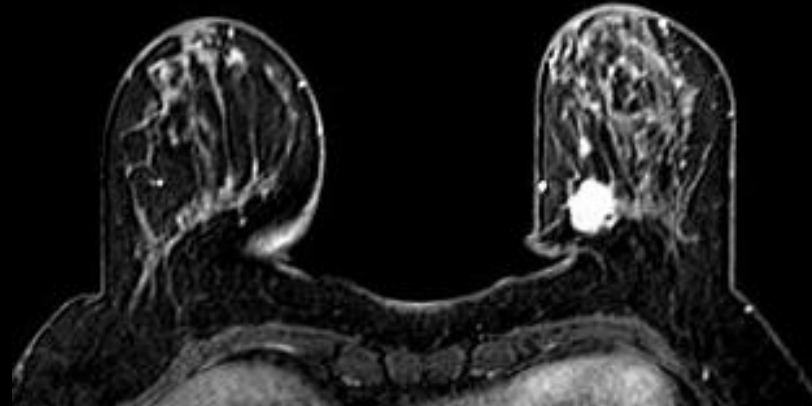
Subtraction (contrast series
minus unenhanced series,
pixel by pixel)

Technique – Fat suppression

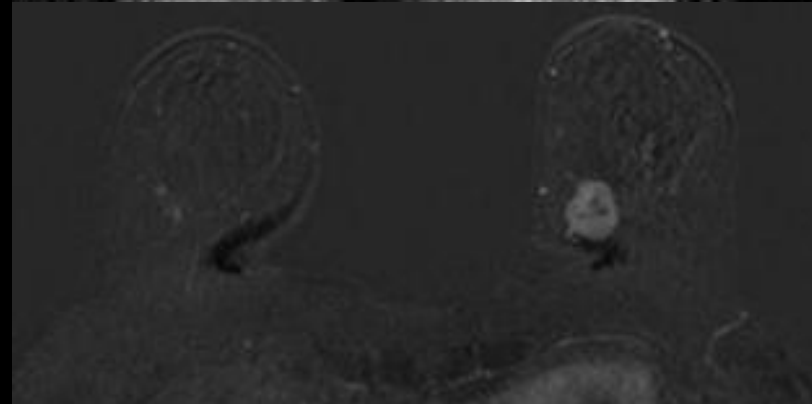
skr.: MR Mammografi, serie med
skr.: dyn_THRIVE
ros.: HFP
10 mm



Without contrast agent



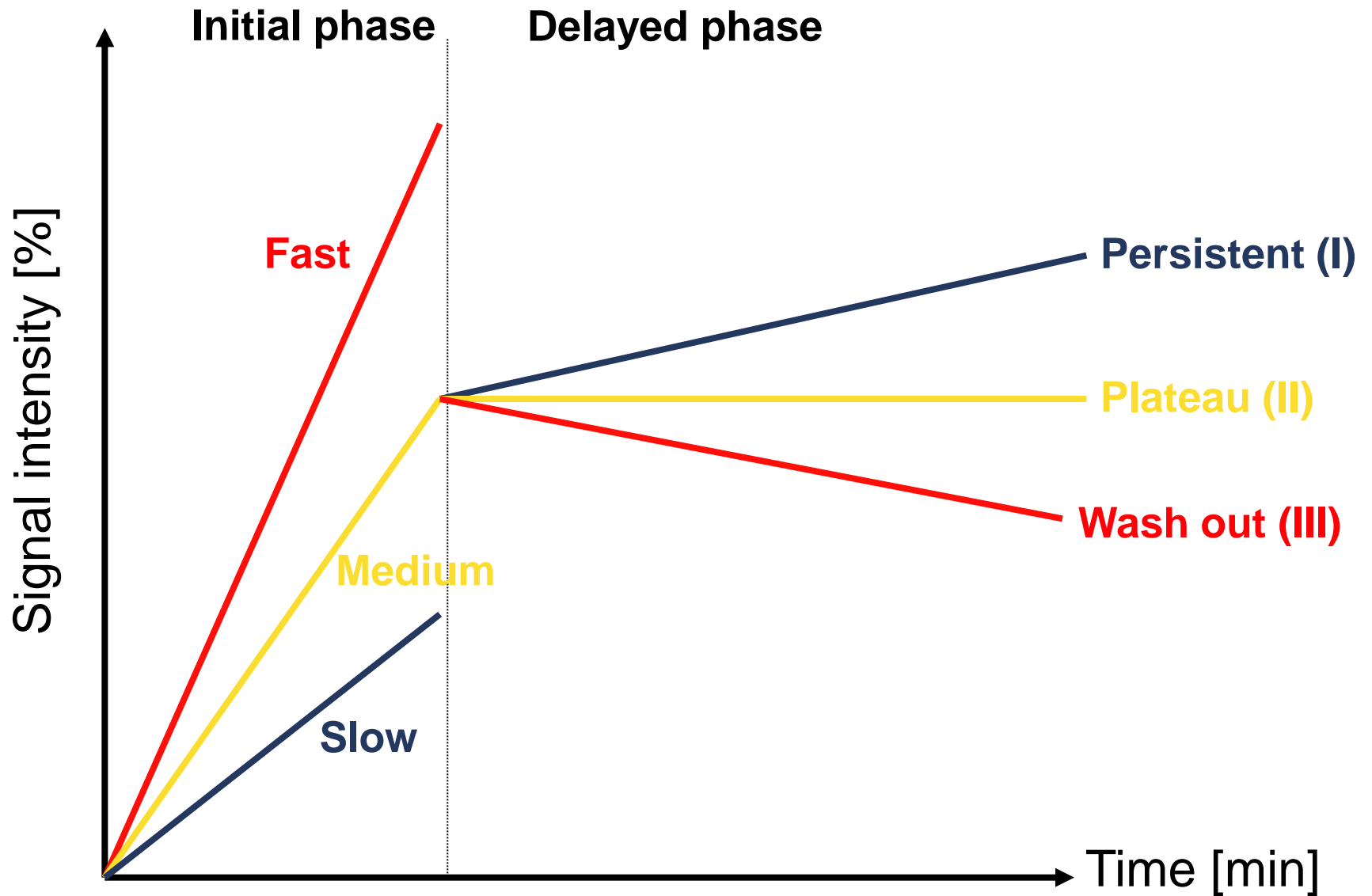
2 min after i.v. injection of
gadolinium containing
contrast agent



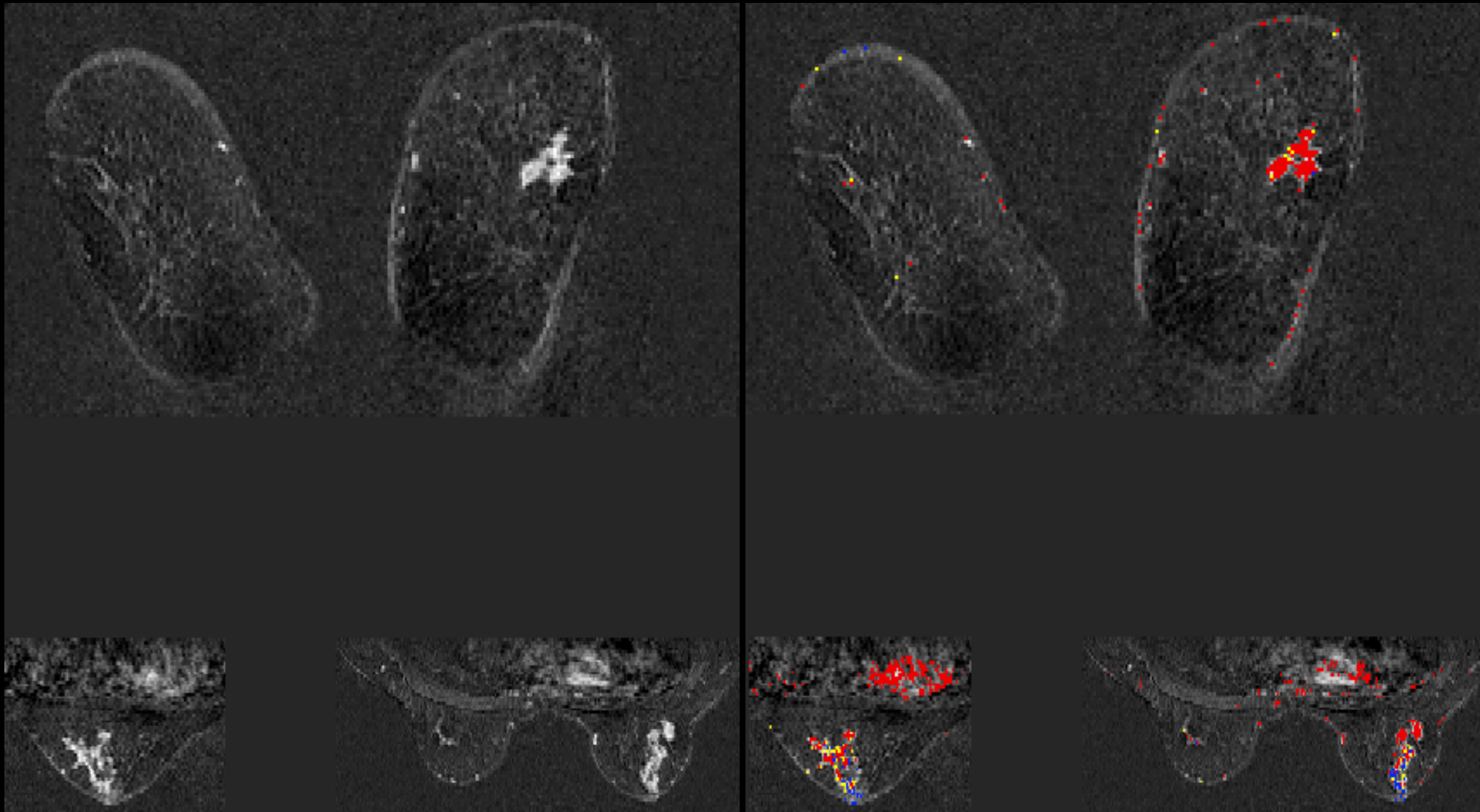
Subtraction (contrast series
minus unenhanced series,
pixel by pixel)



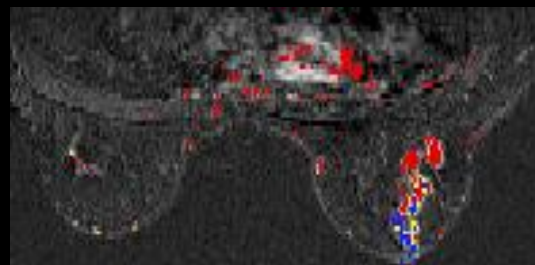
Chocolate Hills in Bohol, Philippines



Initial Phase: First two minutes after contrast agent injection or when curve starts to change.

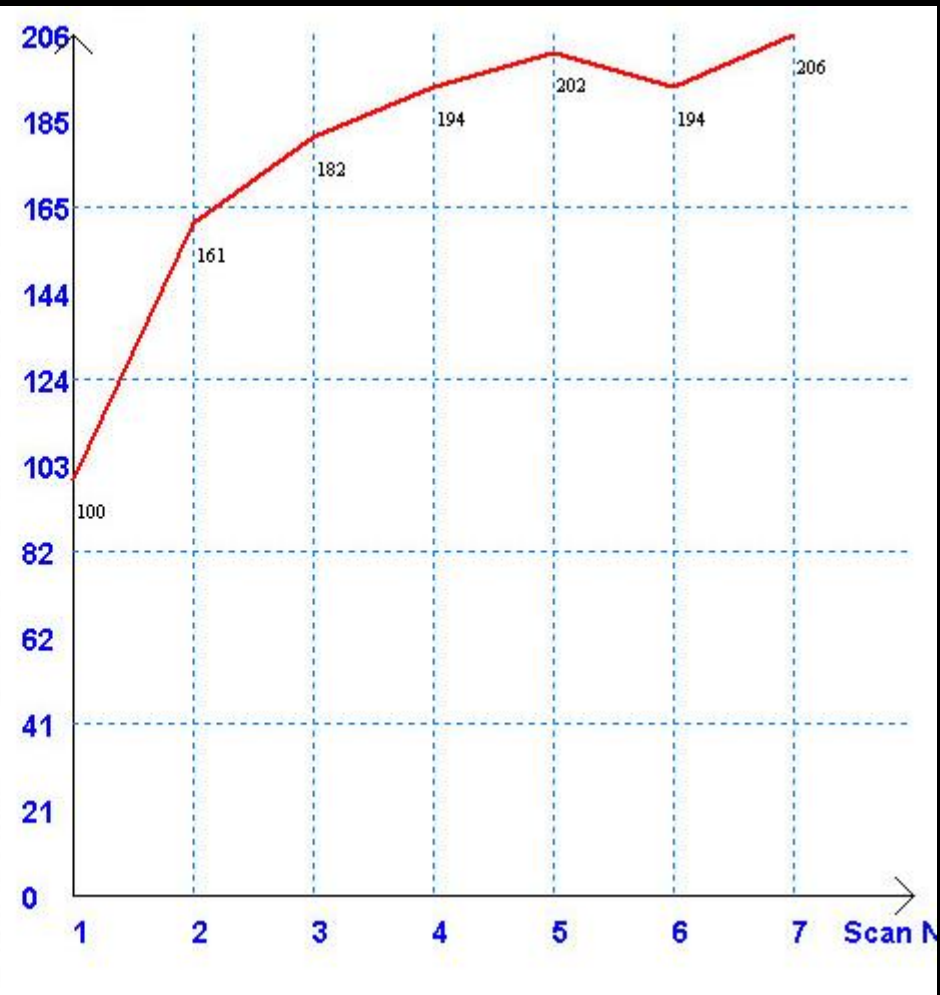
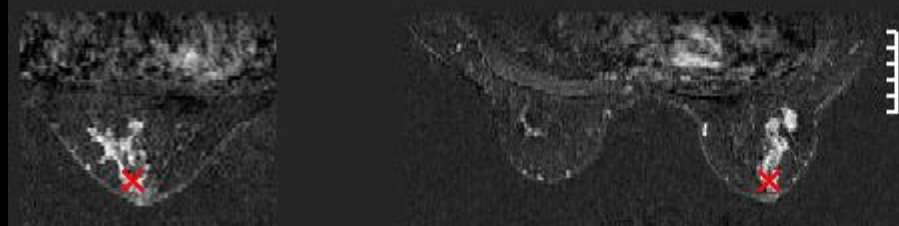
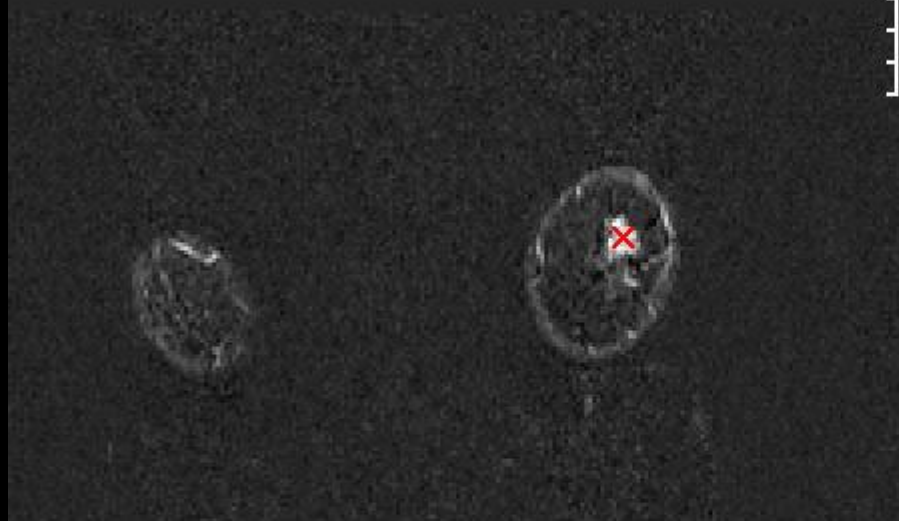


Irregular shaped mass with spiculated margins and inhomogeneous enhancement.

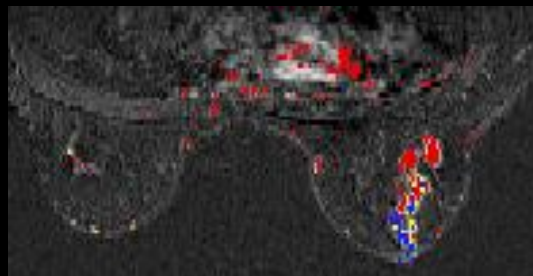


NO.: 43 Serie NO.: 3 - 1
 v: 62 level: 38
 -No.: 237 - 109
 82 y = 120 z = 49

f

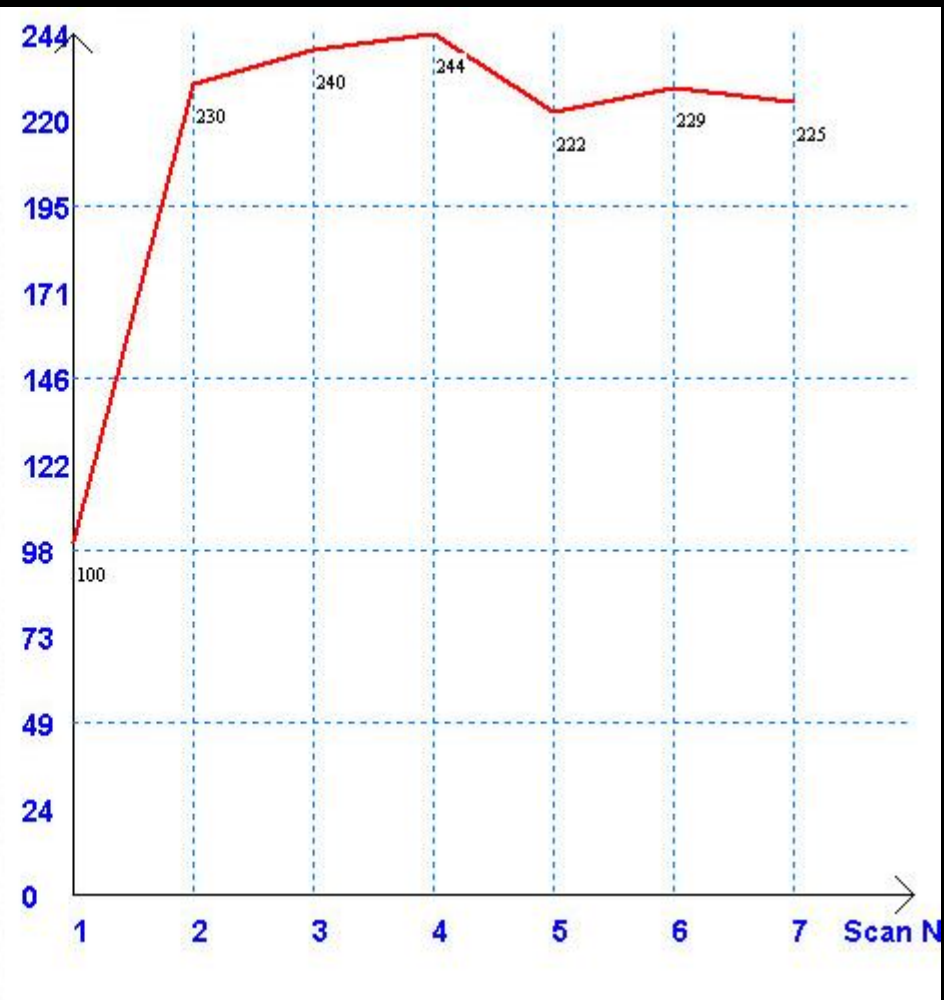
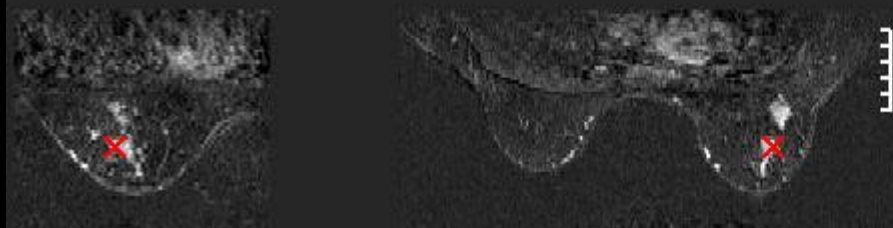
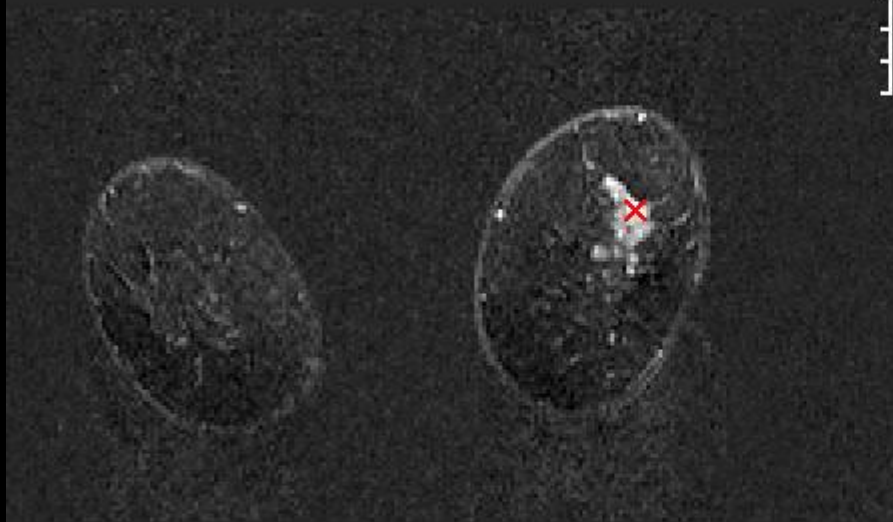


Type I Time Intensity curve (TIC): Persistent rise

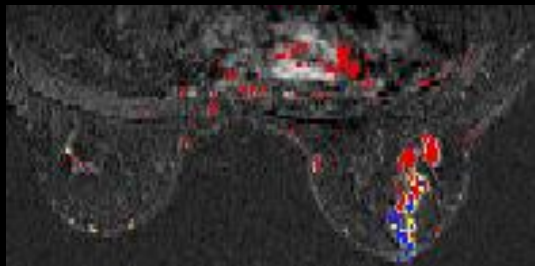


No.: 40 Serie No.: 3 - 1
 v: 62 level: 38
 -No.: 228 - 100
 37 y = 114 z = 40

e

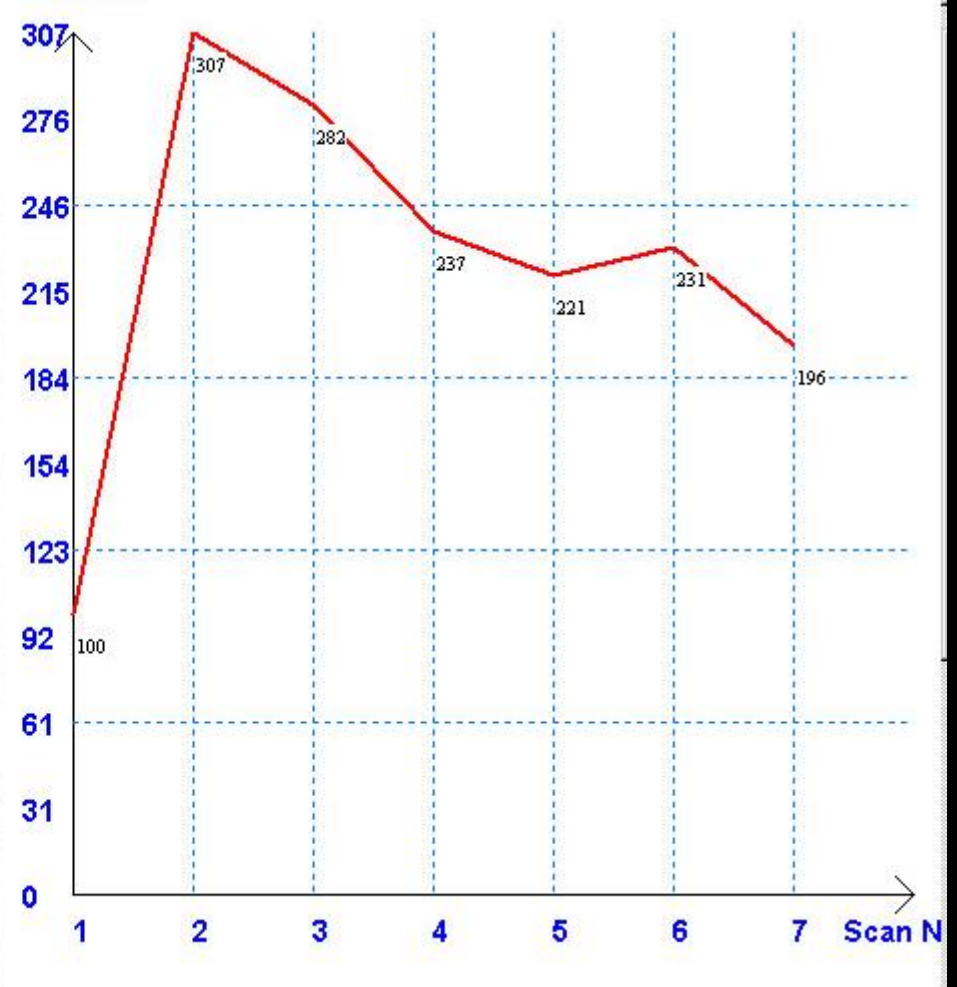
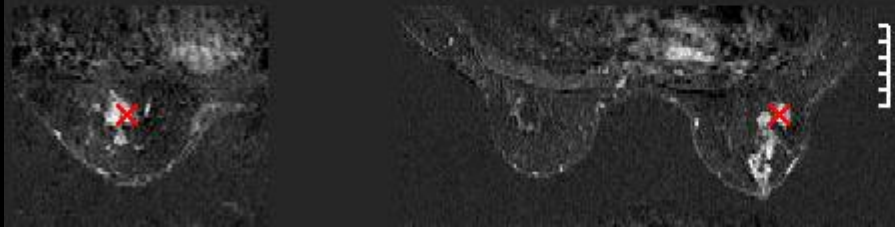
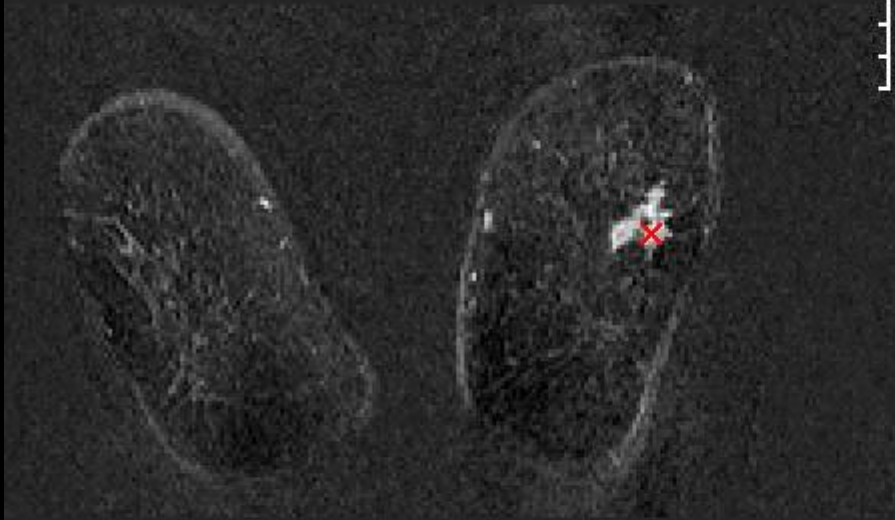


Type II TIC: Rapid rise and plateau



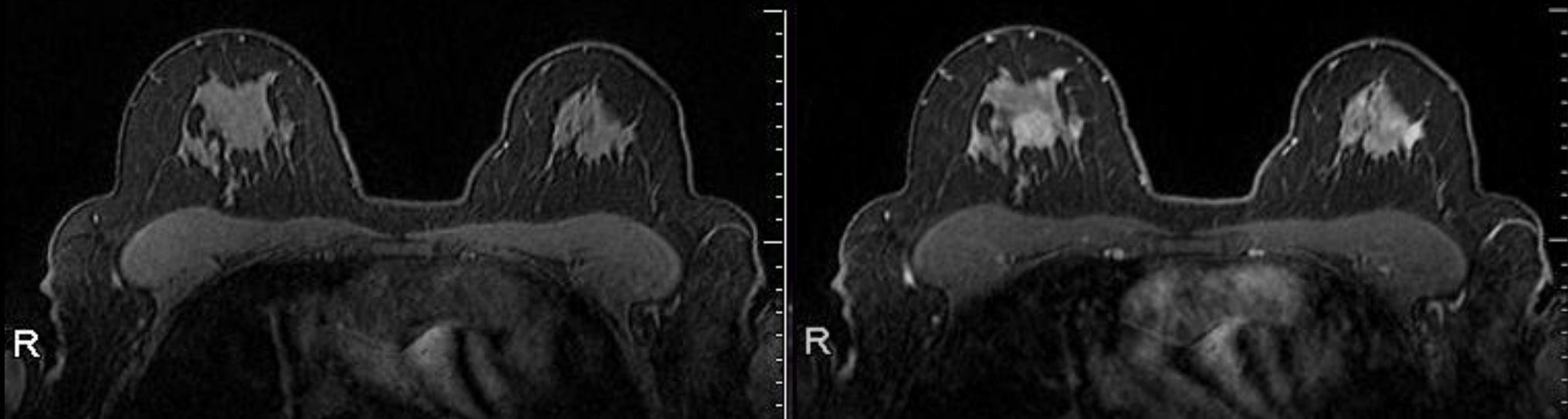
No.: 32 Serie No.: 3 - 1
 r: 62 level: 38
 -No.: 220 - 92
 01 y = 121 z = 32

d

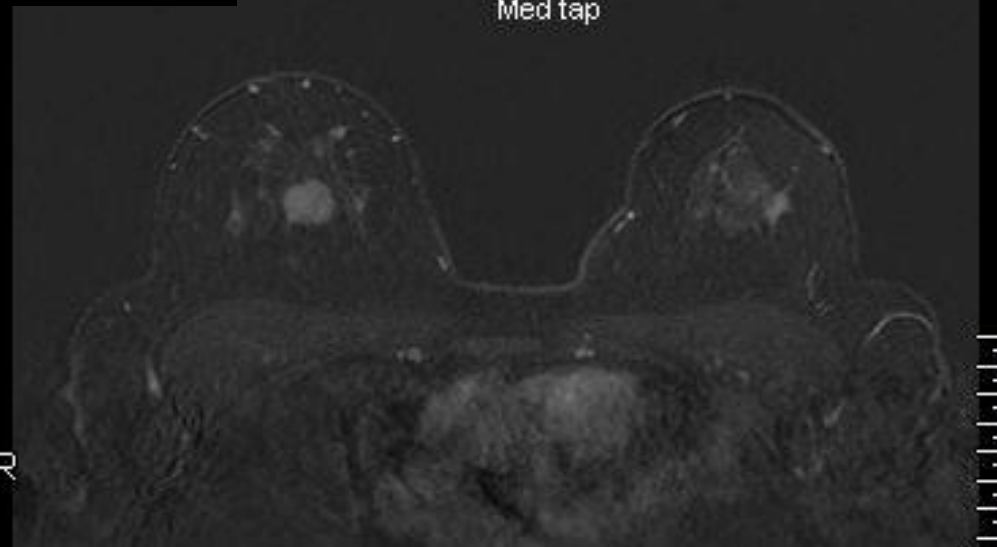
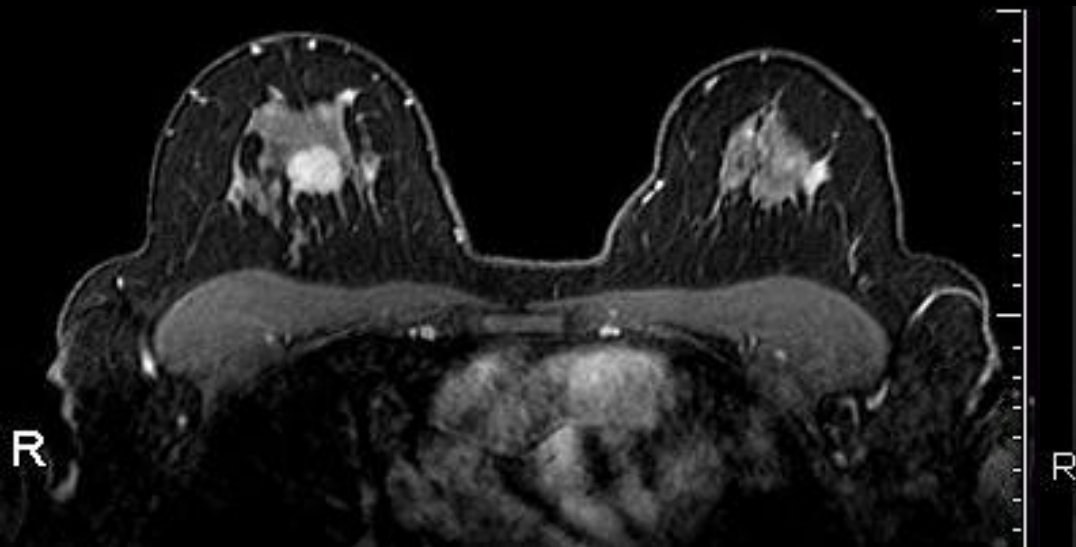
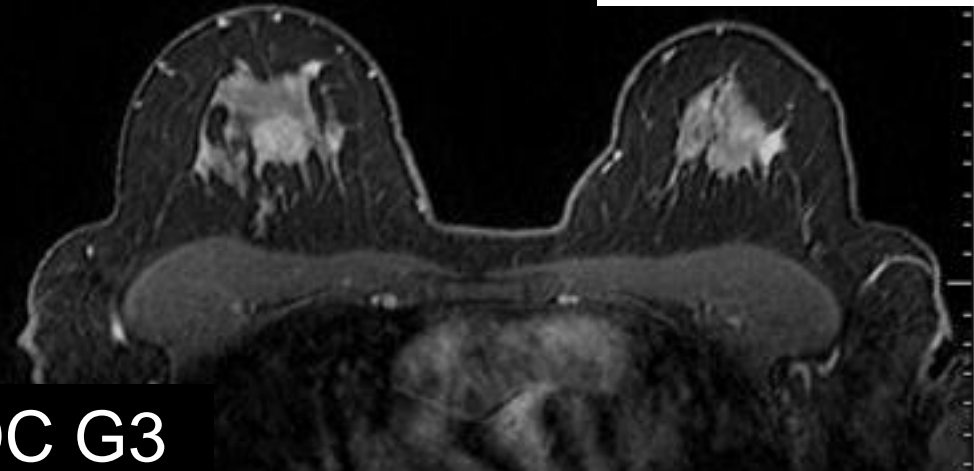
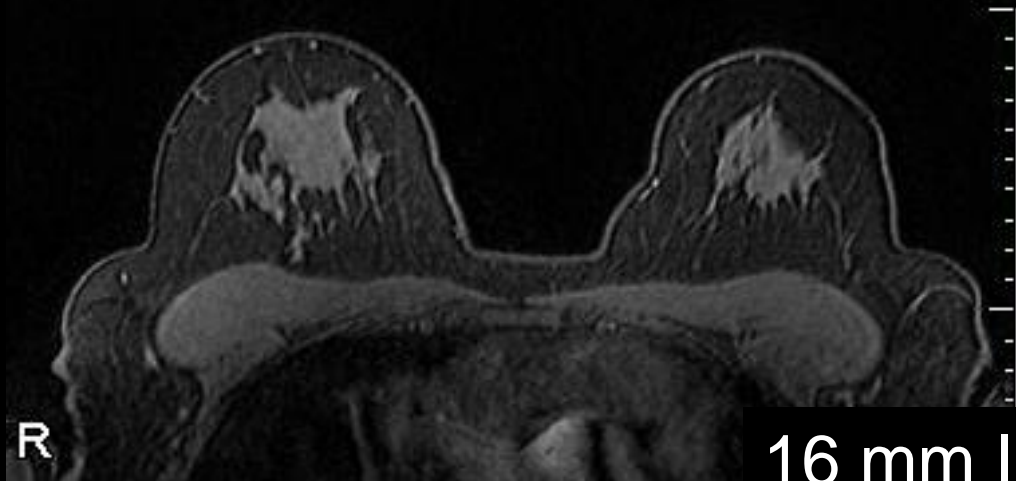
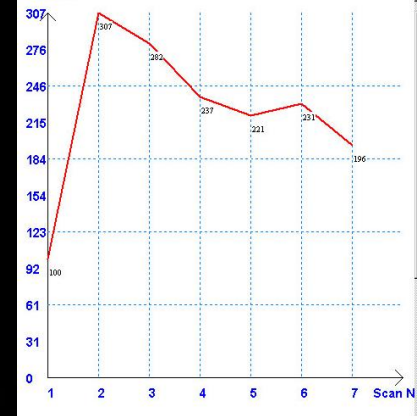


Type III TIC: Rapid rise and wash out

Why performe dynamic series?



Why performe dynamic series?





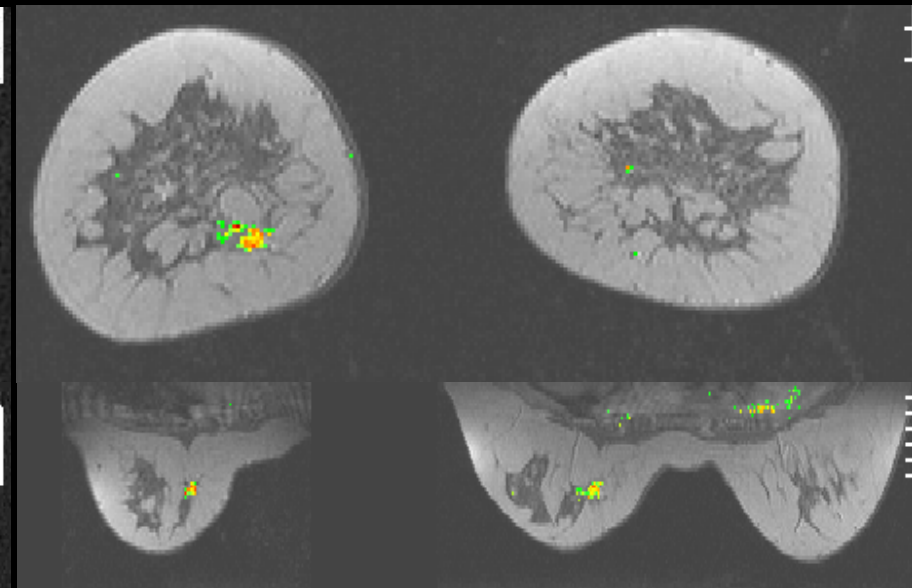
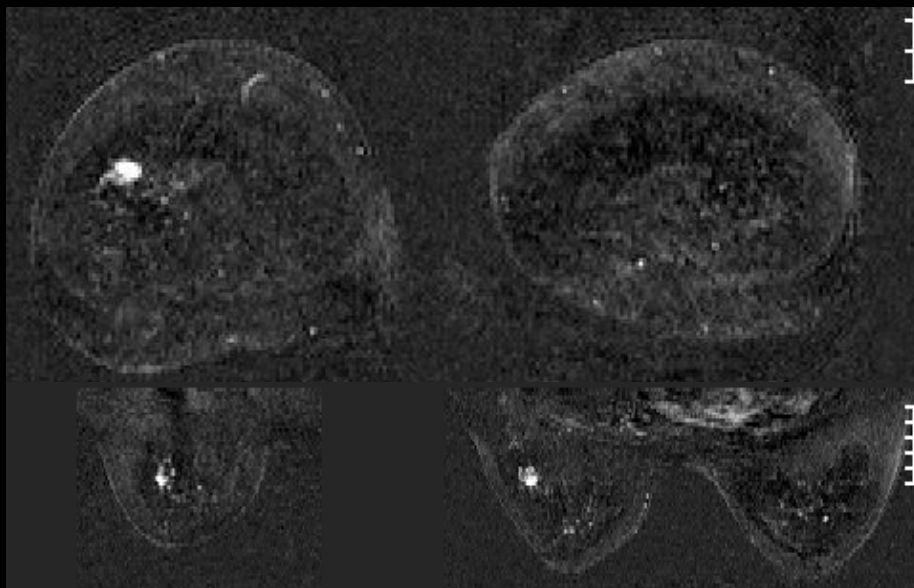
Crystal Hills, Hohenems, Australia

Indications

- Preoperative: „Rule out“ multifocal / multicentric growth of carcinoma prior to planned breast conserving therapy (especially by dense breasts and invasive lobular carcinoma)
- Differentiate between scar and recurrent disease after breast conserving therapy
- Control the tumor response by neoadjuvant chemotherapy
- Carcinoma of unknown region
- High risk

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- Palpable lump 10 o'clock right breast
- Mammography normal
- Sonography mass suspect of malignancy
correlative to palpable lump
- MRI mamma: Another mass suspect of malignancy
at 4 o'clock right breast
- Histology: Multicentric invasiv lobular carcinoma

Local staging preoperative

- Main indication for breast conserving therapy: Small carcinomas compared to the size of the breast
- Main contraindication: Multicentric or multifocal growth of tumor
- MRI of the breast is more accurate than the combination of clinical examination, mammography and sonography

Local staging preoperative

- 16% additional carcinomas in the ipsilateral breast (range 6-34%).
52% TP
- 6% additional contralateral carcinomas (range 3-24%)
- Invasive lobular carcinomas
- Positive family history of breast cancer

After
✓ clinical
examination
✓ MG
✓ US

Libermann L. Breast MR imaging in assessing extent of disease. Magn Reson Imaging Clin N Am. 2006 Aug;14(3):339-49, vi (Review)

Local staging preoperative

- Especially important by
 - lobular carcinoma
 - patients with dense breasts
 - high risk patients
- BUT: Discussion in the literature because there is not such a high recurrence rate (16%).



Available online at www.sciencedirect.com



The Breast 16 (2007) S34–S44

THE BREAST

www.elsevier.com/locate/breast

Original Article

Pre-operative staging of breast cancer with breast MRI: One step forward, two steps back?

C. Kuhl^{a,*}, W. Kuhn^b, M. Braun^b, H. Schild^a

^aDepartment of Radiology, University of Bonn, Sigmund Freud Str. 25, 53105 Bonn, Germany

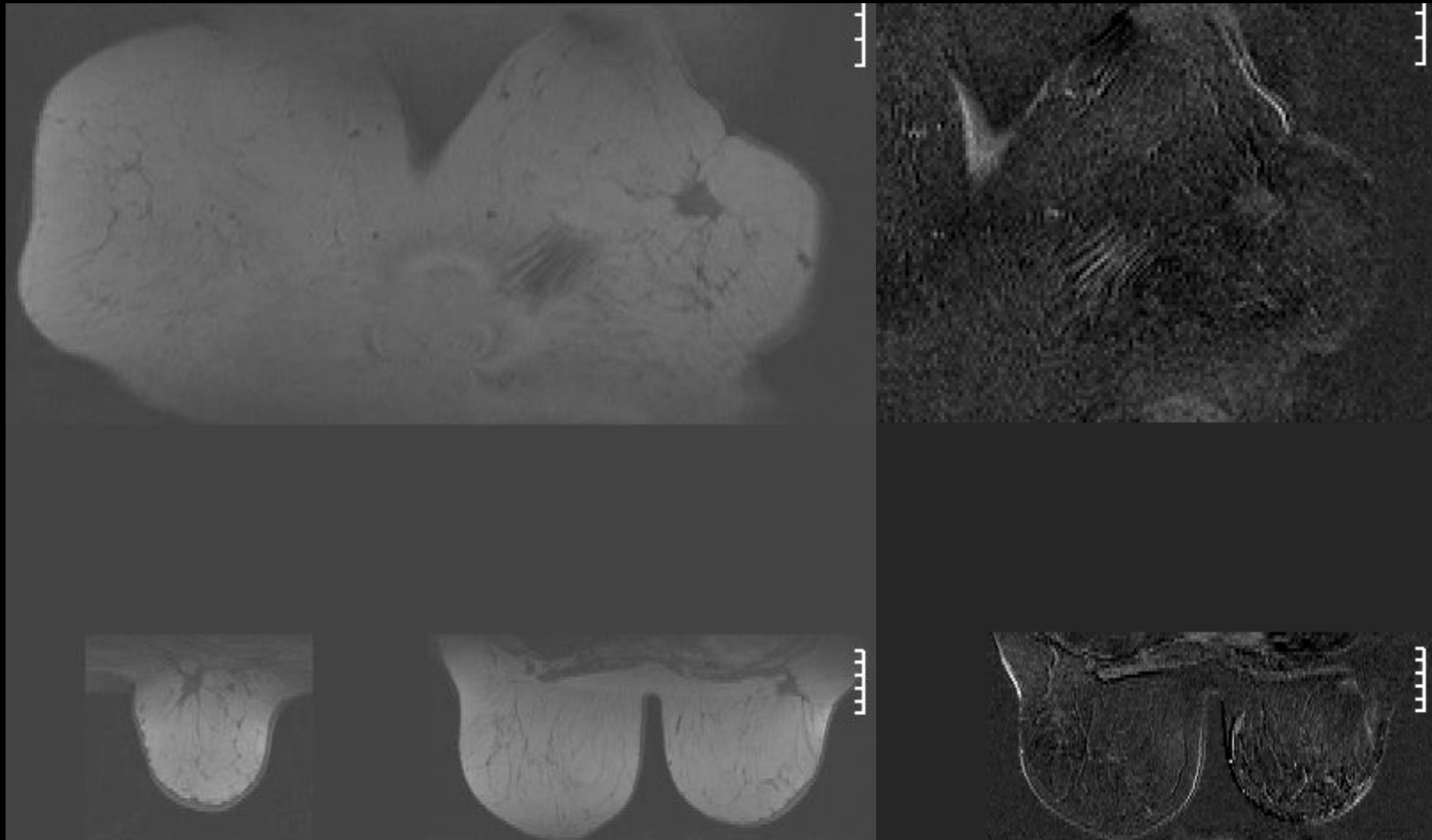
^bDepartment of Gynecology, University of Bonn, Sigmund Freud Str. 25, 53105 Bonn, Germany

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Scar ↔ Recurrent disease

- 1% local recurrence by breast conserving therapy per year. MRI of the breast diagnoses the recurrent carcinomas earlier than mammography and ultrasound
- On average 2-3 years after the operation, 5-15 mm size (Rieber 1997, Krämer 1998)
- BUT: The advantage of MRI is the high negative predictive value of 98.8%. Biopsy is not needed by negative MRI (93 patients) Preda L et al. Breast Cancer Res. 2006;8(5):R53



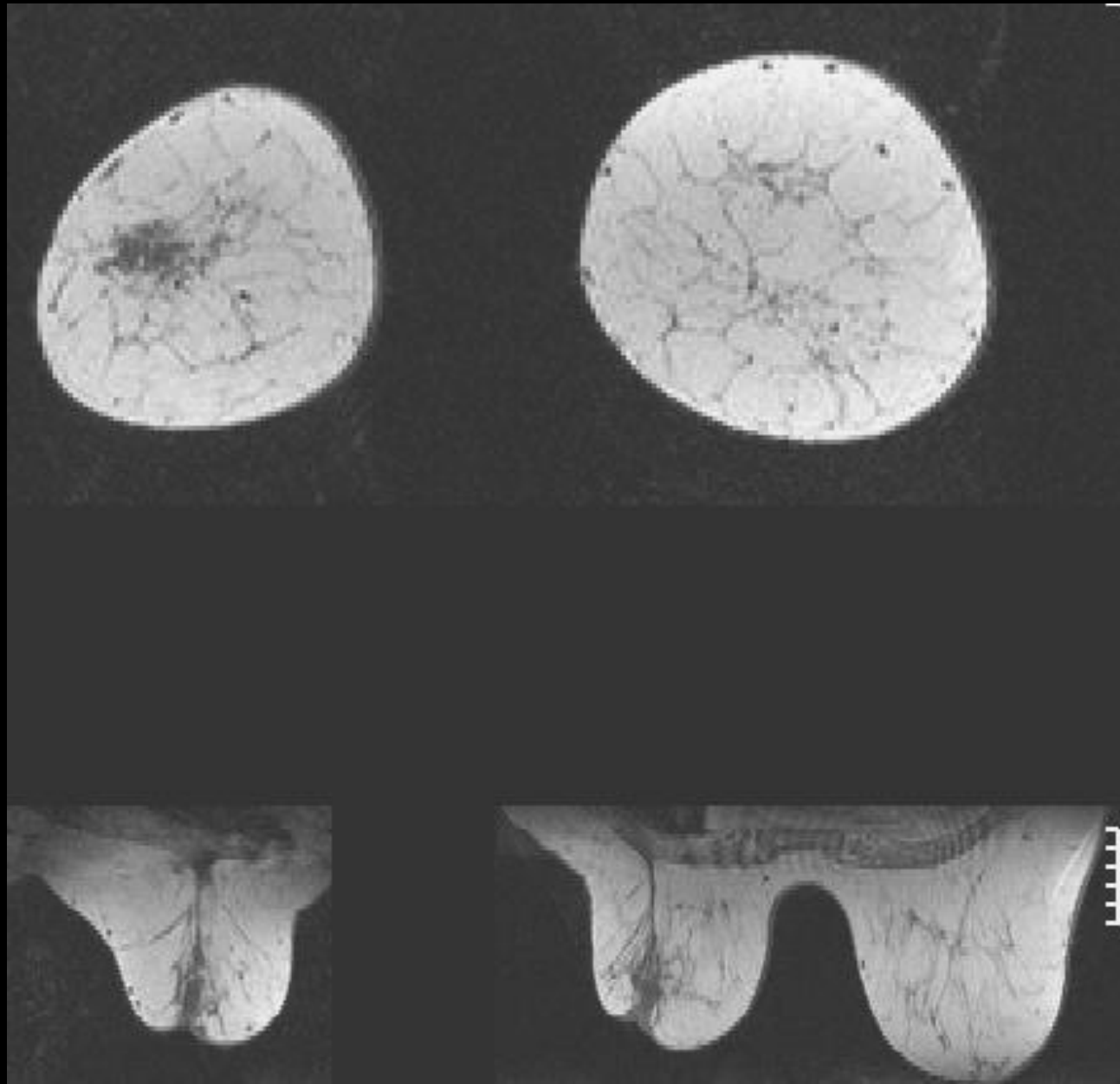
BCT 8 years ago. Aftercare. No signs of local recurrence.

BCT 14 years ago.

Mammography

slightly larger scar.

Ultrasound: Lots of
shadows.

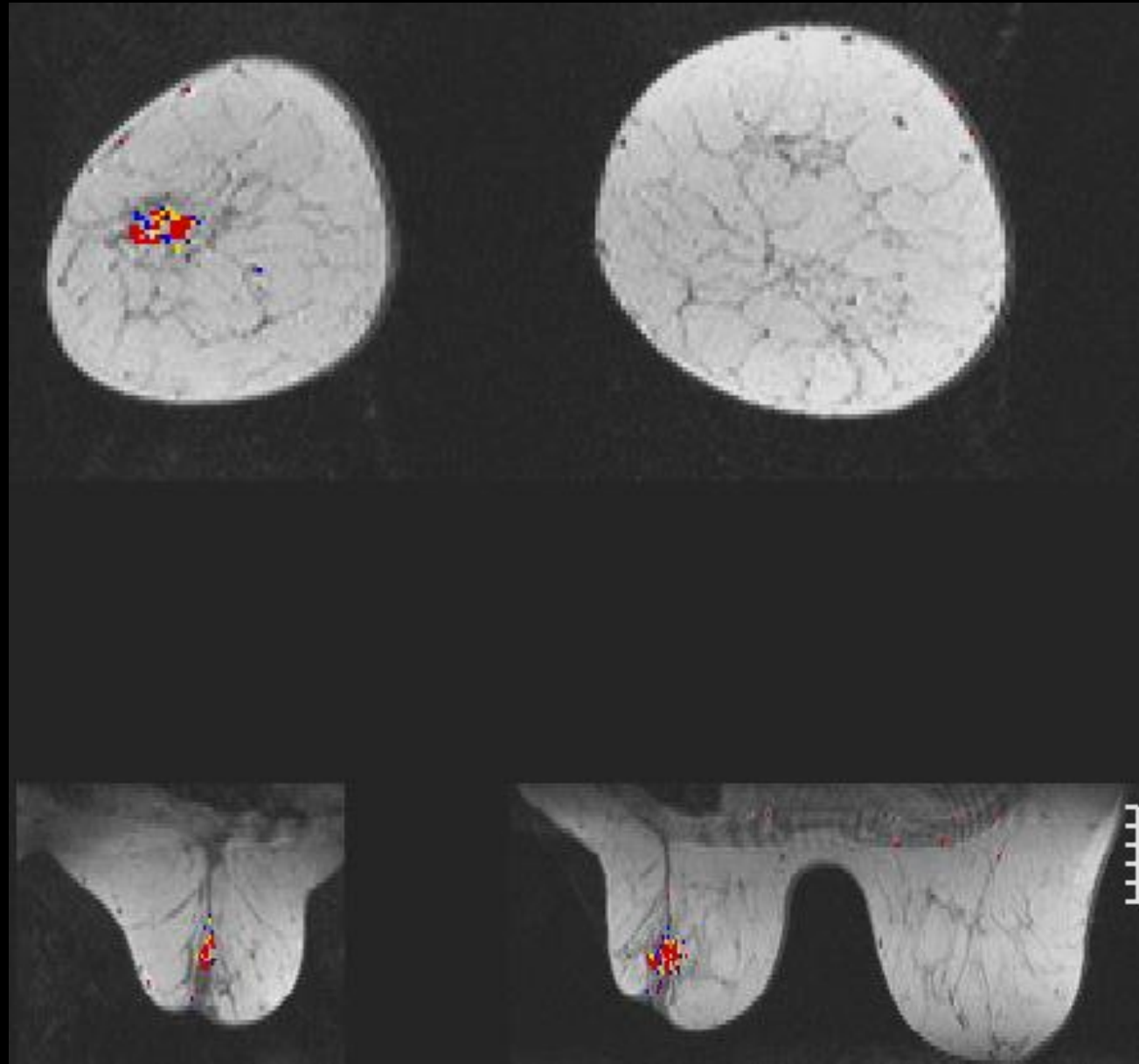


BCT 14 years ago.

Mammography
slightly larger scar.

Ultrasound: Lots of
shadows.

Local recurrence of
invasive ductal
carcinoma.

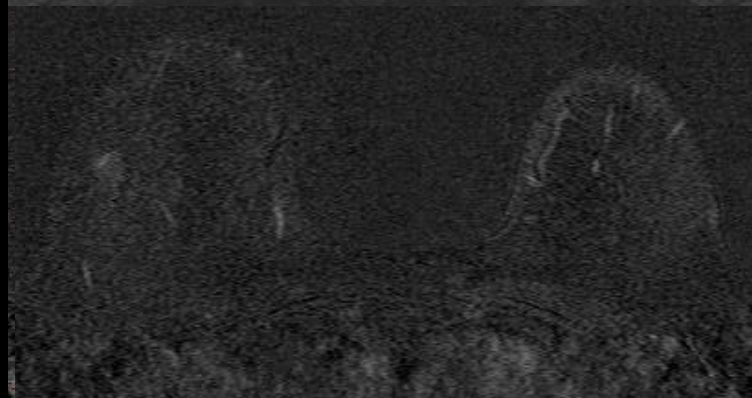
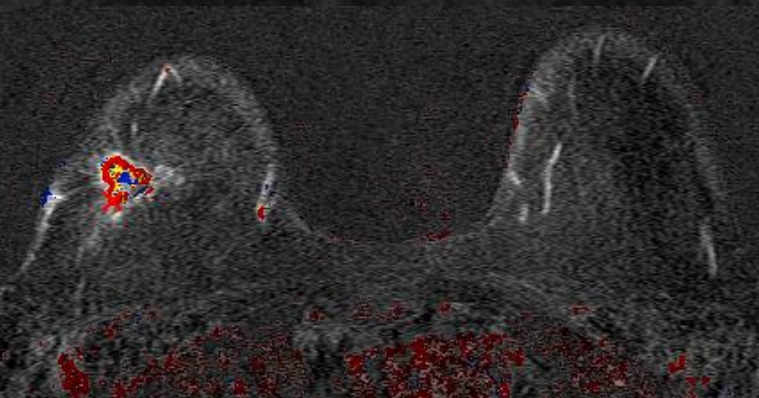
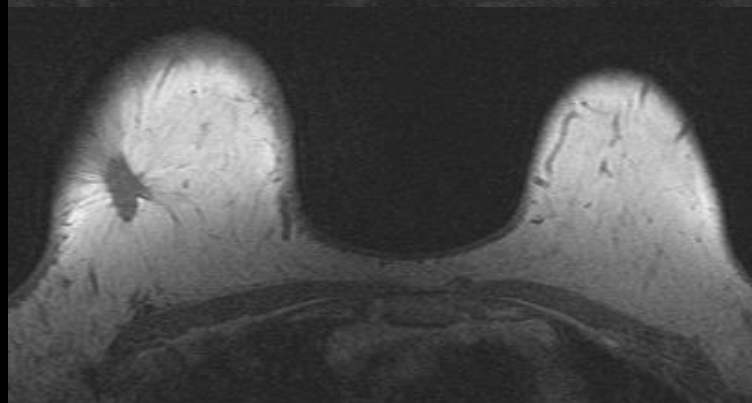
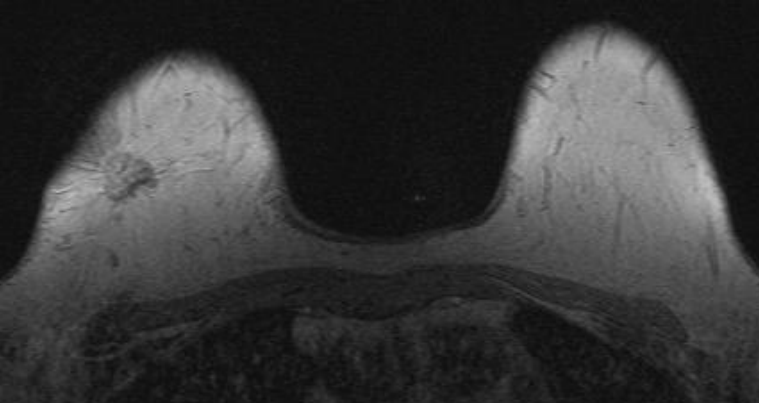
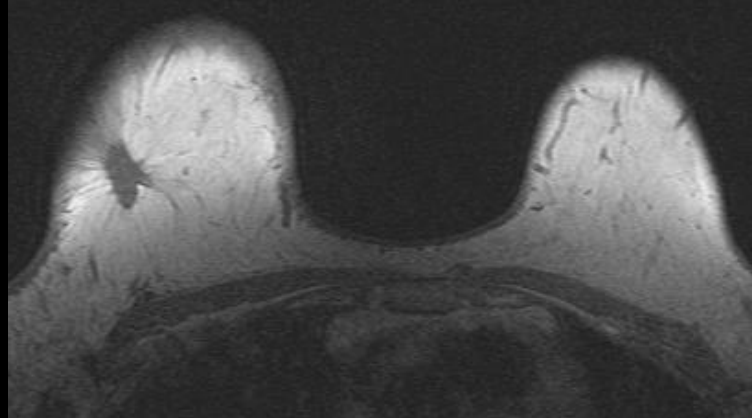
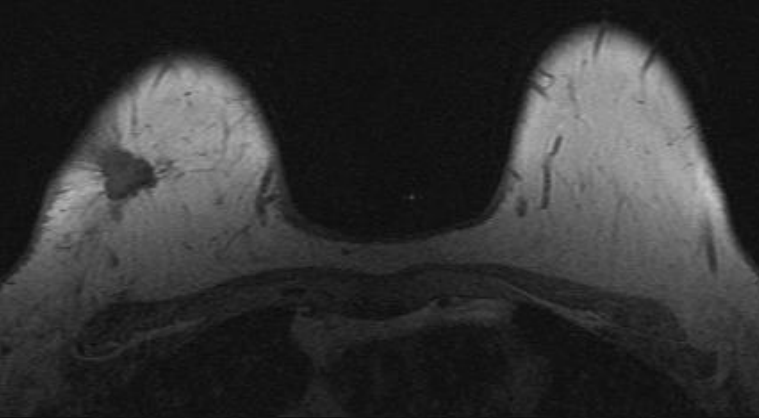


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- Preoperative: „Rule out“ multifocal / multicentric growth of carcinoma prior to planned breast conserving therapy (especially by dense breasts and invasive lobular carcinoma)
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- Carcinoma of unknown region
- High risk

Neoadjuvant chemotherapy

- The size can be measured clinically, mammographically and by ultrasound
- MRI can be used to control the effect of the therapy
- MRI of the breast shows the best correlation between preoperative measured and histologically measured size



46 yo
patient with
IDC G3
infiltrating
the skin
(cT4bN1biv
M1).

Indications

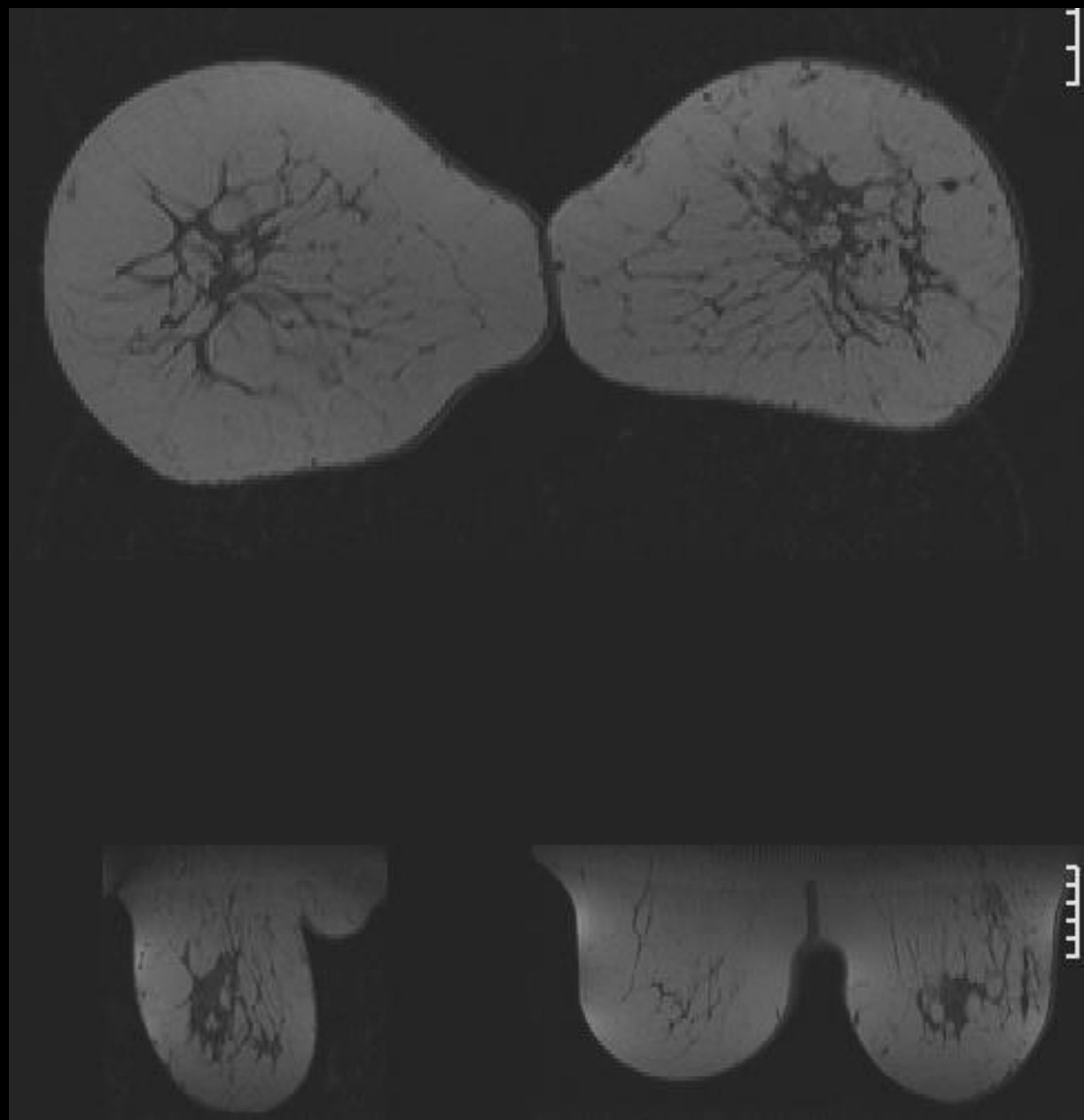
- Preoperative: „Rule out“ multifocal / multicentric growth of carcinoma prior to planned breast conserving therapy (especially by dense breasts and invasive lobular carcinoma)
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Carcinoma of unknown primary

- Usually axillary lymph node metastasis, but also i.e. bone- or liver metastasis
- Clinical examination, mammography, ultrasound
- > 99% of the carcinomas in the breast are found
- MRI of the breast will find around 80% of the remaining breast carcinomas

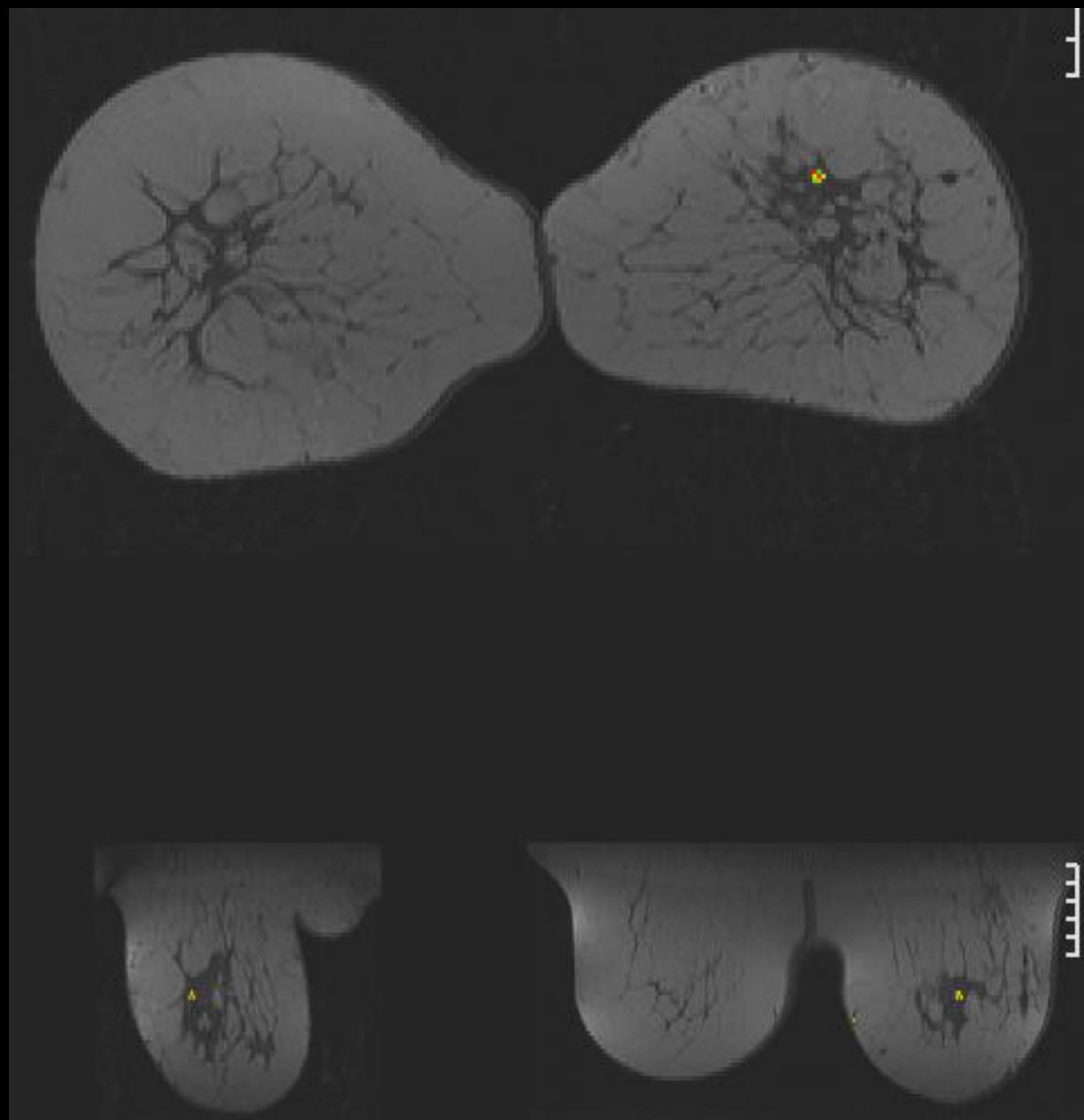
Axillary lymph node
metastasis on the left
side.

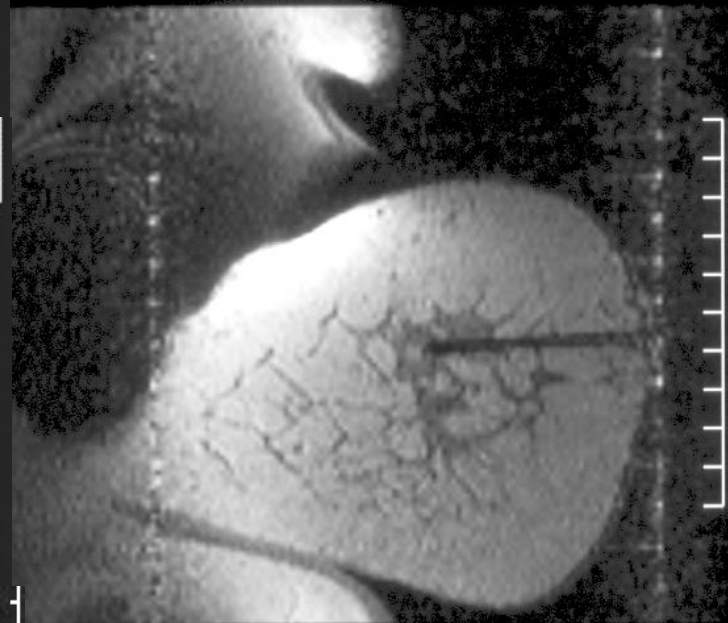
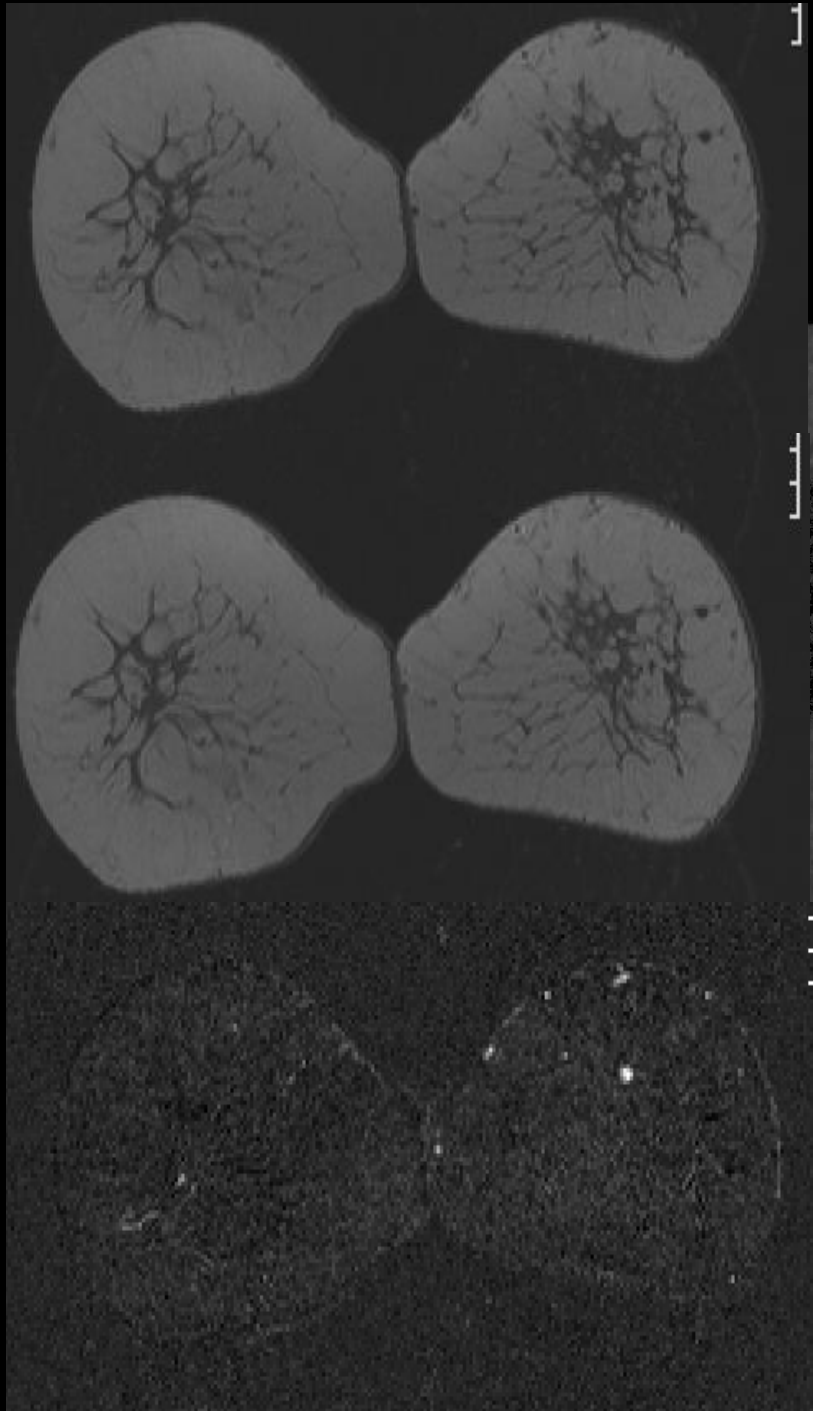
No signs of malignancy
by clinical examination,
mammography and
ultrasound.



Axillary lymph node
metastasis on the left
side.

No signs of malignancy
by clinical examination,
mammography and
ultrasound.

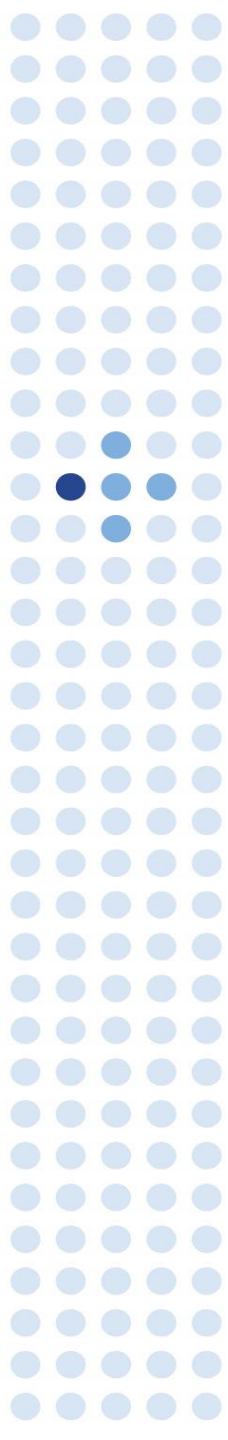




SP -5.6

MRI-guided needle
localization.

5 mm invasive ductal
carcinoma



One of the few times one gets
happy by diagnosing a
carcinoma of the breast 😊



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Efficacy of MRI and Mammography for Breast-Cancer Screening in Women with a Familial or Genetic Predisposition

Mieke Kriege, M.Sc., Cecile T.M. Brekelmans, M.D., Ph.D., Carla Boetes, M.D., Ph.D., Peter E. Besnard, M.D., Ph.D., Harmine M. Zonderland, M.D., Ph.D., Inge Marie Obdeijn, M.D., Radu A. Manoliu, M.D., Ph.D., Theo Kok, M.D., Ph.D., Hans Peterse, M.D., Madeleine M.A. Tilanus-Linthorst, M.D., Sara H. Muller, M.D., Ph.D., Sybren Meijer, M.D., Ph.D., Jan C. Oosterwijk, M.D., Ph.D., Louk V.A.M. Beek, M.D., Ph.D., Rob A.E.M. Tollenaar, M.D., Ph.D., Harry J. de Koning, M.D., Ph.D., Emiel J.T. Rutgers, M.D., Ph.D., and Leo F.M. Klus, M.D., Ph.D., for the Magnetic Resonance Imaging Screening Study Group

Screening with magnetic resonance imaging and mammography of a UK population at high familial risk of breast cancer: a prospective multicentre cohort study (MARIBS)

MARIBS study group*

VOLUME 28 · NUMBER 9 · MARCH 20 2010

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT



Lancet 2005; 365: 1769-78

Prospective Multicenter Cohort Study to Refine Management Recommendations for Women at Elevated Familial Risk of Breast Cancer: The EVA Trial

Christiane Kuhl, Stefanie Weigel, Simone Schrading, Birke Arand, Heribert Bieling, Roy König, Bernd Tombach, Claudia Leutner, Andrea Rieber-Brambs, Dennis Nordhoff, Walter Heindel, Maximilian Reiser, and Hans H. Schild

Multicenter Comparative Multimodality Surveillance of Women at Genetic-Familial High Risk for Breast Cancer (HIBCRIT Study): Interim Results¹

Purpose:

To prospectively compare clinical breast examination (CBE), mammography, ultrasonography (US), and contrast material-enhanced magnetic resonance (MR) imaging for screening women at genetic-familial high risk for breast cancer and report interim results, with pathologic findings as standard.

Francesco Sardanelli, MD
Franca Podo, DrSci
Giuliano D'Agnolo, PhD
Arduino Verdecchia, DrSci
Mariano Santaquilani, Tech Eng
Renato Musumeci, MD
Giovanna Trecate, MD

Mammography, Breast Ultrasound, and Magnetic Resonance Imaging for Surveillance of Women at High Familial Risk for Breast Cancer

Christiane K. Kuhl, Simone Schrading, Claudia C. Leutner, Nuschin Morakabati-Spitz, Eva Wardelmann, Rolf Fimmers, Walther Kuhn, and Hans H. Schild

The Breast (2007) 16, 367-374



THE BREAST

www.elsevier.com/locate/breast

ORIGINAL ARTICLE

Sensitivity of MRI versus conventional screening in the diagnosis of BRCA-associated breast cancer in a national prospective series[☆]

Anne I. Hagen^a, Kjell Arne Kvistad^b, Lovise Maehle^c, Marit Muri Holmen^d, Hildegunn Aase^e, Bodil Styr^f, Anita Vabø^c, Jaran Apold^g, Per Skaane^h, Pål Møller^{c,*}

ORIGINAL ARTICLE

Multicenter Surveillance of Women at High Genetic Breast Cancer Risk Using Mammography, Ultrasonography, and Contrast-Enhanced Magnetic Resonance Imaging (the High Breast Cancer Risk Italian 1 Study)

Final Results

Francesco Sardanelli, MD,* Franca Podo, DrSci,† Filippo Santoro, DrSci,† Siranoush Manoukian, MD,‡ Silvana Bergonzi, MD,§ Giovanna Trecate, MD,¶ Daniele Vergnaghi, MD,¶ Massimo Federico, MD,|| Laura Cortesi, MD,|| Stefano Corcione, MD,** Sandro Morassut, MD,†† Cosimo Di Maggio, MD,‡‡ Anna Cilotti, MD,§§ Laura Martincich, MD,¶¶ Massimo Calabrese, MD,||| Chiara Zucchi, MD,*** Lorenzo Preda, MD,††† Bernardo Bonanni, MD,‡‡‡ Luca A. Carbonaro, MD,* Alma Contegiacomo, MD,§§§ Pietro Panizza, MD,¶¶¶ Ernesto Di Cesare, MD,|||| Antonella Savarese, MD,**** Marcello Crecco, MD,†††† Daniela Turchetti, MD,‡‡‡‡ Maura Tomatti, MD,§§§§ Paolo Belli, MD,¶¶¶¶ and Alessandro Del Maschio, MD,¶¶¶¶ for the High Breast Cancer Risk Italian 1 (HIBCRIT-1) Study

Radiology



Stavanger Universitetssjukehus
Helse Stavanger HF

Study overview

| Study | n | Ca. | IVC | | Sensitivity [%] | | | PPV [%] | | |
|-------------------------|-----------|-----|-----|-----|-----------------|----|----|---------|----|----|
| | | | n | [%] | MX | US | MR | MX | US | MR |
| Kriege ¹ | 1909/4169 | 45 | 4 | 9 | 40 | - | 71 | 72 | - | 57 |
| Warner ² | 236*/457 | 22 | 1 | 5 | 36 | 33 | 77 | 89 | 29 | 46 |
| Leach ³ | 649/1881 | 35 | 2 | 6 | 40 | - | 77 | - | - | - |
| Kuhl ⁴ | 529/1452 | 43 | 1 | 2 | 33 | 40 | 91 | 24 | 11 | 50 |
| Hagen ⁵ | 491*/867 | 21 | 2 | 10 | 50** | - | 86 | - | - | - |
| Riedl ⁶ | 327/672 | 27 | 2 | 7 | 50 | 43 | 86 | 36 | 43 | 19 |
| Kuhl ⁷ | 687/869 | 27 | | 0 | 33 | 37 | 93 | 39 | 36 | 48 |
| Sardanelli ⁸ | 501/1592 | 52 | 3 | 6 | 50 | 52 | 91 | 71 | 62 | 56 |

* Mutation carriers only

** Combined with ultrasound if clinical indicated

1) NEJM 2004; 351:427-37

2) JAMA 2004; 292:1317-25

3) Lancet 2005; 365:1769-78

4) J Clin Oncol 2005;23:8469-76

5) Breast 2007; 16:367-74

6) Clin Cancer Res 2007; 15:6144-52

7) J Clin Oncol 2010; 28:1450-57

8) Invest Radiol 2011; 46:94-105

Study-differences

- Sample size
- Number of screening events
- Number of detected cancers
- Lifetime risk
- Age
- Single- or multicenter setting
- Clinical breast examination and ultrasound
- Exclusion of high-risk women with previous breast cancer
- BI-RADS 3: Positive or negative finding

| Study | n | Ca. | IVC n [%] | Sensitivity[%] | | | PPV [%] | | |
|------------------------|-----------|-----|--------------|----------------|----|----|---------|----|----|
| | | | | MX | US | MR | MX | US | MR |
| Kriege ¹ | 1909/4169 | 45 | 4 9 | 40 | - | 71 | 72 | - | 57 |
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High risk screening studies

Despite heterogeneity in the studies, results have been remarkably consistent with sensitivity of MRI between 71% – 93% and 33% - 50% for mammography

| Study | n | Ca. | IVC n [%] | Sensitivity[%] | | | PPV [%] | | |
|------------------------|-----------|-----|--------------|----------------|----|----|---------|----|----|
| | | | | MX | US | MR | MX | US | MR |
| Kriege ¹ | 1909/4169 | 45 | 4 9 | 40 | - | 71 | 72 | - | 57 |
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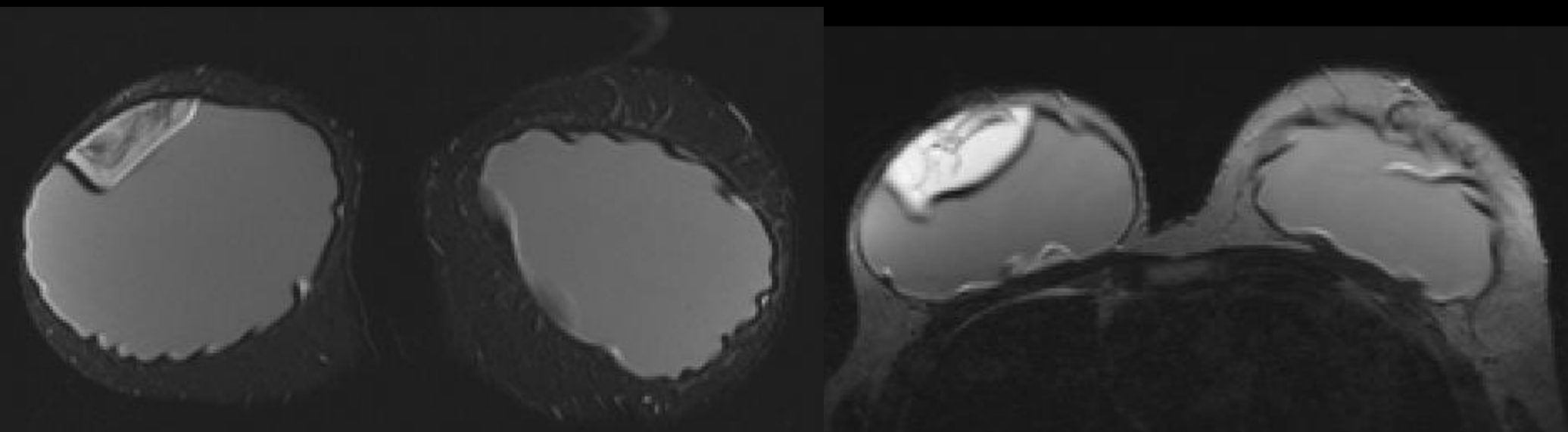




Rapaälv, Sverige

Optional indications

- Discordant findings by imaging and minimal invasive biopsy results
- Screening of women with silicone implants and implant rupture evaluation





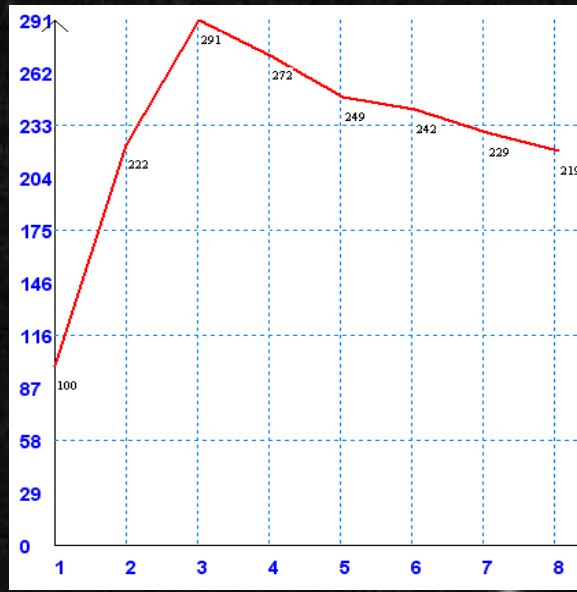
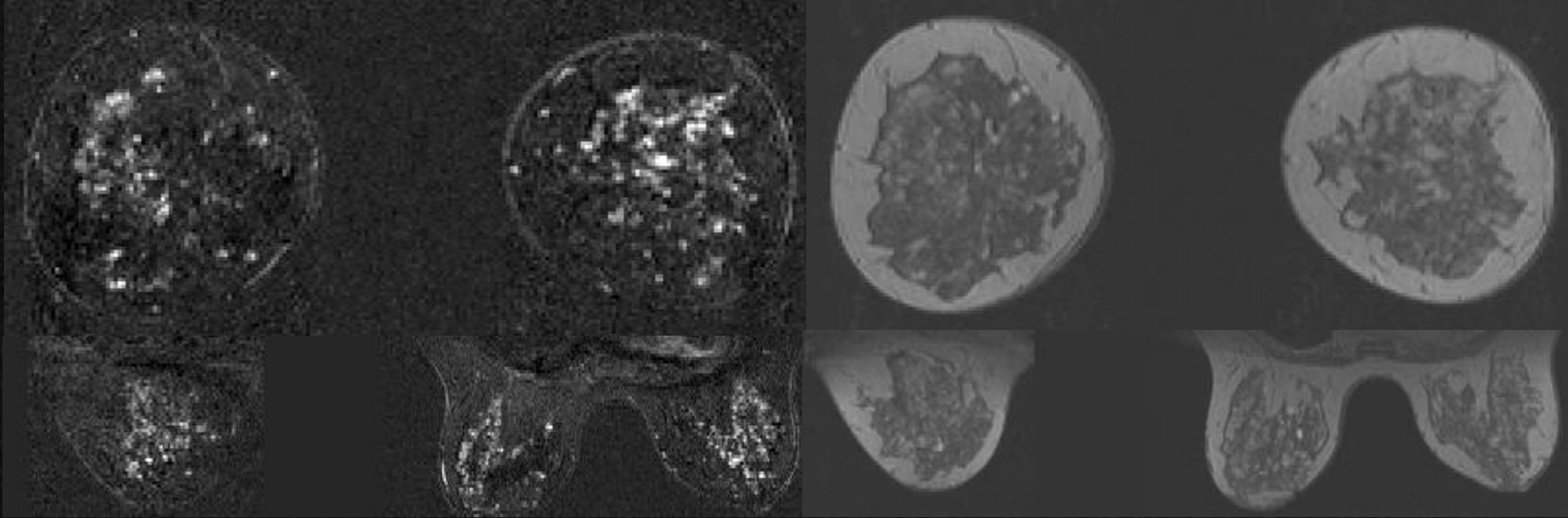
Rio negro, Brasil

When is MRI of the breast not expedient?

- Without good indication (to expensive, to many false positives)
- First line examination of palpable masses
- By hormone replacement treatment
- In the wrong phase of the menstrual cycle
- Soon after operations, by or soon after radiation treatment only in special cases



Starry sky



Contraindications / difficulties

- Contraindications against gadolinium containing contrast agent or MR
 - i.e. renal insufficiency, allergy, pregnancy
- Pacemaker, cochlea implant
- Magnetic expanders
- Claustrophobia, difficulty with prone positioning
- Adipositas per magna



Fremtidsperspektiver

- Diffusjonsvektet serie. Kontrastløs MR mamma. Screening? DCIS er allerede vist at en ser det bedre på MR mamma enn ved Mammografi og ultralyd (Kuhl CK, Lancet 2007)
- Enda bedre oppløsning => Bedre spesifisitet
- Mer av det!!



Summary

- MRI is a useful diagnostic tool by special indications.



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