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Multimodal Diagnostics in Breast Cancer Screening

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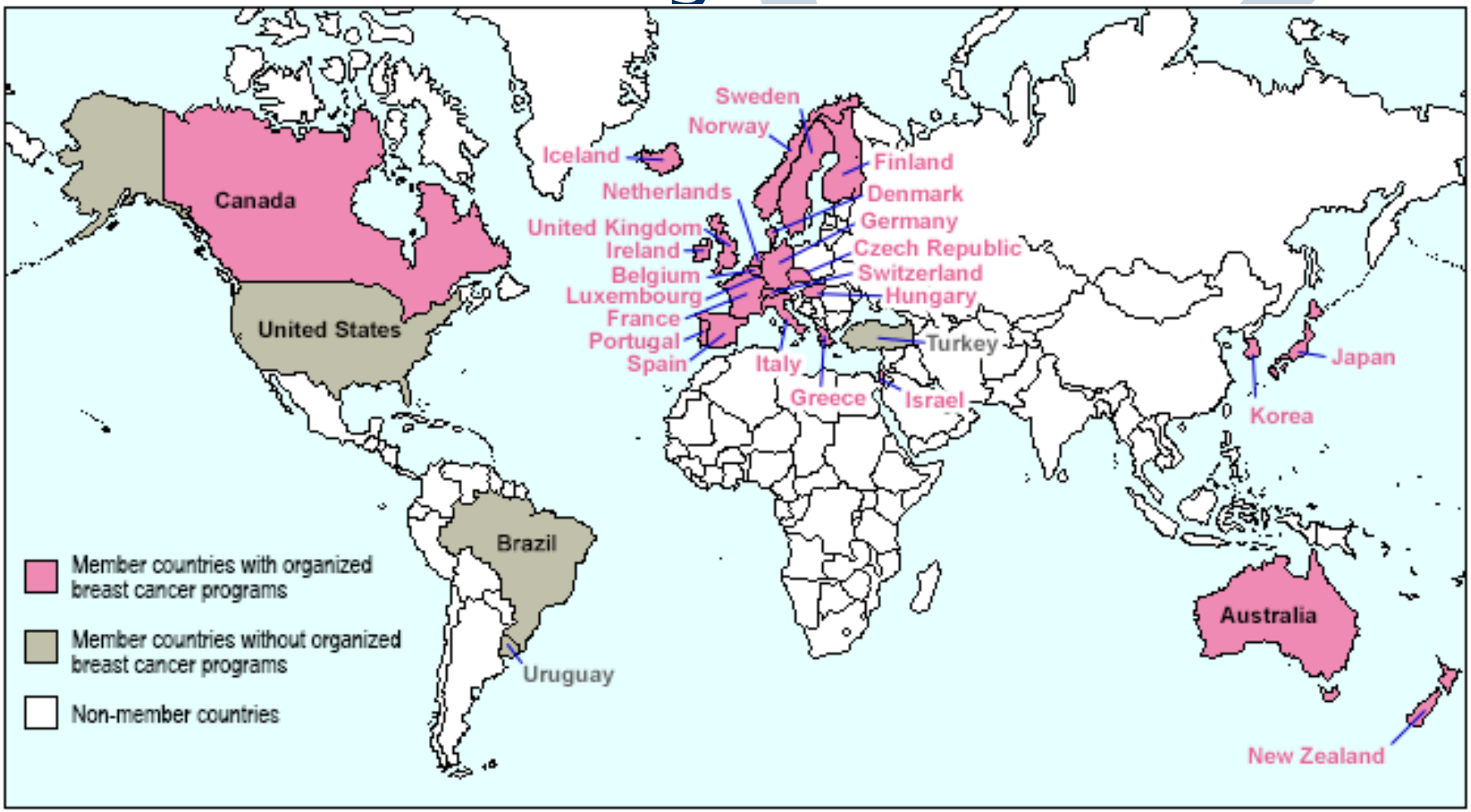
Breast Cancer Screening

- Mammography
  established method for women with average breast cancer risk in age group (40)-50 to 70-(75) years
- MRI
  for high (genetic) risk from 25 years to 50-(60) years

Organized mammography screening world wide



from: International Cancer Screening Network, January 2015

Sensitivity of Mammography in Screening

Region	IR / 10.000*** (C50+D05)	relat.ICA-Rate (von IR) 0-11 Mon. nach Sc.	relat.ICA-Rate (von IR) 12-23 Mon. nach Sc.	relat.ICA-Rate (von IR) 0-23 Mon. nach Sc.
NDS*	32,0	22,5%	55,6%	**39,1%**
NRW**	28,4	26,7%	54,2%	**40,4%**
Zielwerte EU-LL		<30%	<50%	**(<40%)**

Lit: I. Urbschat, O. Heidinger. Ermittlung der Rate von Intervallkarzinomen im deutschen Mammographie-Screening-Programm mit Hilfe epidemiologischer Krebsregister. Bundesgesundheitsblatt, Januar 2014

- European Guidelines:
  - Interval carcinoma
    - < 30% of background incidence in first year
    - < 50% of background incidence in second year

  Even in a quality assured mammography screening program 40% of cases may not be detected by the screening program

Reasons for Moderate Sensitivity

- Fast growth of some breast cancers
  - Demands shorter intervals
    - Effect very limited [1]
- Masking by dense breast tissue
  - Improved mammography technique
    - Digital mammography
      - Detection increased in dense tissue [2]
    - Tomosynthesis
      - Detection increased overall by ~ 30 % [3,4,5]
- Mammography with tomosynthesis has the potential to reduce interval carcinoma rates significantly

Other modalities to increase sensitivity

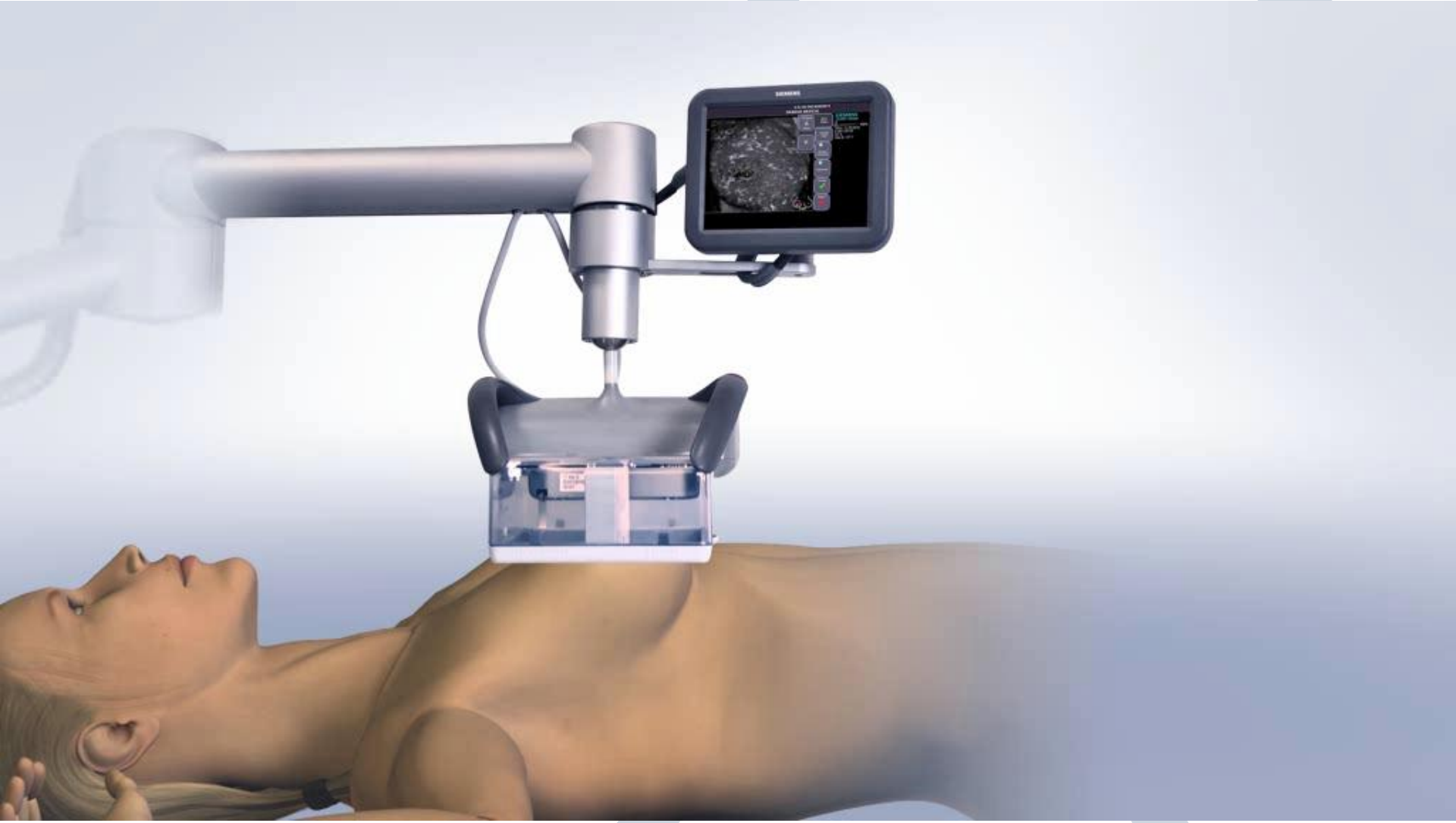
- MRI
  - Most sensitive method
  - Data on screening of normal risk women not available
  - Not adequate for general population screening (contrast media necessary, low specificity, high cost, more reading time)
- Ultrasound
  - Not hampered by dense tissue
  - In population of elevated risk cancer detection increased by ~ 50% [1]
  - Not cost efficient in population of average breast cancer risk [2]

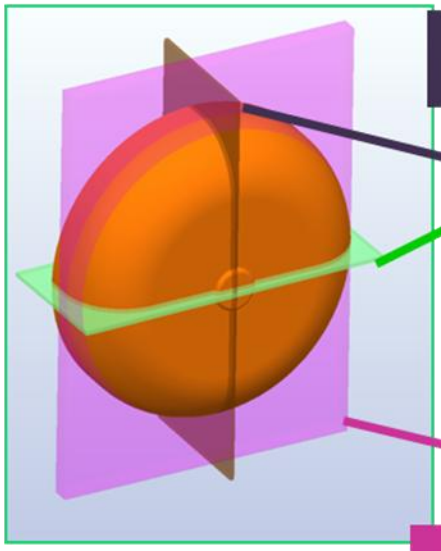
1 Berg et al JAMA 2012, 2 Sprague et al Ann Int Med 2015

Drawbacks of conventional ultrasound

- Handheld method is:
  - Time consuming (15 min of expert time per case)
  - Difficult to standardize
  - Full documentation not possible (no retrospective evaluation/second opinion possible)
  - High number of false positive biopsies

*A*utomated *B*reast *V*olume *S*can
A way to overcome limitations of handheld US?

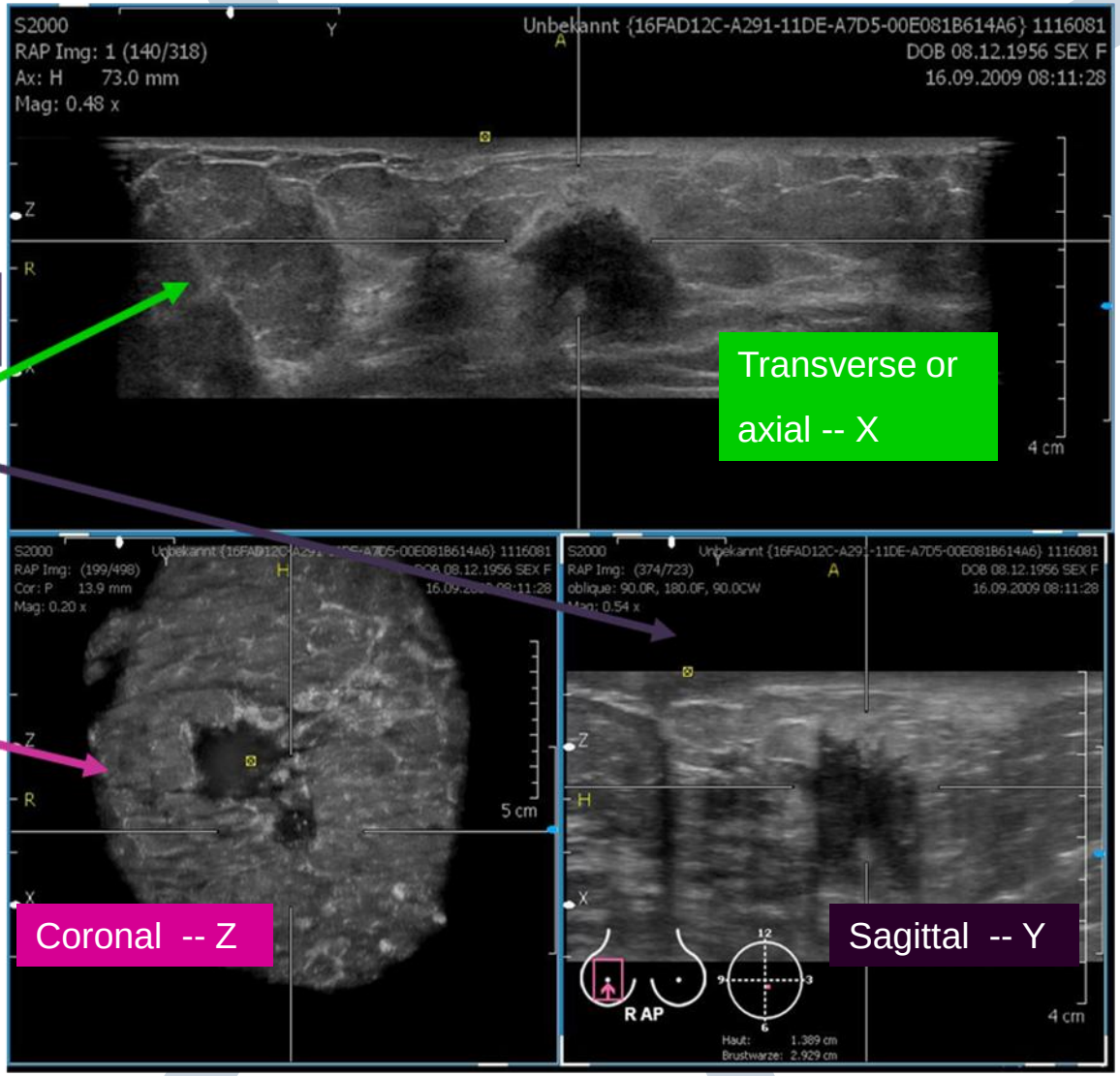




Sagittal

Axial

Coronal



ABVS – Study

Golatta M et al, 2014

Results: Applicability (Scan and evaluation time)

Time of examination: 4 – 21 min → mean 11 min

Time for data evaluation: 1 – 14 min → mean 5,5 min

The duration of data evaluation differed according to the number of acquired scans per patient and the number of lesions described.

ABVS - Studies

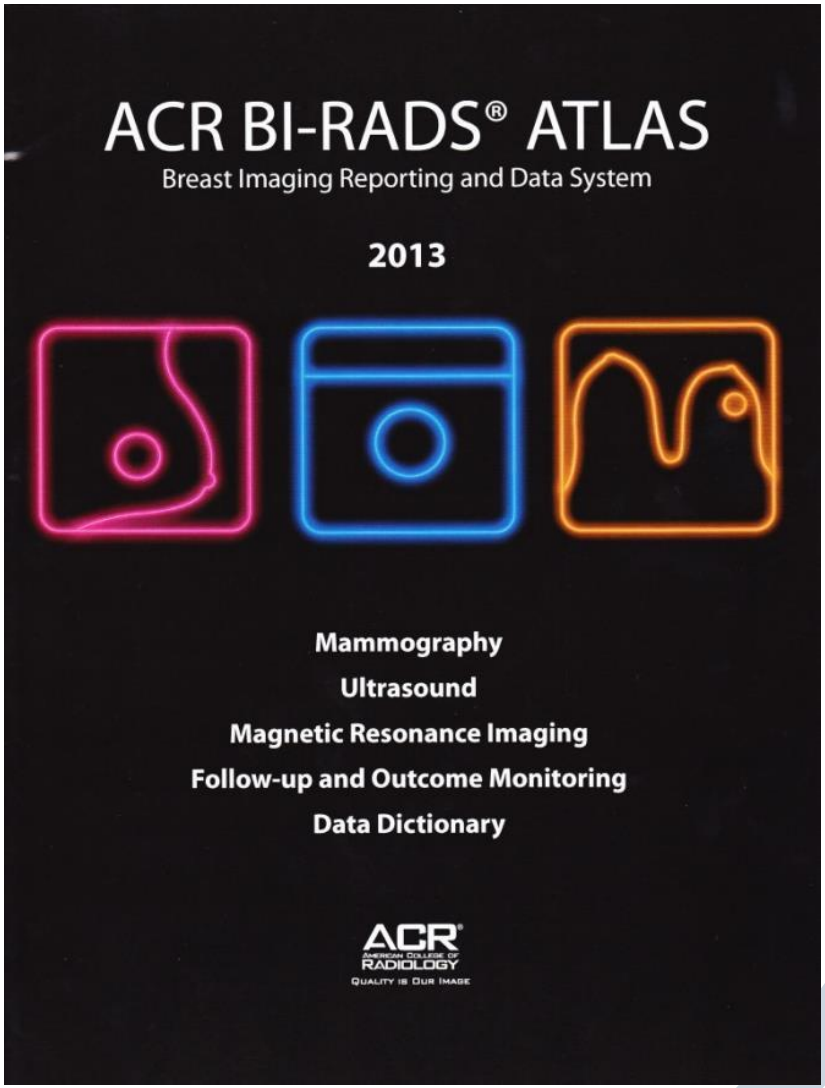
The development of ABVS seems to be a diagnostic method with good interobserver reproducability and sensitivity, in comparison to HHUS

Golatta M, et al. Interobserver reliability of automated breast volume scanner (ABVS) interpretation and agreement of ABVS findings with hand held breast ultrasound (HHUS), mammography and pathology results. Eur J Radiol (2013)

Wojcinski S, Degenhardt F et. al. Diagnostic performance and inter-observer concordance in lesion detection with the automated breast volume scanner (ABVS). BMC Med Imaging. (2013)

Choi WJ et. al. Comparison of automated breast volume scanning and hand- held ultrasound in the detection of breast cancer: an analysis of 5,566 patient evaluations. Asian Pac J Cancer Prev. (2014)

Means to improve specificity and number of false positive biopsies



Elastography

introduced into the new 5th Edition of BIRADS® lexicon

D'Orsi CJ, Sickles EA, Mendelson EB, Morris EA et al. ACR BI-RADS® Atlas,

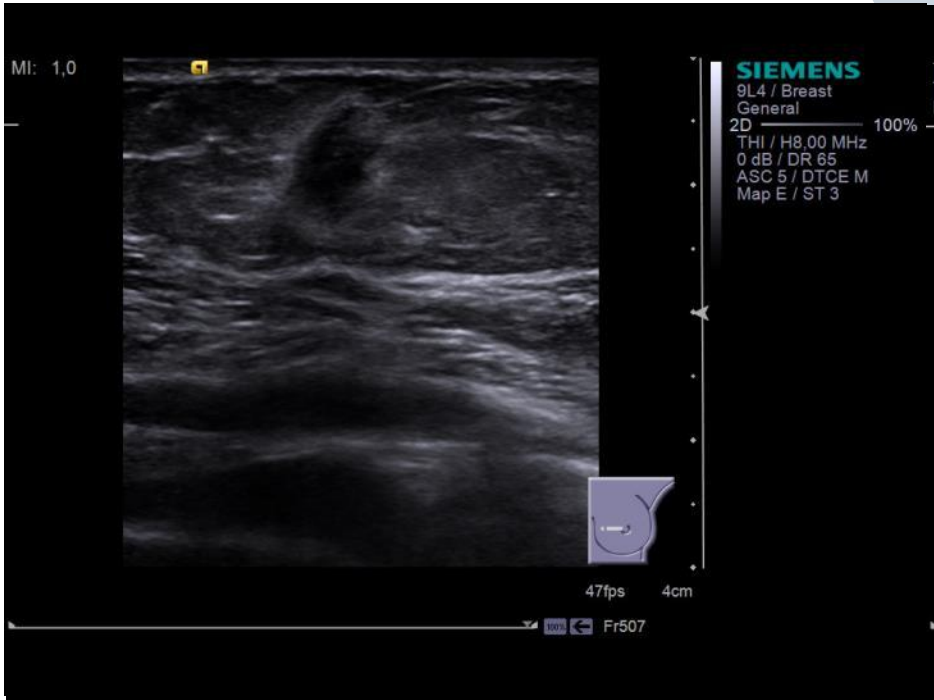
Breast Imaging Reporting and Data System. Reston, VA,

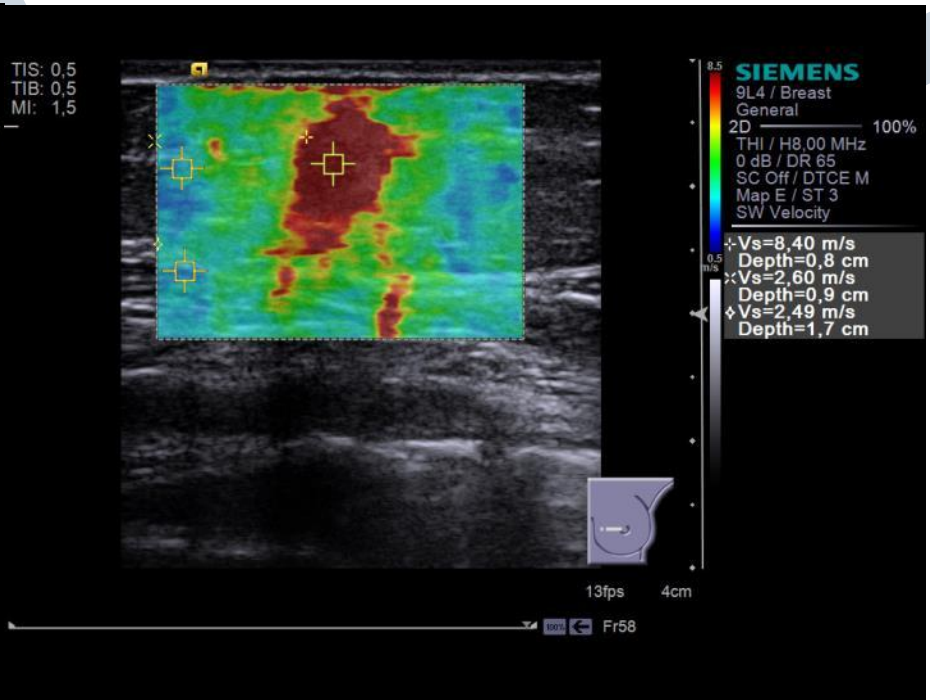
American College of Radiology; 2013

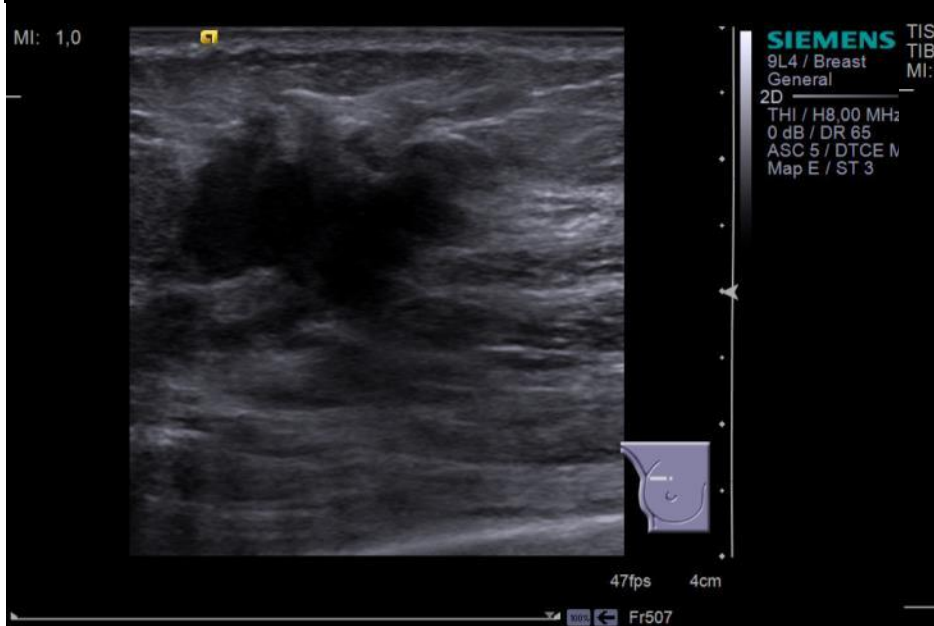
Elastography - VTIQ

VTIQ = Virtual Touch Tissue Imaging Quantification

Examiner independent quantitative elastography technique based on "Shear Wave Velocity Imaging"


MI: 1,0
SIEMENS
9L4 / Breast
General
2D 100%
THI / H8,00 MHz
0 dB / DR 65
ASC 5 / DTCE M
Map E / ST 3
TIS: 0,5
TIB: 0,5
MI: 1,5
47fps 4cm
Fr507


SIEMENS
9L4 / Breast
General
2D 100%
THI / H8,00 MHz
0 dB / DR 65
SC Off / DTCE M
Map E / ST 3
SW Velocity
Vs=8,40 m/s
Depth=0,8 cm
Vs=2,60 m/s
Depth=0,9 cm
Vs=2,49 m/s
Depth=1,7 cm
13fps 4cm
Fr58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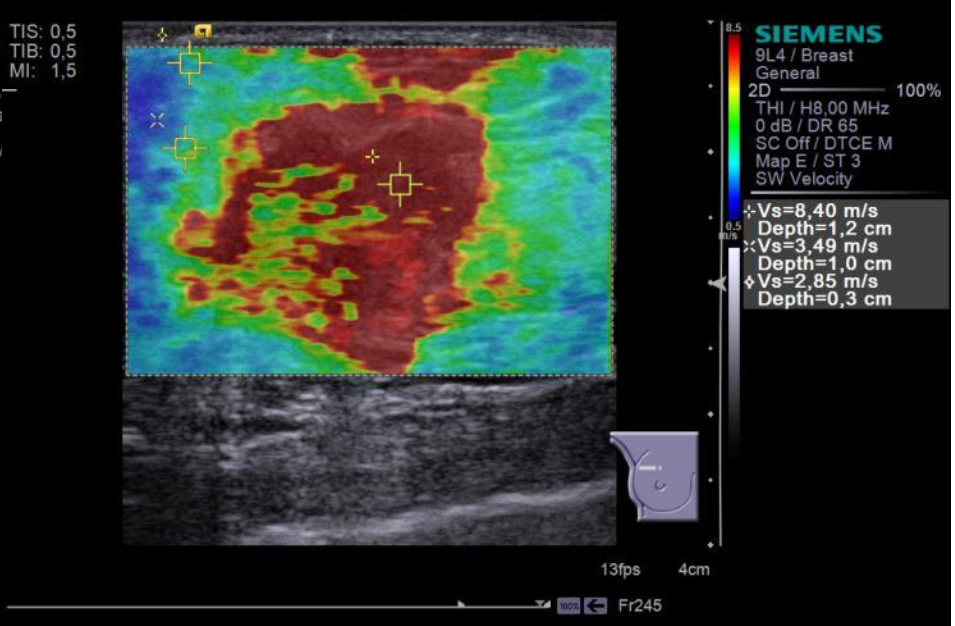
SIEMENS
9L4 / Breast
General
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THI / H8,00 MHz
0 dB / DR 65
SC Off / DTCE M
Map E / ST 3
SW Velocity
Vs=8,40 m/s
Depth=1,2 cm
Vs=3,49 m/s
Depth=1,0 cm
Vs=2,85 m/s
Depth=0,3 cm
13fps 4cm
Fr245

Addition of VTIQ to HHUS

104 breast lesions

	Ultrasound	VTIQ (cut-off 5,18 m/s)	Ultrasound+VTIQ
Sensitivity	100	98	98
Specificity	30	68	82
PPV	61	77	86
NPV	100	97	98
AUC	0,96	0,94	0,98

Comparison of the individual methods and the combination of BIRADS®+VTIQ

Sensitivity→, Specificity ↑, PPV ↑, NPV→ and AUC ↑

Evaluation of Virtual Touch Tissue Imaging Quantification (VTIQ), a new Shear Wave Velocity Imaging Method, for Breast Lesion Assessment by Ultrasound

Golatta M, Schweitzer-Martin M, Harcos A, Schott S, Gomez C, Stieber A, Rauch G, Domschke C, Rom J, Schütz F, Sohn C, Heil J.

Biomed Res Int. 2014;2014:960262. doi: 10.1155/2014/960262. Epub 2014 Mar 31.

Means to reduce reader time in automatically acquired scans: CAD?

By using the CAD system for classification of lesions in automated 3D breast ultrasound, which on its own performed as good as the best readers, the performance of inexperienced readers improved while that of experienced readers remained unaffected.

Evaluation of the effect of computer-aided classification of benign and malignant lesions on reader performance in automated three-dimensional breast ultrasound.

Tan T1, Platel B, Twellmann T, van Schie G, Mus R, Grivegnée A, Mann RM, Karssemeijer N. - Acad Radiol. 2013

Summary

- Technical advances may improve the effectivity of added ultrasound breast cancer screening
- A multimodality approach may become feasibel especially in higher risk populations
- A thorough evaluation of benefits and harms has to be performed before new screening methods are introduced at population level