



UniversityHospital Heidelberg

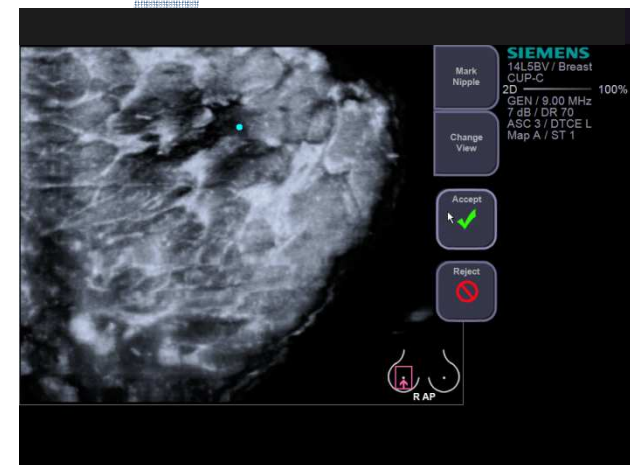
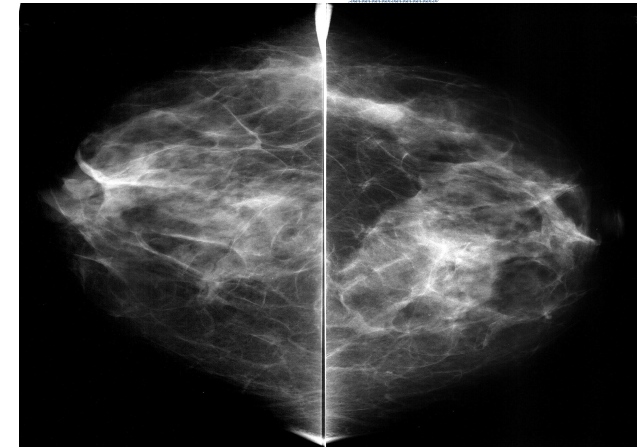
The latest developments - Automated Breast Volume Scanning

Dr. med. M. Golatta



Automated Breast Volume US: Why?

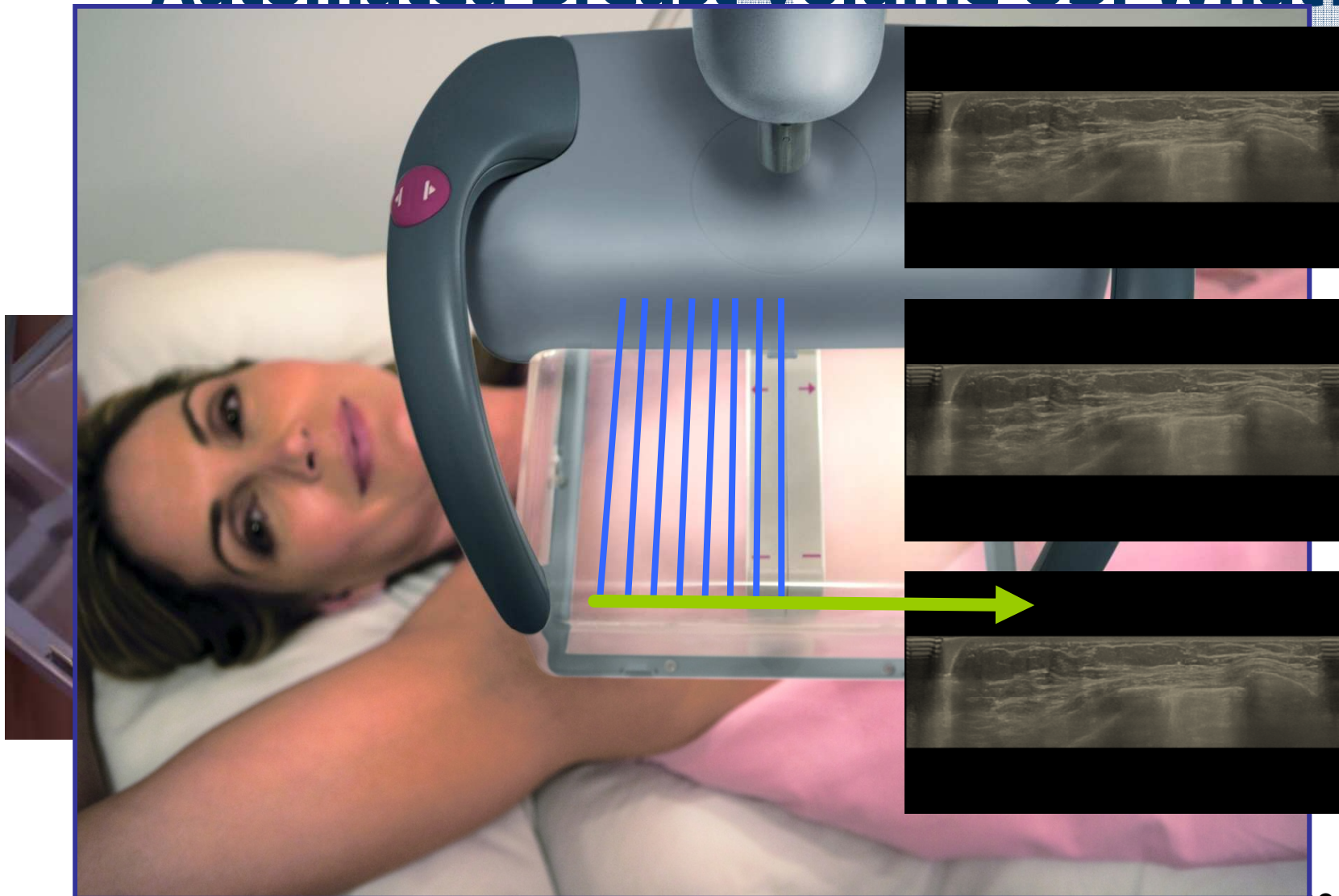
- Mammography is limited in dense breasts: high false negative rate...
- Many of these tumors are detectable with high frequency breast ultrasound...if it is done
- Conventional 2D ultrasound:
 - has a limited field of view
 - requires high level of skill/experience
 - very time consuming
- Conventional US is not suited to general screening and infrequently used even for high risk patients



Kolb et al.: Dense Breasts Mammography misses 50% of cancers
Addition of Ultrasound improves detection to 97%!
Radiology 2002 Oct;225(1):165-75



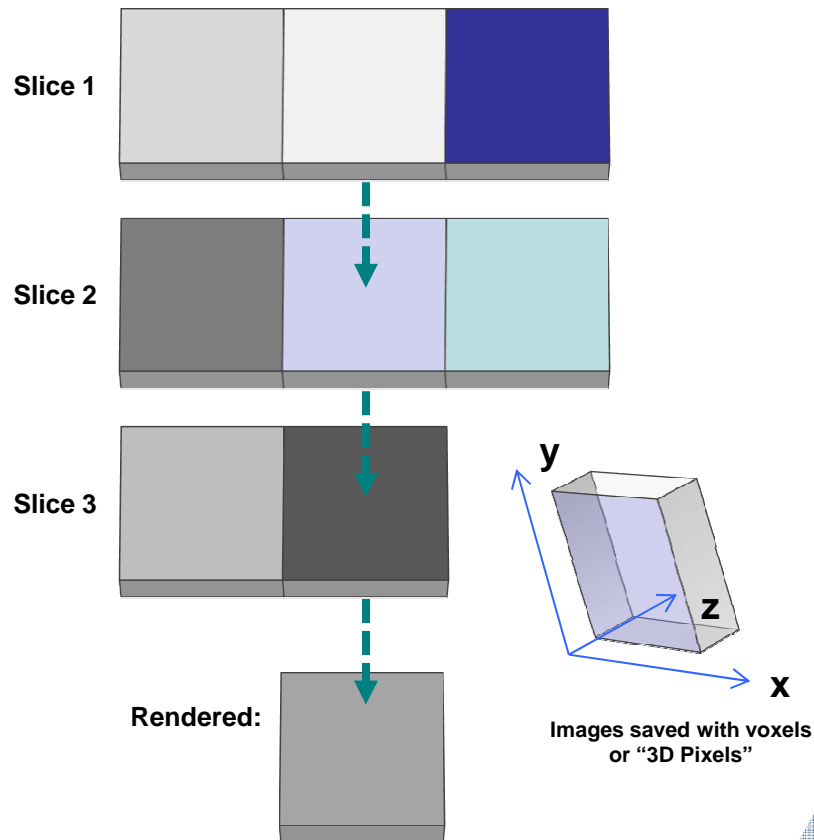
Automated Breast Volume US: What?





Reconstruction

The slices are layered together to form a 3D volume.



3D Volume Rendered: Maximum Intensity Projection



Automated Breast Volume US: What?

- **Automated acquisition of a large number of thin 2D slices to produce a 3D volumetric data set**
- **Not operator dependent; requires little skill for acquisition: More reproducible and standardized;**
- **Can be done at time of Mammography and reviewed later**
→ time shift
- **Transverse linear B-mode acquisition**
Reconstructions by post-processing: sagittal and coronal with 3D navigation rotation, radial, anti-radial, thin or thick slices, multislice tomographic and many other displays
- **3D allows correlation with Mammography, MRI**
- **Preoperative for planning: Supine as on operating table**

ACUSON S2000™ Automated Breast Volume Scanner (ABVS)





Technical Data

	SIEMENS Acuson S2000 ABVS Rev 1.0
Core Image Quality: Line density	1024
Imaging Plate	15,4 x 16,8 cm
Depth setting	4 depth settings (3, 4, 5, 6 cm)
Transducer Frequency Range	6-14 MHz
Presets for Breast Size	Breast cup size selection optimizes imaging
Pressure and locking	Automatic pressure & locking mechanism

• Scan Workstation

- operated by tech, radiographer or nurse



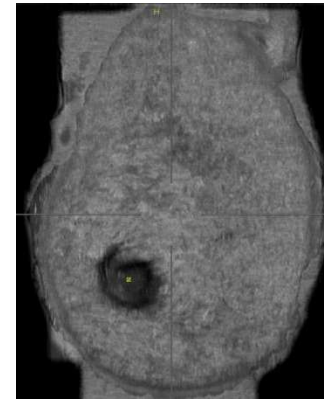
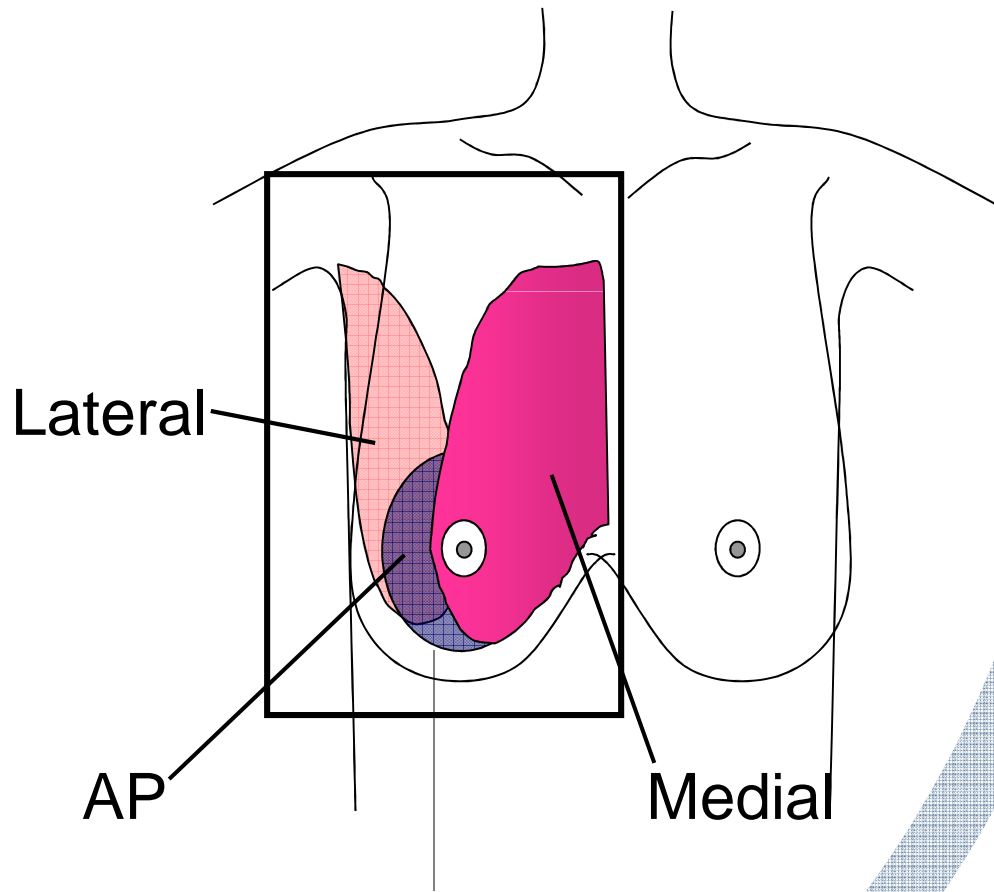
• Reading Workstation

- Diagnose by breast imager
- 3D Data: sagittal, radial, anti-radial view
- Tomographic view
- Cine View

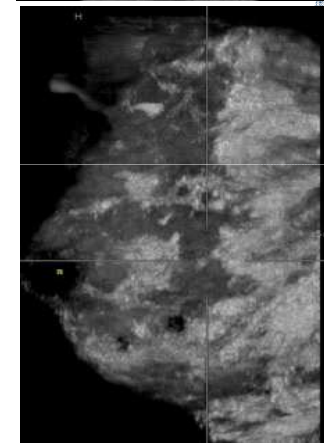




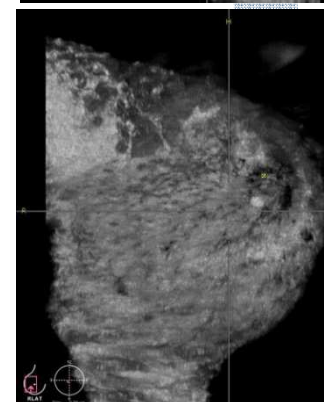
ACUSON S2000 ABVS 3 Common Views



**Frontal
Right**



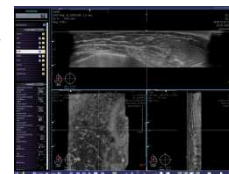
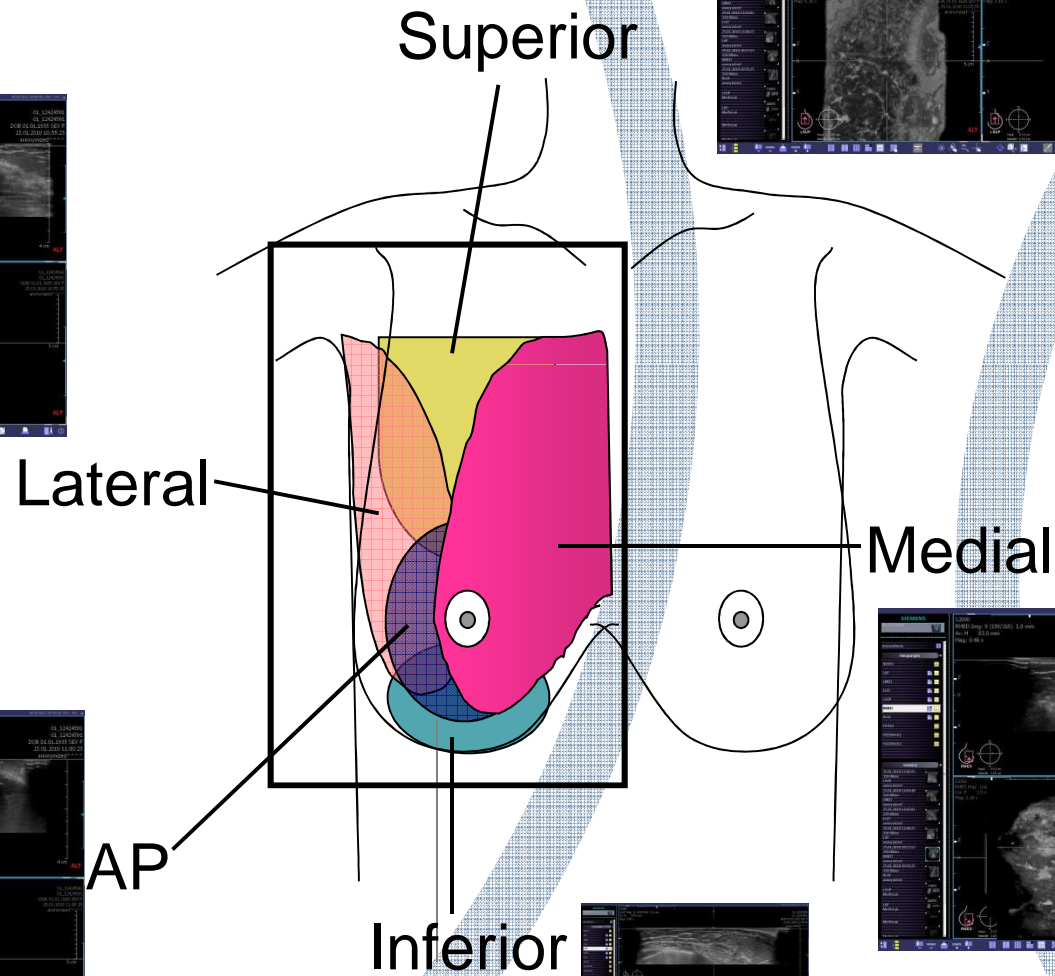
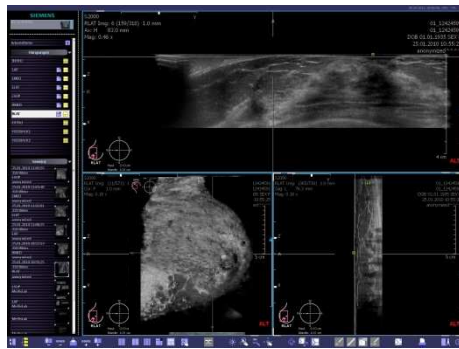
**Medial
Right**

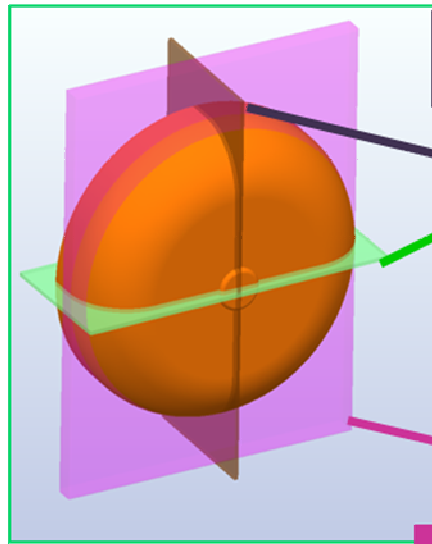


**Lateral
Right**



ACUSON S2000 ABVS 5 Views for Full Coverage

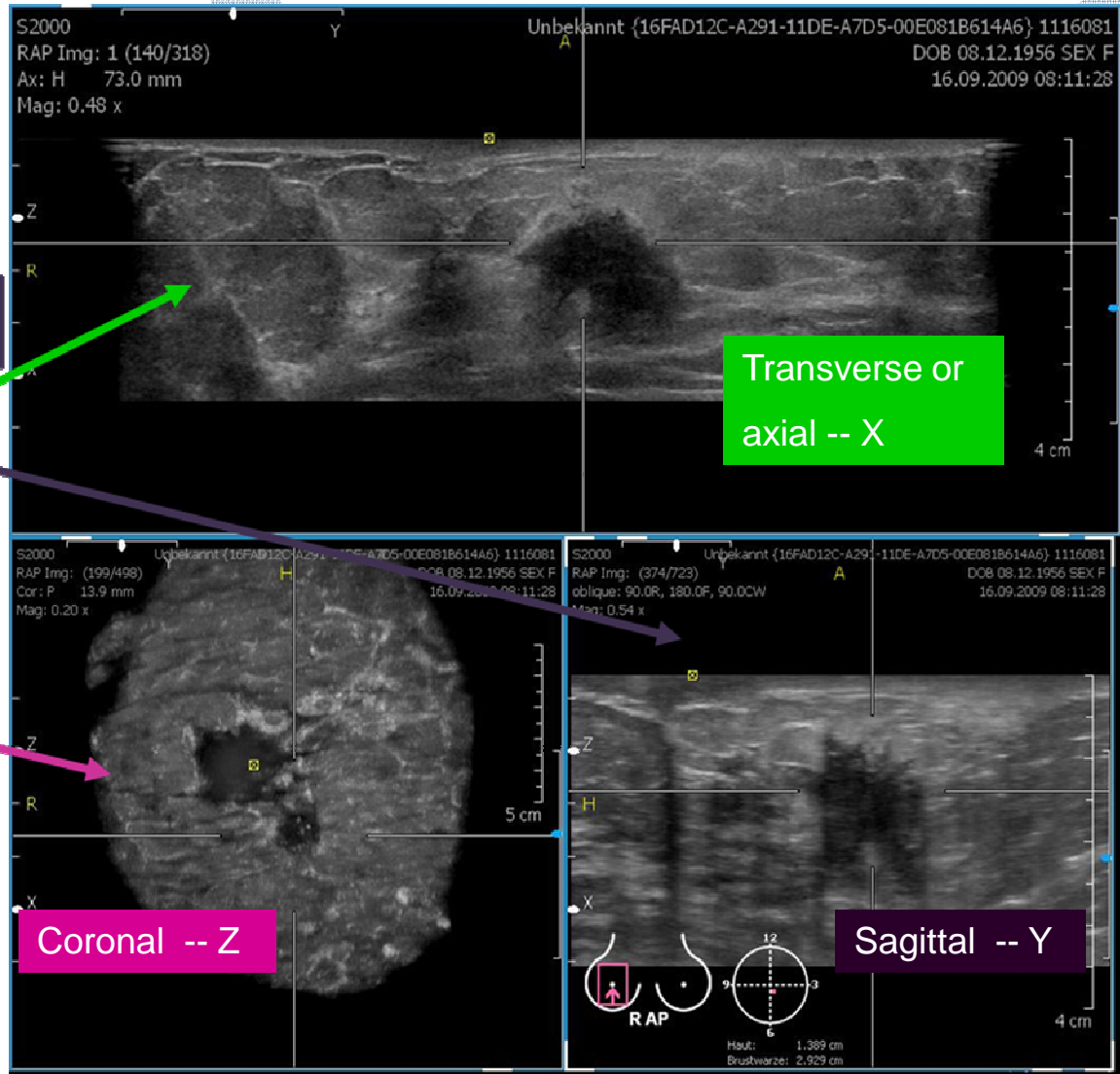




Sagittal

Axial

Coronal



Transverse or axial -- X

Coronal -- Z

Sagittal -- Y

FRIDAY 13
2/13/2009 10:34:50 AM

Work area

Hangings

Study Overview p.1

Study Overview p.2

RAP

RLAT

RLAT (1)

Comparison Space

Series

2/13/2009 11:03:27 AM
Created by ABVS Workpl...

2/13/2009 11:01:09 AM
320 images
RLAT
ACQ-CLIP-

2/13/2009 10:55:40 AM
3 images

2/13/2009 10:53:01 AM
320 images
RLAT
ACQ-CLIP-

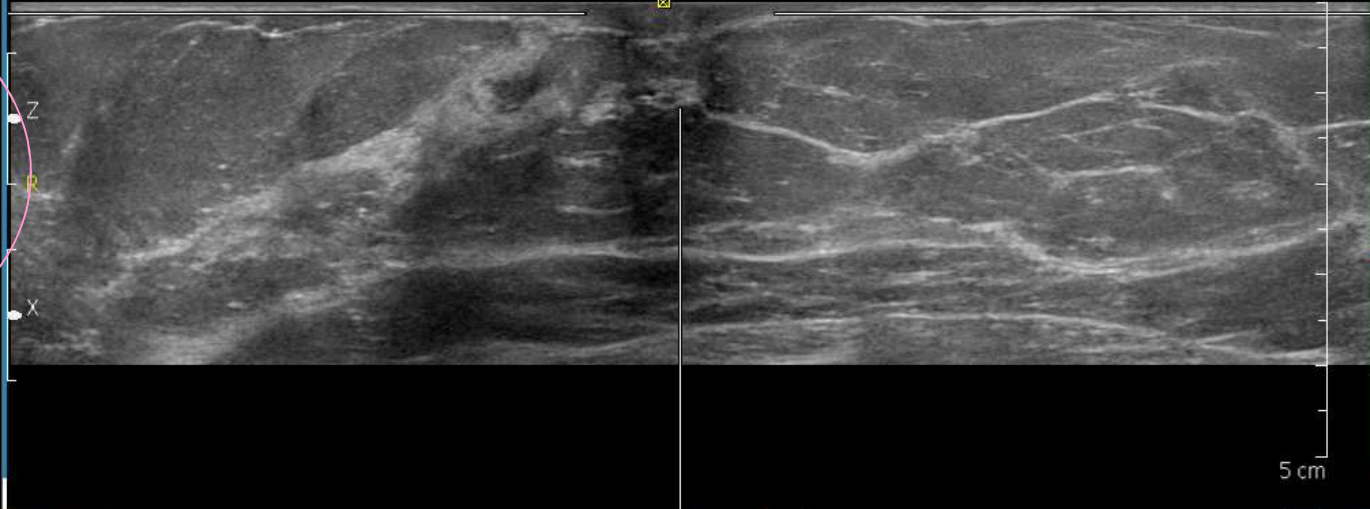
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RAP
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2 images

Reports

BI-RADS US Report
BI-RADS US Report
2/24/2009 5:18:10 PM

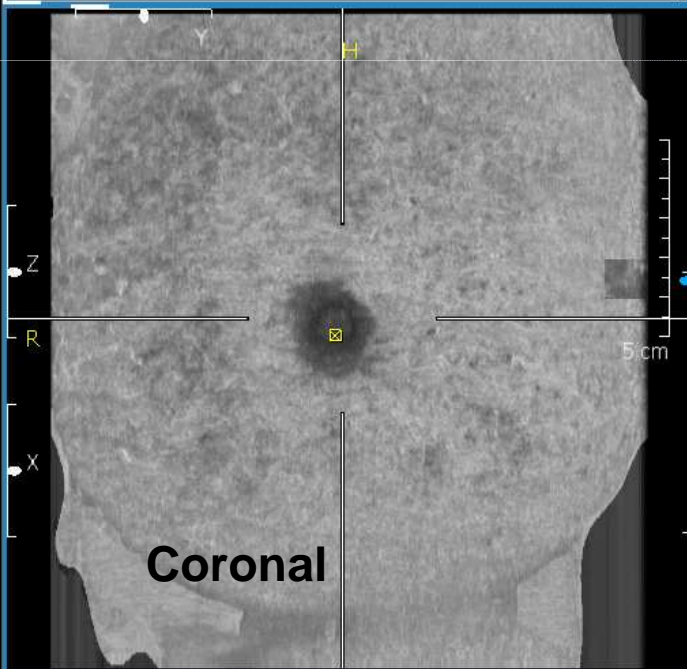
Transverse



Sagittal

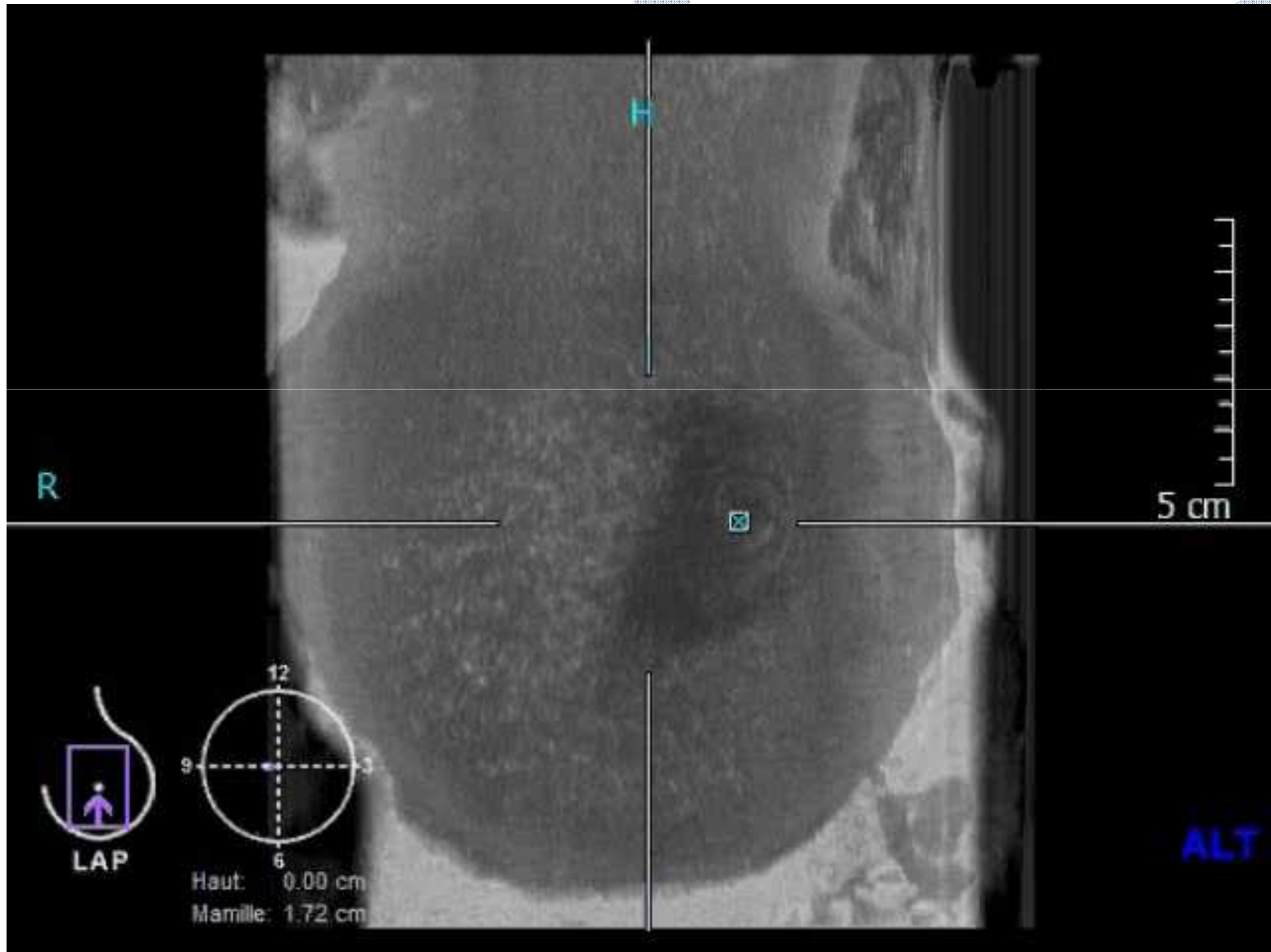


Coronal





The coronal view





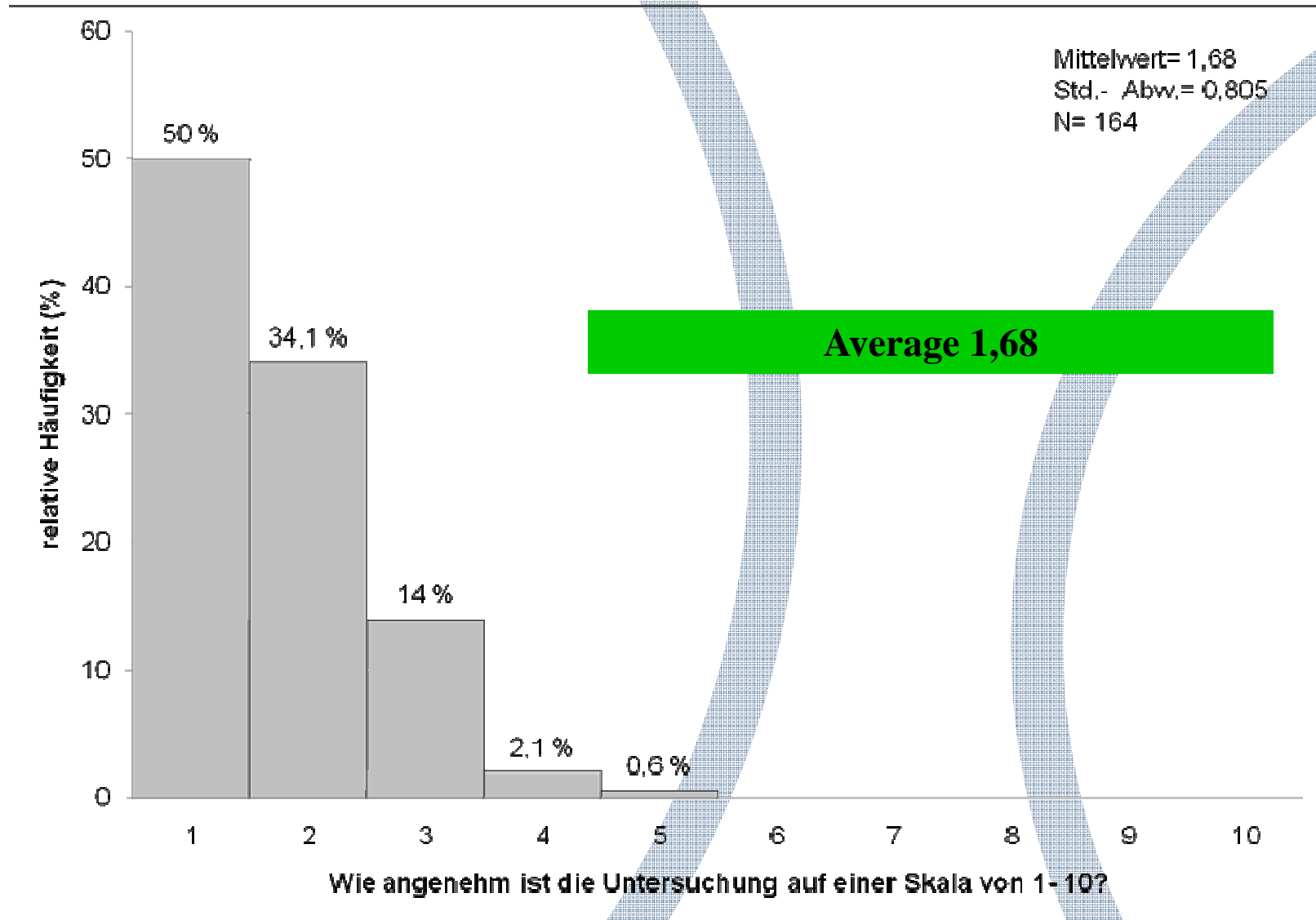
ABVS - Study

Results: Applicability (Patient comfort)

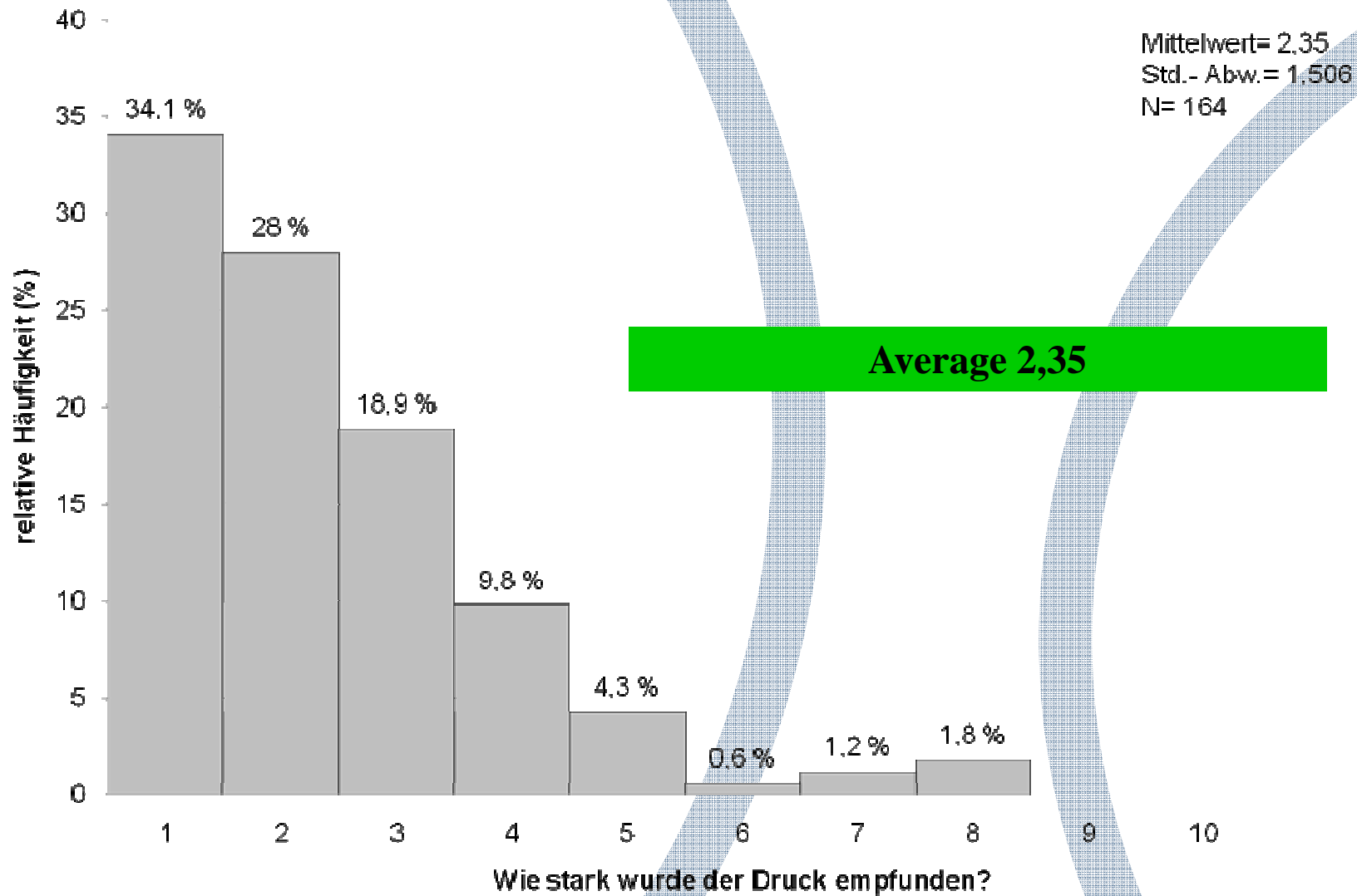
- **How patient friendly is the exam in comparison to handheld US and to Mammography?**

1) On a scale from 1 (comfortable) to 10 (very unpleasant) the patients were asked to give a score.

2) The applied pressure were given on a scale from 1 (low pressure) to 10 (high pressure).



Patient comfort on scale from 1 - 10



Pressure level on a scale from 1 - 10



ABVS Study

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.



		Mean	Minimum	Maximum	Median
ABVS	Exam time	10, 42 Min.	4 Min.	21 Min.	11 Min.
Reading time	Expert (more than 20 years experience in breast diagnostics)	4, 12 Min.	1 Min.	8 Min.	4 Min.
		4, 31 Min.	1 Min.	10 Min.	4 Min.
		5, 29 Min.	2 Min.	9 Min.	5 Min.
	1 – 7 years experience in breast diagnostics	7, 36 Min.	2 Min.	14 Min.	7, 5 Min.
		6, 40 Min.	1 Min.	13 Min.	6 Min.
		6, 60 Min.	2 Min.	12 Min.	7 Min.
			5, 68 Min.	2 Min	11 Min.



ABVS Pilot study - 84 cases

Material and Methods

- 84 cases
- all scans have been analyzed by six senologists
- all lesions have been described according to the BI-RADS
- the results have been compared to the “gold standard” → HHUS, mammography and histology



ABVS Pilot study - 84 cases

Results

- 32 suspicious lesions received histological workup and revealed 19 invasive cancers, one DCIS, 12 benign
- Specificity 58 – 83 %
- Sensitivity 75 – 90 %
- The Kappa coefficient indicated a moderate agreement (0.4) between the BI-RADS categories of ABVS and HHUS
- McNemar – test revealed no significant tendency that one of the methods tends to show opposite results to the other two.



ABVS Pilot study - 84 cases

Conclusion

The ABVS permits the differentiation of benign and malignant lesions with a reproducible moderate to high accuracy in a selected patient population.

The use of the ABVS in clinical daily routine provides the opportunity of time saving and is mainly well accepted by the patients.



Prospect

LECANDUS – Study (LEsion CANDidate Detection in UltraSound Data)

Purpose:

To develop a module prototype for a CAD – System

Materials and Methods:

63 Patients (126 breasts) · ABVS - 2 - 5 scans of each breast

+ HHUS (13.5 MHz), mammography + if indicated core needle biopsy

All exams were analyzed and annotated, before they were evaluated with a prototype blob detector to find lesion candidates.



Prospect

LECANDUS – Study (LEsion CANDidate Detection in UltraSound Data)

Results:

All lesions (32 carcinomas and 13 fibroadenomas) were detected

→ Sensitivity 100 %

On the other hand the positive predictive value is very low, because there is on each scan a very high false positive rate.

Conclusion:

ABVS gives the opportunity to store a data volume, which can be postprocessed and be used by a potential CAD – Software. This study is the first step showing that lesions can be detected with a high sensitivity. Further studies are necessary to evaluate how to reduce the high number of false positive hits.



Conclusion I

- **standardizable and reproducible**
- **User - independent**
- **high quality → comparable sensitivity and specificity to handheld US (Studies still ongoing)**



Conclusion 2

- **ABVS could be used in a screening program in addition to mammography**
- **it's not a substitute for handheld US in general**
- **further studies to evaluate the system are necessary**
- **a CAD – System might be implemented in the future**



**Thank you very much
for your attention!**