

ELECTROIMPEDANCE MAMMOGRAPHY

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**Slovak Republic** 

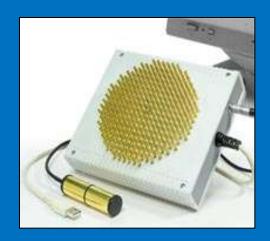


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### **History of mammography**







Model 3

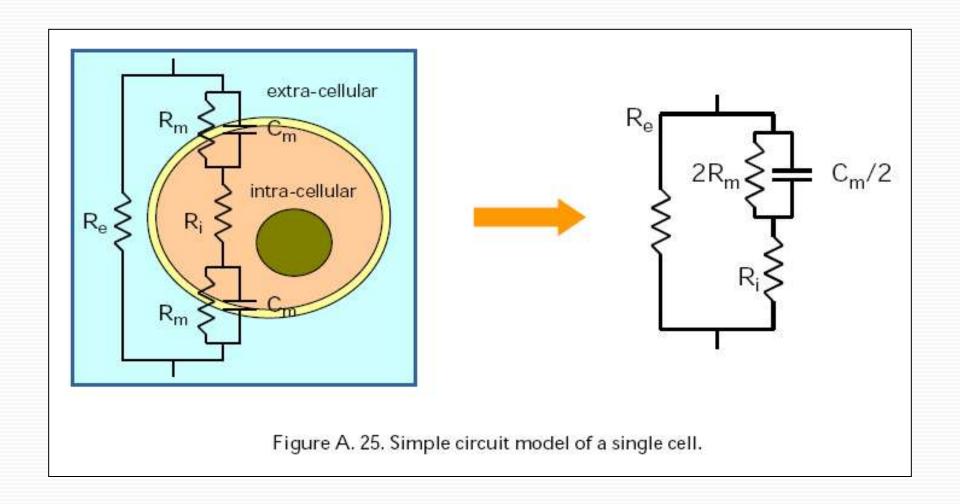


Model 5

The first version of diagnostic instrument was called "electro-impedance computer mammogram EIM 003 KORVET"

Patents RF for the invention Nº 2153285 and Nº 2127075 and patents of the USA Nº 6,167,300 and Nº 6,236,886

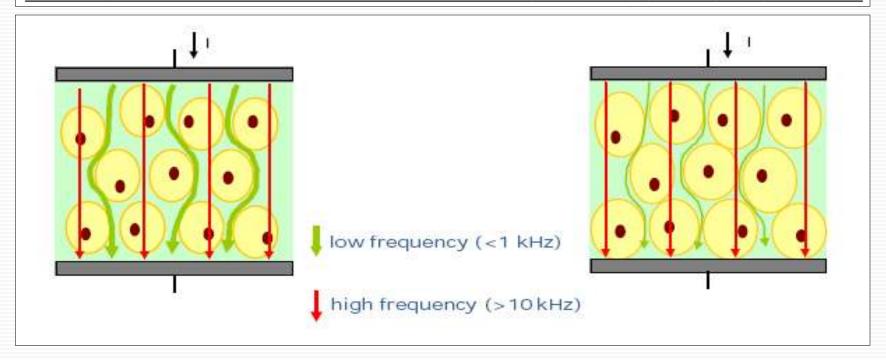
## Simple electrical model of a cell



#### **Electrical characterisation of the materials**

#### **Dielectric properties**

Parameter	Symbols	Units	Equations							
conductivity	σ, κ	S/cm	$Y = G + jB = K(\sigma + j\omega \epsilon);  \sigma = G/K$							
permittivity	ε	F/cm	$Y = G + jB = K(\sigma + j\omega \epsilon);  \epsilon = B/(\omega K)$							
relative permittivity	$\epsilon_{\rm r}$	no units	$\varepsilon_{\rm r} = \varepsilon/\varepsilon_0$							
resistivity	ρ	$\Omega$ .cm	$Z = 1/Y = (R + jX);$ $R = (1/K).\rho;$ $\rho \neq 1/\sigma$							

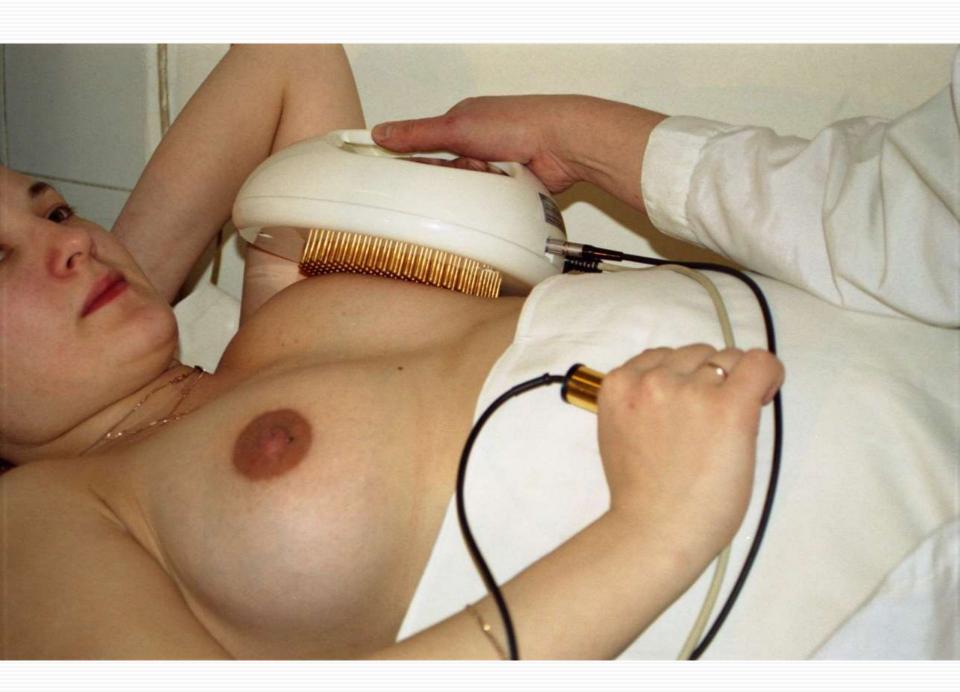


## **Electroconductivity map**

												76	0.69	0.50	0.54	0.56	0.57	0.57	0.52	0.46	0.42	n 39	0.41												
_																-		0.50				_		l	1				ı				ı		I
_					_			0.62	0.00	0.02		<u> </u>	-			-		0.50				<u> </u>	_		0.20	0.20	0.24	_	H						
-														-				0.46									-	_	H						
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			-						-	-		-				-						-	-						-		0.31				
		0.43	0.39	0.32	0.33	030	0.30	0.26	0.25	0.29	0.33	034	0.29	0.30	0.29	0.31	0.31	0.31	034	0.36	0.44	0.49	0.59	0.63	0.67	0.64	0.58	051	0.48	0.45	0.36	0.30	0.28		
		0.46	0.38	0.32	0.31	0.29	0.28	0.28	0.28	0.31	0.33	033	0.31	0.30	033	0.38	0.42	0.41	039	0.37	0.40	0.46	0.54	0.63	88.0	0.71	0.67	0.56	0.55	0.52	0.38	0.28	0.24		
																															0.46				
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.38	0.31	0.29	0.33	0.38	0.48	8 0.0	0.73	0.70	0.61	0.52	0.45	0.42	0.41	0.49	0.60	0.65	0.62	0.55	0.42	0.40	0.49	0.52	0.55	0.53	0.54	0.59	0.60	0.60	0.60	0.63	0.58	0.55	0.52	0.48	0.36
.44	0.36	035	0.35	0.37	0.47	0.66	0.74	0.76	0.70	0.57	0.49	0.46	0.44	0.50	0.56	0.59	0.55	0.48	0.42	0.43	0.52	0.55	0.54	0.52	0.50	0.54	0.54	0.52	0.57	0.60	0.52	0.49	0.47	0.42	0.38
.48	0.44	0.40	0.39	0.37	0.48	0.64	0.73	0.73	0.69	0.60	0.52	0.48	0.44	0.49	0.52	0.55	0.52	0.48	0.45	0.46	0.53	0.53	0.54	0.50	0.49	0.46	0.47	0.47	0.50	0.55	0.48	0.44	0.44	0.42	0.40
.53	0.51	0.49	0.46	0.45	0.53	0.66	0.72	0.68	0.66	0.65	0.58	0.52	0.47	0.51	0.53	0.55	0.53	0.51	0.50	0.50	0.54	0.52	0.54	0.52	0.50	0.47	0.45	0.45	0.47	0.51	0.46	0.44	0.44	0.44	0.45
		0.53	0.51	0.50	0.58	0.69	0.71	0.66	0.61	0.64	0.60	0.54	0.47	0.50	051	0.54	0.54	0.52	051	0.53	0.54	0.49	0.51	0.50	0.50	0.49	0.47	0.46	0.49	0.46	0.46	0.44	0.42		
		0.62	0.57	0.52	0.58	0.67	0.70	0.63	0.55	0.57	0.59	0.54	0.48	0.50	051	0.56	0.55	0.53	0.53	0.54	0.56	0.52	0.50	0.50	0.52	0.54	0.51	0.52	0.49	0.46	0.45	0.44	0.43		
		80.0	0.62	0.51	0.56	0.63	0.70	0.64	0.54	0.53	0.53	0.53	0.48	0.49	0.49	0.52	0.54	0.52	0.53	0.56	0.59	0.52	0.50	0.49	0.53	0.57	0.54	0.47	0.44	0.43	0.41	0.41	0.42		
		0.75	0.72	0.55	0.52	0.55	0.63	0.65	0.59	0.51	051	0.54	0.48	0.46	0.45	0.46	0.48	0.49	0.52	0.57	0.58	0.52	0.47	0.45	0.49	0.53	0.49	0.46	0.42	0.43	0.41	0.38	0.40		
				0.65	0.54	0.51	0.54	0.63	0.65	0.56	0.53	0.51	0.48	0.45	0.44	0.42	0.44	0.46	0.51	0.58	0.52	0.46	0.41	038	0.41	0.49	0.47	0.44	0.41	0.43	0.37				
				0.77	0.64	0.50	0.49	0.54	0.59	0.57	0.50	0.47	0.46	0.46	0.42	0.39	0.43	0.45	0.53	0.55	0.49	0.41	036	035	0.39	0.46	0.44	0.45	0.40	038	0.38				
						0.61	0.52	0.53	0.54	0.52	0.45	0.42	0.42	0.45	0.43	0.37	0.40	0.50	0.56	0.55	0.42	0.36	033	036	0.42	0.46	0.43	0.40	035						
						0.73	0.63	0.56	0.53	0.51	0.42	0.36	0.39	0.43	0.42	0.36	036	0.44	0.51	0.46	0.40	0.36	036	0.41	0.43	0.45	0.43	0.36	034		П				
								0.71	0.63	0.57	0.48	0.39	0.36	038	0.40	0.38	037	038	0.39	039	038	0.37	038	0.42	0.40	0.40	0.40								
								0.70	0.65	0.63	0.56	0.44	0.33	037	0.36	0.38	035	031	0.32	032	036	0.37	0.43	0.42	0.40	037	039								
								_			_	0.52	0.40	036	0.39	0.42	039	037	0.34	035	0.41	0.38	039												
													0.51							_															

## Diagnostic set





#### **Operating characteristics**

- sensitivity 92%
- specificity 99%
- the prognostic value of positive result -73%
- the prognostic value of negative result -99%

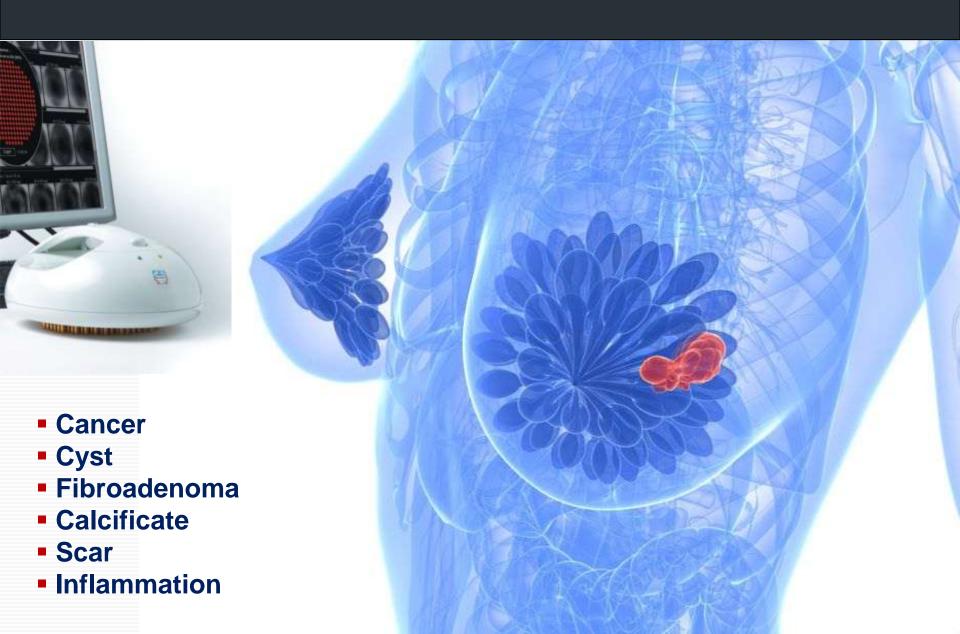


#### **Usage Time Features**

- Duration of the procedure: scanning is accomplished in 35 seconds.
- The process of diagnostic inspection, from the moment of the collection of anamnesis to the delivery of conclusion, takes in average up to 15 minutes.
- Inspection with the screening takes 3-5 min.



#### Identification of pathologies using EI mammograph



#### Breast cancer; type I.a

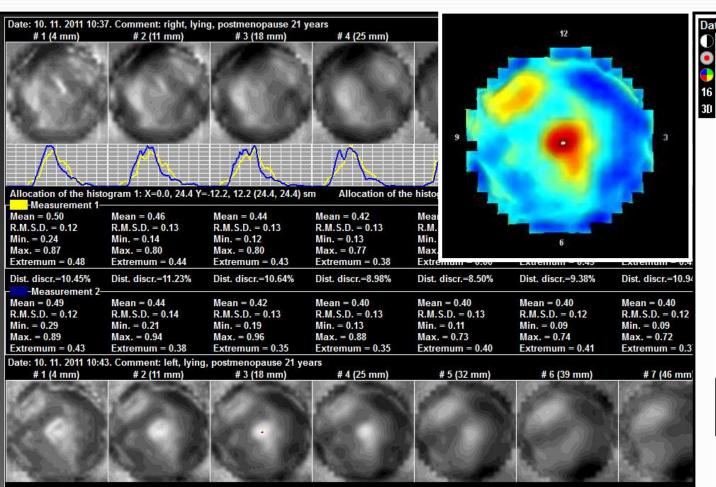
Visual and quantitative assessment data of the electroimpedance image of the patients' mammary glands

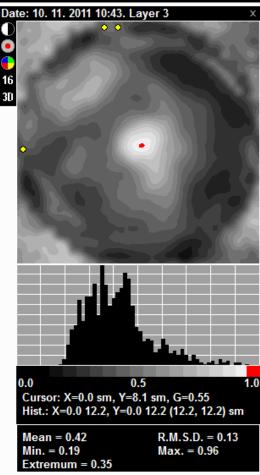


#### Breast cancer; type I.a

Visual and quantitative assessment data of the electroimpedance image of the patients' mammary glands

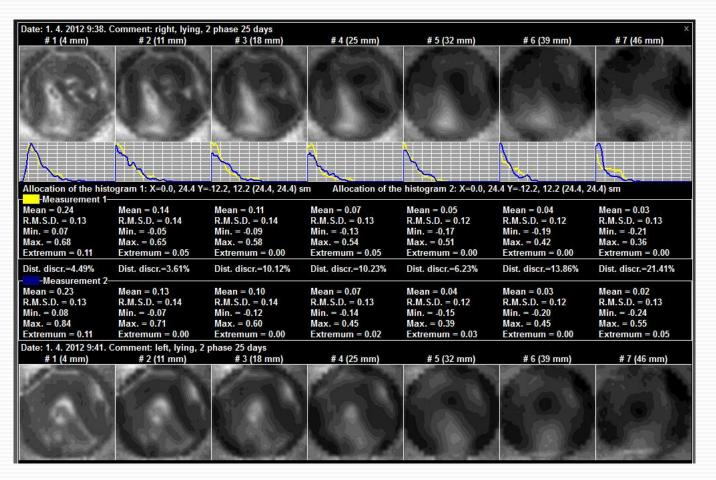
#### Patient 74 years old, 21 years after menopause



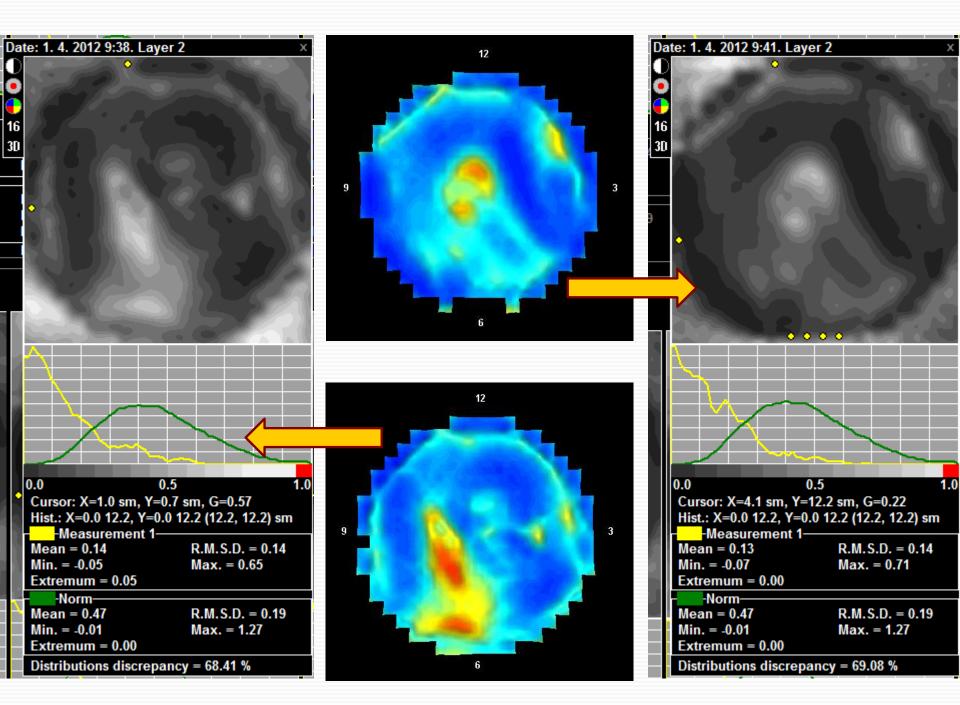


#### Breast cancer; type I.b

Visual and quantitative assessment data of the electroimpedance image of the patients' mammary glands



Patient 45 years old, histology T<sub>2</sub> N<sub>0</sub> M<sub>0</sub>



## Breast cancer; type I.b



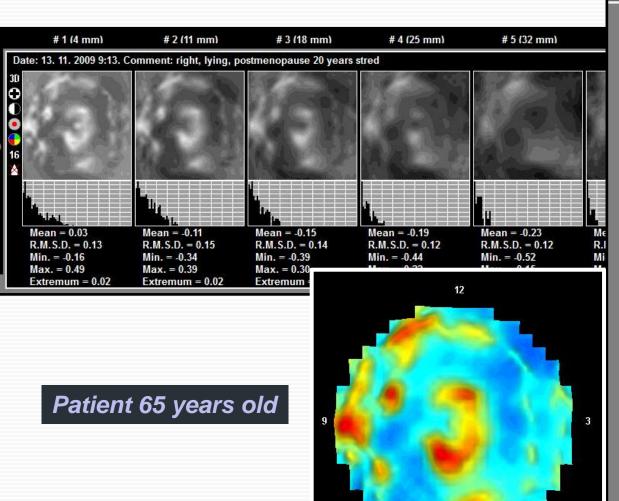


**Before surgery** 

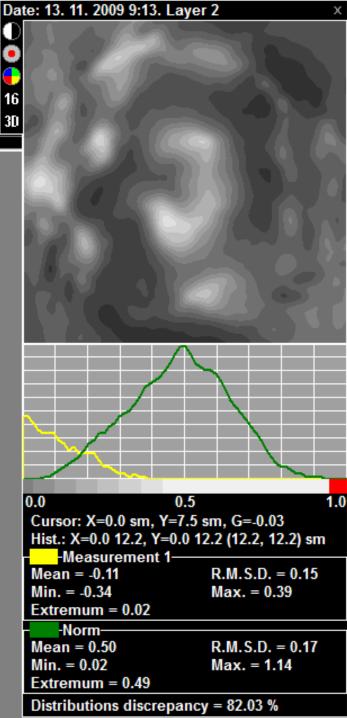
**After surgery** 

Histogy: Invasive ductal CA with modular features G3, pT2pN0MX

## Breast cancer; type Ic.

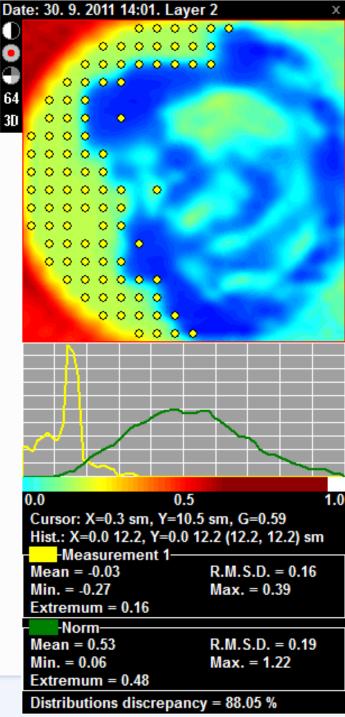


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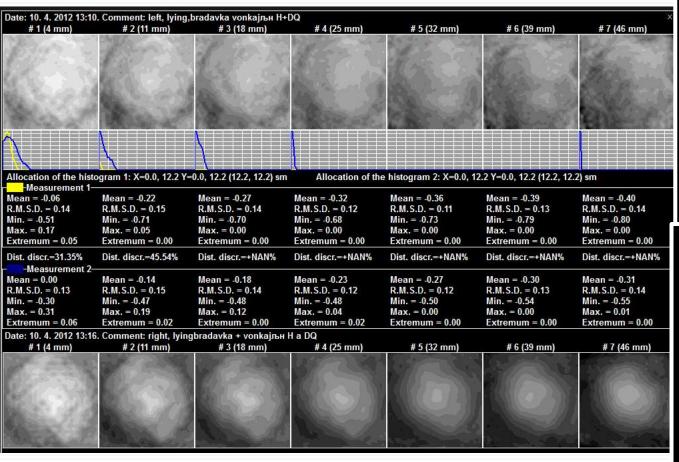
#### Breast cancer; type Ic.



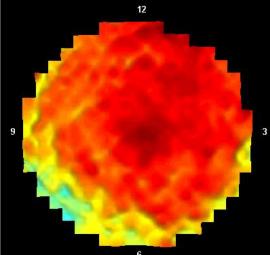


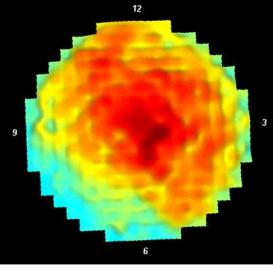
#### Atypical breast cancer - haemangioma

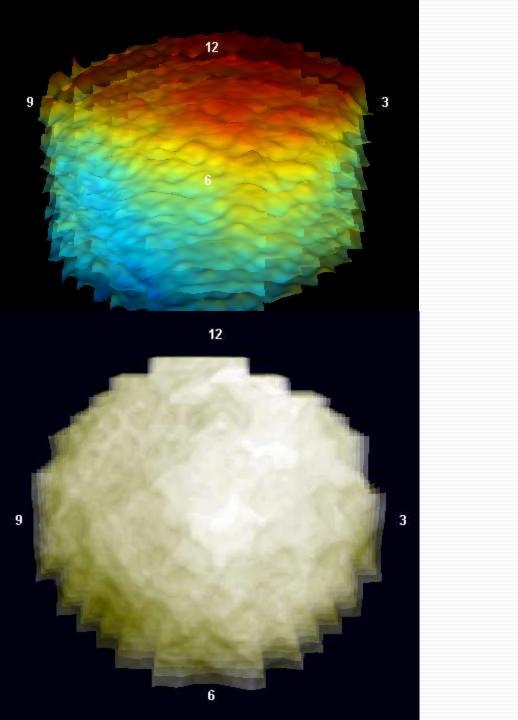
A cancerous tumor which is hard, translucent, of a gray or bluish color, and emits a creaking sound when incised.

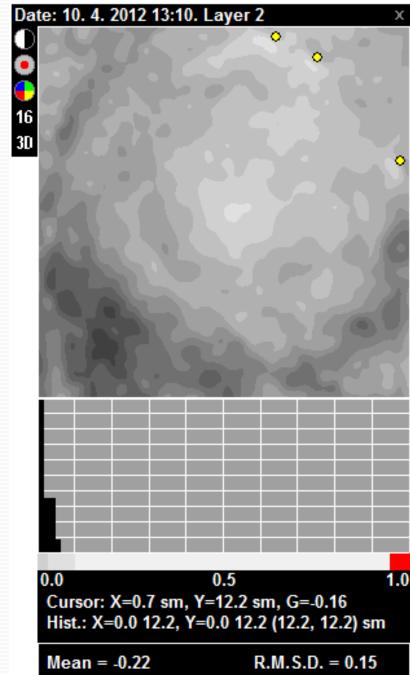


Patient 44 years old





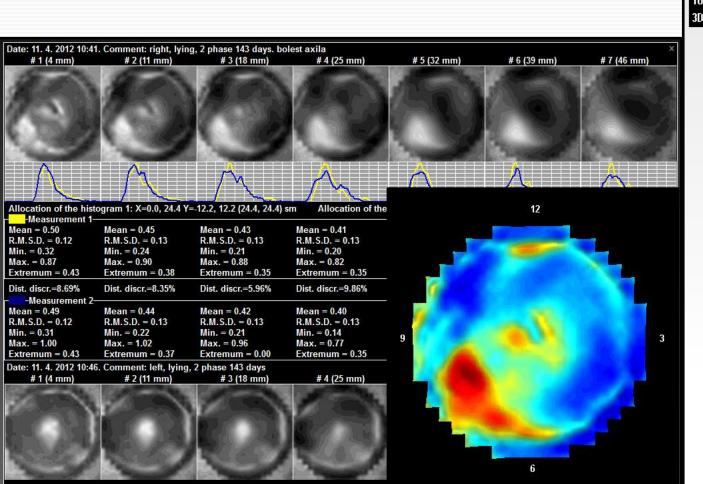


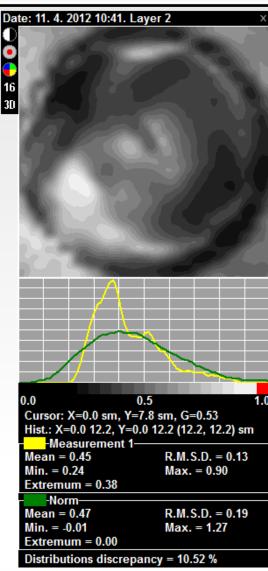


Mean = -0.22 R.M.S.D. = 0.15 Min. = -0.71 Max. = 0.05 Extremum = 0.00

#### Mammary gland visualization - cysts

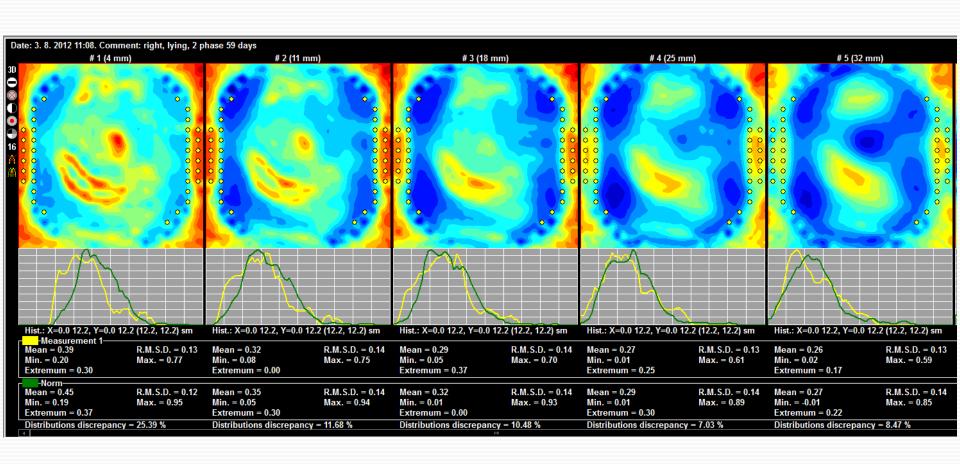
#### Patient 48 years old





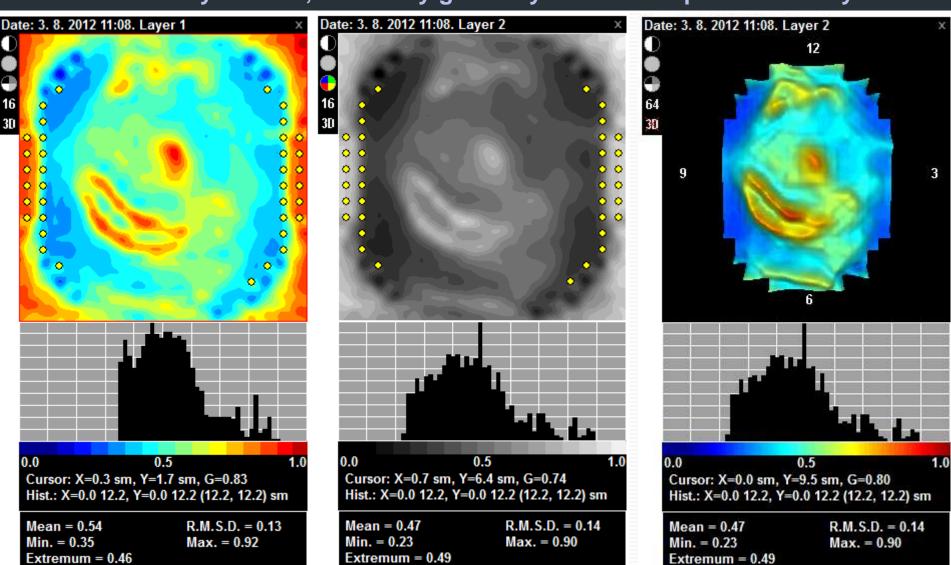
#### Mammary gland visualization - cysts

Patient 53 years old, mammary gland 3 years after aspiration of a cyst

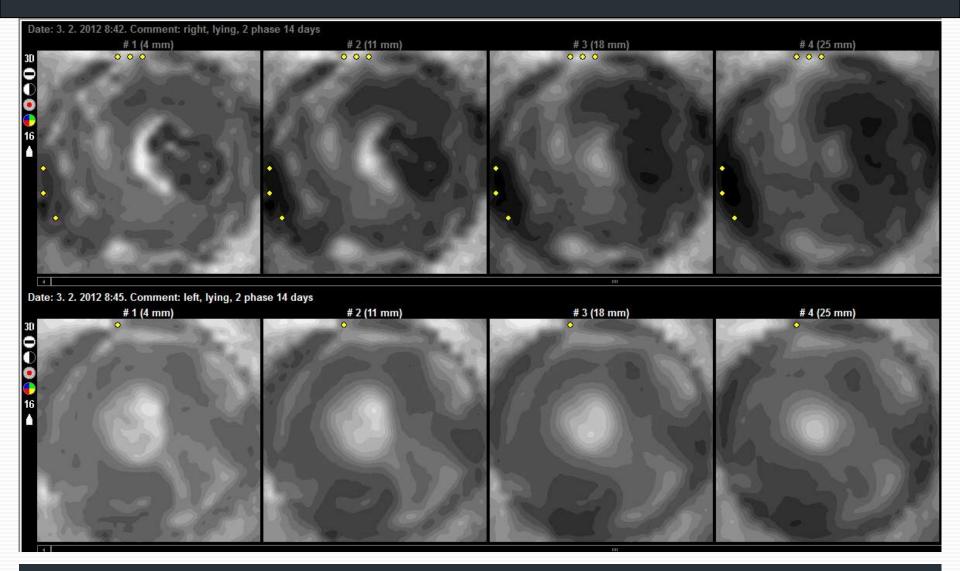


#### Mammary gland visualization - cysts

Patient 53 years old, mammary gland 3 years after aspiration of a cyst



# **Fibroadenoma**



44 years old patient; Fibroadenoma bilat., lumpectomia bilat.

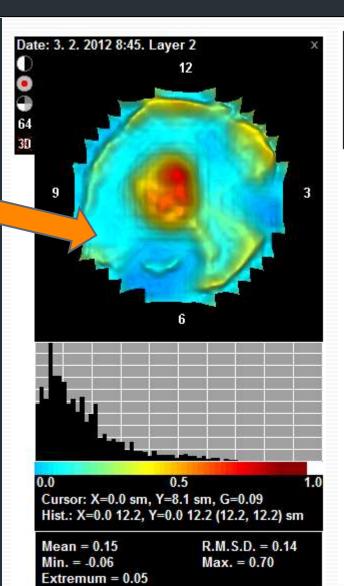
# **Fibroadenoma**

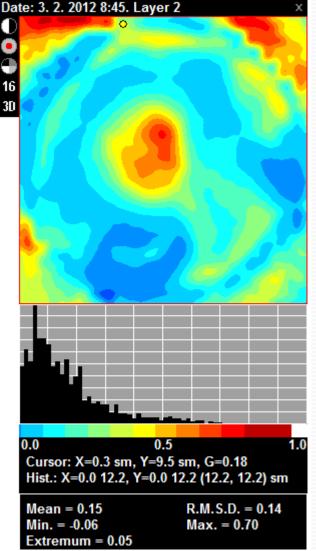
#### Left breast:

fibroadenoma mammae I. sin., extirpated 35 x 25 x 20 mm non capsulated lobular lesion,

# Histopathologically demonstrated:

Phylloides tumor (PT), (cystosarcoma phyllodes, sometimes called "giant fibroadenomas)





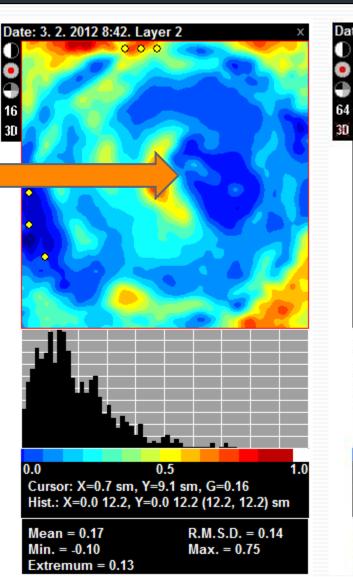
# **Fibroadenoma**

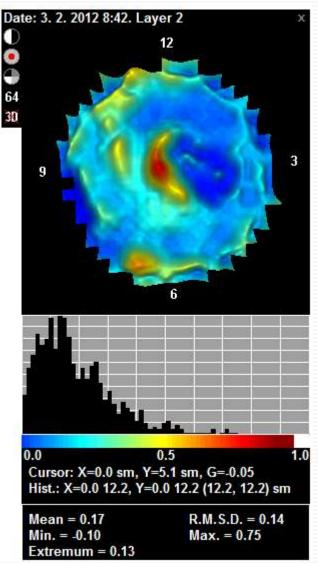
#### Right breast:

fibroadenoma mammae I. dx. extirpated 40 x 35 x 30 mm adipose tissue fibrosis

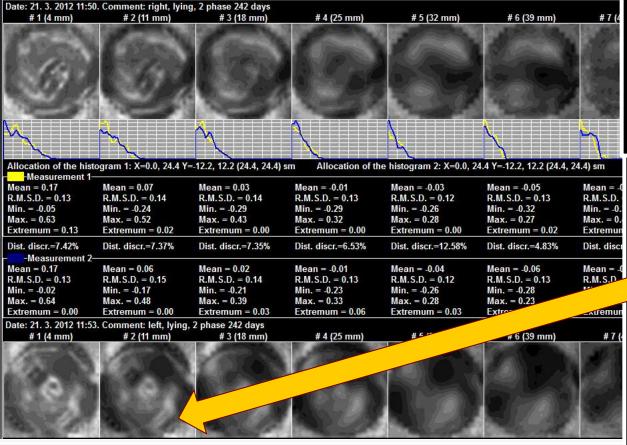
Histopathologically demonstrated:

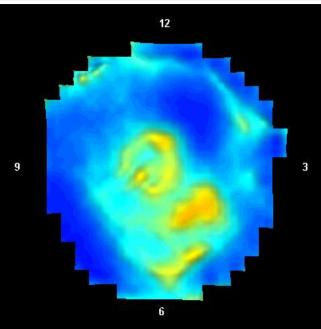
fibrocystic parenchym of right breast

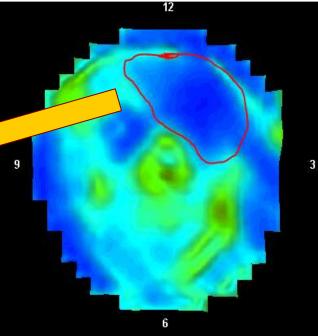




# Mammary gland visualization - mastitis







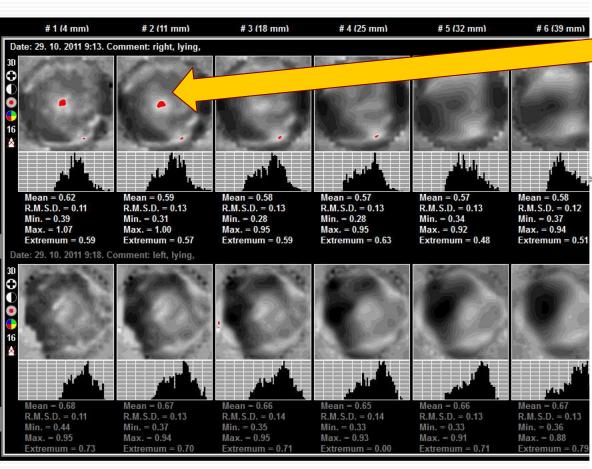
## **Mammary gland visualization - mastitis**

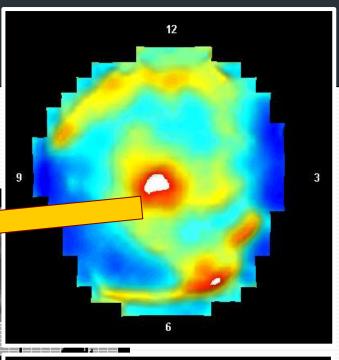


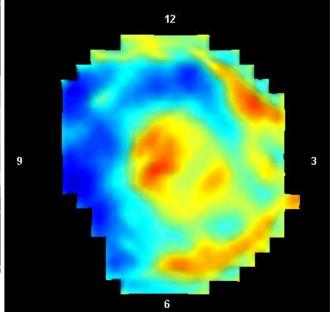
Pregnant woman with mastitis

# Diagnostics of men for breast cancer

#### Patient 45 years old







Diagnostics of men for breast cancer



Patient 45 years old

#### **EIM vs. ACR**

EIM	ACR
Common scale	BI-RADS categories
no score	BI-RADS 0 poor image
0-1	BI-RADS 1 lesion is not defined
2-3	BI-RADS 2 benign tumours – routine mammography
4	BI-RADS 3 probably benign findings
5-7	BI-RADS 4 suspicious abnormality - biopsy
8-10	BI-RADS 5 highly suggestive of malignancy – treatment/biopsy

ACR - American college of radiology