WHAT'S NEW IN BREAST IMAGING

Patricia Hassell
BCCA

- Magnetic Resonance Imaging
- Positron Emission Tomography/PET
- Ultrasound
- Digital Mammography

BREAST MRI

- Improved spatial resolution of surface coils
- Use of intravenous Gadolinium to detect angiogenesis
- Imaging protocols are becoming more standardized
- Currently has a role as a problem solving tool in selected cases

CLINICAL INDICATIONS FOR BREAST MRI

SILICONE IMPLANT EVALUATION

- MRI shown to be superior in detecting rupture
  Goodman C M et al, Ann Plas Surg. 1998:41:577-586

- Mean Sensitivity

Mammography	28%
Ultrasound	59%
MRI	78%

OCCULT BREAST CANCER

<2% of patients present with palpable axillary nodes and a negative mammogram and ultrasound.

MR imaging of the breast in patients with occult primary breast cancer

Morris E.A. et al; Radiology 1999.205:437-440

MRI detected in 9/12 (75%)
Negative 3/12 (25%). No tumor at mastectomy.

PREOPERATIVE ASSESSMENT OF LOCAL DISEASE

Several studies have shown that MRI can detect cancer not seen on mammography in up to 33% of patients.

Harms S.E. et al. Radiology 1993;187:493-501.

Orel SG et al. Radiology 1995;196:115-122

Fischer U et al. Radiology;213:881-888

Unclear if this information impacts patient survival or if cost effective.

Not all patients benefited from MRI; up to 8% had further surgery for lesions which proved to be benign disease.

Highly accurate in suspected pectoral muscle invasion.
Evaluation of the contralateral breast (reported incidence 2-9%)

MRI useful in patients in whom the disease extent is uncertain from physical examination, mammography or ultrasound

POST OPERATIVE ASSESSMENT OF POSITIVE MARGINS

Difficulty in differentiating post surgical change from residual cancer limits the accuracy.

More useful in detection of previously unsuspected multicentric or multifocal disease

Lee J.AJR 2004;182;473-480

Frei K.AJR 2000;175;1577-1584

EVALUATION OF THE PROBLEM MAMMOGRAM

- ? Architectural distortion
- Suspicious lesions seen in only one view
- Equivocal changes at site of previous surgery
- Lee C.H. AJR 1999:173;1323-1329
- 38/86 positive MRI lesions
- 10/26 corresponded to mammographic abnormality were malignant

SCAR VERSUS RECURRENT TUMOR

- Mammogram and ultrasound are inconclusive
- Post surgical and radiation changes can enhance up to 18 months post treatment
- MRI useful if there is no enhancement as the Negative Predictive Value is close to 100%

RESPONSE TO NEOADJUVANT CHEMOTHERAPY

Partridge, S.C. et al. AJR. 2002: 179: 1193,

MRI detected all 44/52 patients with residual disease

Rieber A. Br J Rad 1997;70;452-458

MRI provided information on responders versus non-responders

4/13 False Negative for residual disease

2/13 Underestimation of residual disease

SCREENING OF HIGH RISK PATIENTS

- At BCCA proven BRCA 1 and 2 carriers :
- Annual mammography, ultrasound and MRI

Breast MR imaging screening in 192 women proven or suspected to be carriers of a breast susceptibility gene;
Kuhl, C.K. Radiology 2000:268;267-279

9 cancers in asymptomatic women

Mammography detected	3
Ultrasound	3
MRI	9

ACCURACY OF CONTRAST-ENHANCED MRI

- Sensitivity 95-98%
- Specificity 37-97%
- Negative Predictive Value > 95%
- Positive Predictive Value 56-75%

LIMITATIONS OF BREAST MRI

False positives:

- Overlap of benign and malignant lesions
- Incidental enhancing lesions
  Brown et al. AJR 2001:176;1249
- IEL 30/103 patients
- Common in premenopausal women with dense breasts
- 1/30 lesions proved to be cancer

FALSE NEGATIVES

- Invasive lobular carcinoma
- Low grade ductal carcinoma i.e. tubular

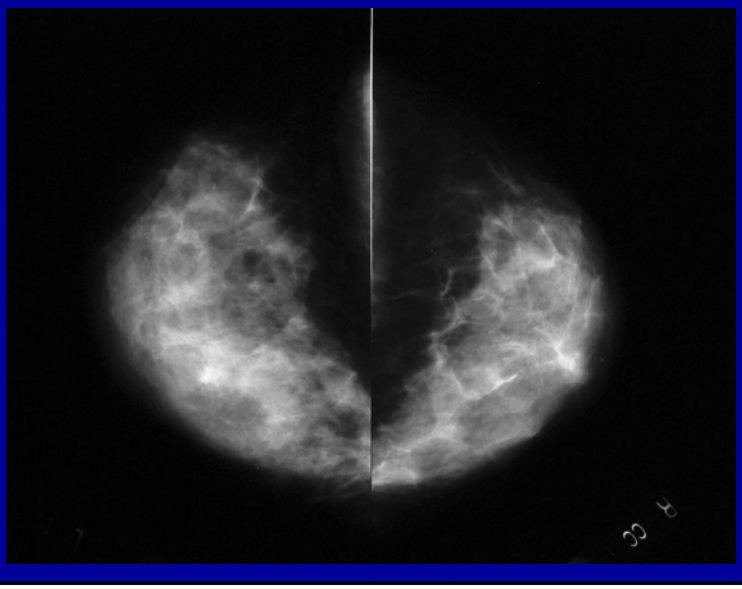
DCIS

- Presents as microcalcifications 73-98%
- MRI sensitivity 40-100%
- Small lesions not detected < 3 mm
- Enhancing pattern often atypical

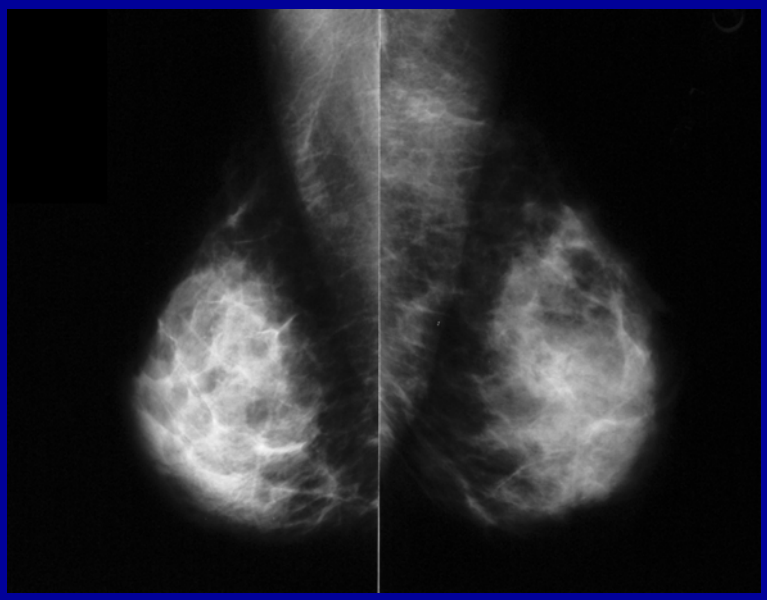
INAPPROPRIATE USES OF MRI

- Should not be substituted for mammography or ultrasound
- Should not be used as a substitute for a histological diagnosis
- No studies proving the efficacy of MRI as a screening tool in the general population

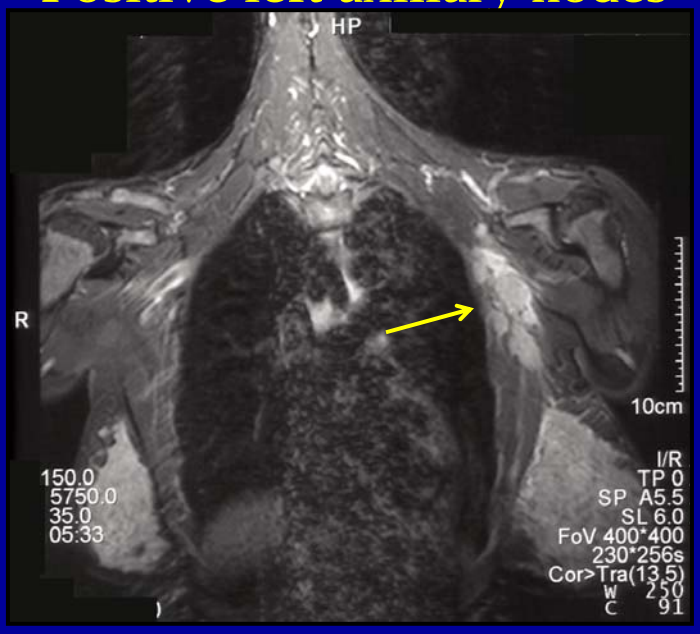
Mammogram CC



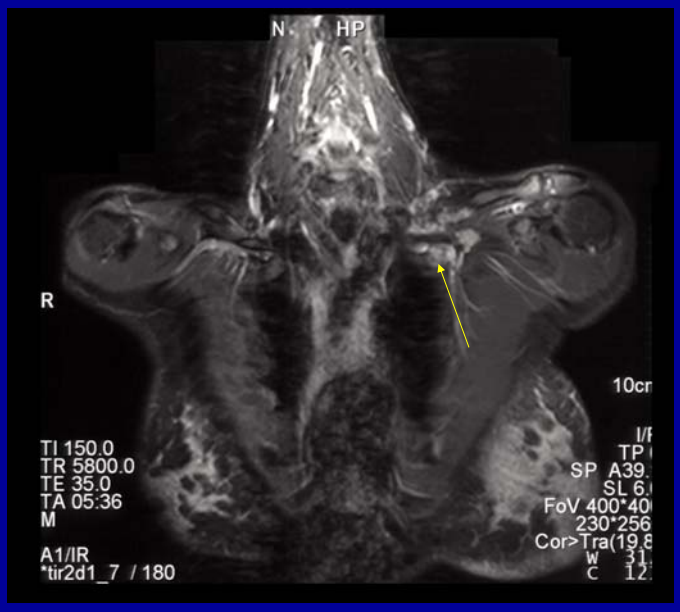
Mammogram MLO



Positive left axillary nodes

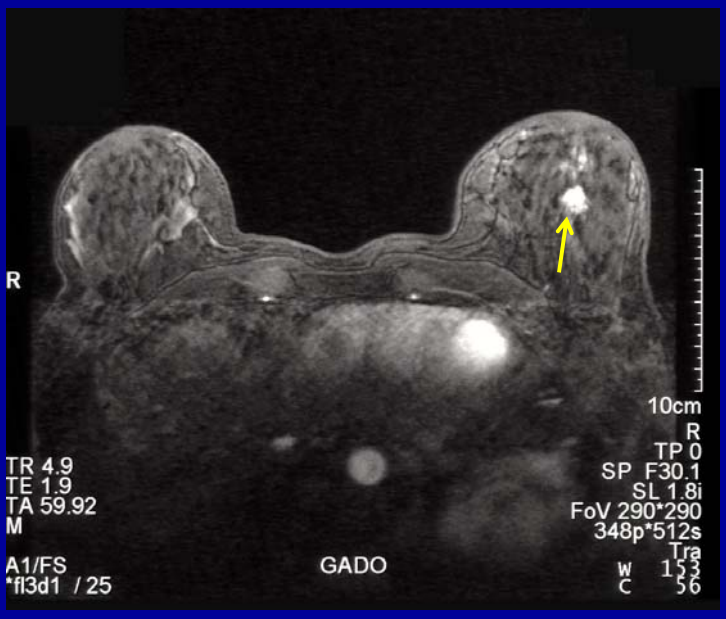


MRI Chest -Pretreatment

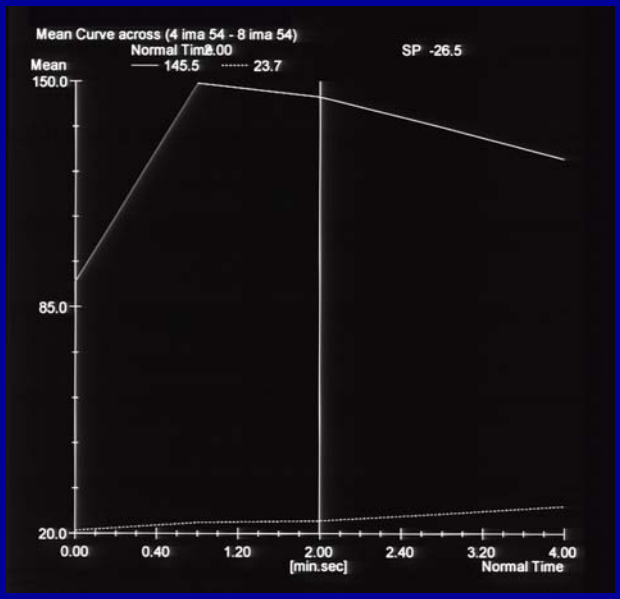


Pre Contrast Scan

Post Gadolinium enhancing mass

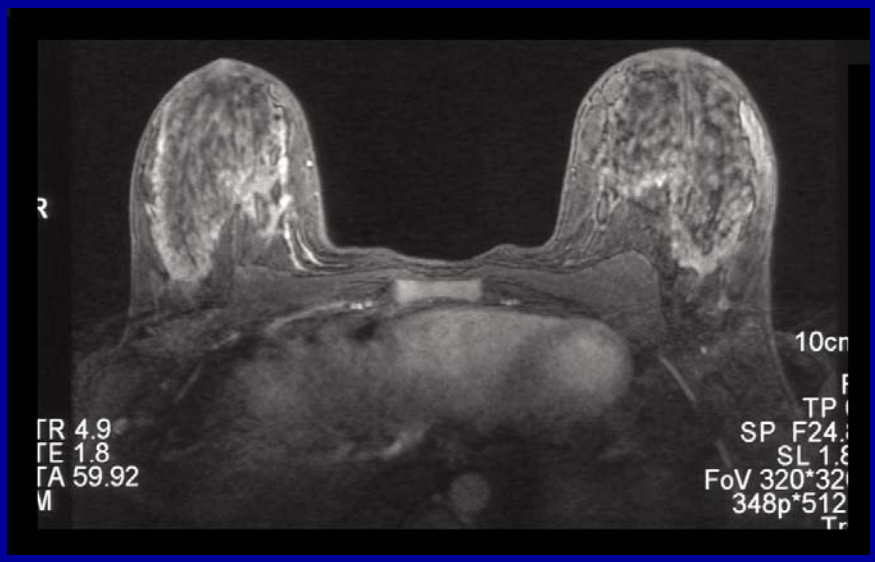


Time Intensity Curve

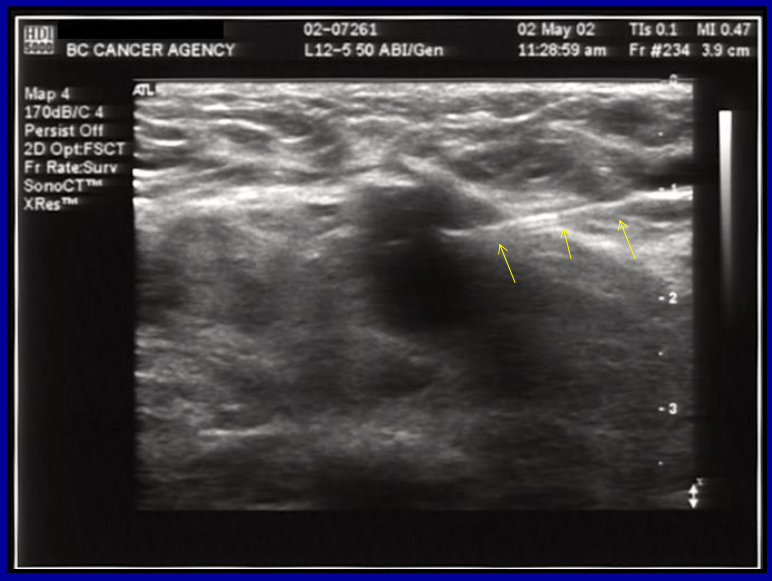


Chest Post 1 cycle of chemotherapy

Post contrast- Post chemotherapy



Ultrasound guided biopsy



POSITRON EMISSION TOMOGRAPHY - PET

- Functional Imaging
- Neoplastic cells have increased glucose utilisation
- Agent used is F-18 Fluorodeoxyglucose
- Reported sensitivity and specificity varies with lesion size

AVRIL N ET AL. JOURNAL OF CLINICAL ONCOLOGY: 20:200;3495-3502

1/8 lesions between 0.5-1 cm were detected by PET

0/5 lesions under 0.5 cm detected
Sensitivity for lesions > 1cm was 78%

False positives due to inflammatory lesions
Positive correlation between the FDG uptake and the grade of the tumor

Worse prognosis with SUV>3

LYMPH NODE STAGING BY PET

Wahl, R.L. et al. J. Clin. Oncol. 2004. 22(2): 277-85

360 women with diagnosed breast cancer underwent FDG PET.

Sensitivity	61	PPV	62
Specificity	80	NPV	79

PET failed to detect small nodal metastases.

Not routinely recommended for axillary staging.

ULTRASOUND SCREENING FOR BREAST CANCER

SCREENING MAMMOGRAMS SENSITIVITY

Age	Fatty breasts	Dense breasts
>50 years	98.4%	83.7 %
<50 years	81.8 %	85.4%
< 50 years + family Hx	68.8%	

KerlikowskeK.. JAMA 1996;276-33-38

Several studies have shown that Ultrasound can detect small non palpable invasive cancers not seen on mammography, especially in dense breasts.

Cancer detection rate 3.4 per 1,000 women
Negative biopsy rate 2-6%
Short interval follow up 3-10%

No randomized trials have been carried out to see if there is an impact on survival.

DIGITAL MAMMOGRAPHY

- Next step in the evolution of mammography
- Limitation of screen-film mammography is image cannot be altered
- Digital image is acquired as an electronic signal which is stored in a computer and displayed as film or on a monitor

CLINICAL COMPARISON OF FULL-FIELD DIGITAL MAMMOGRAPHY AND SCREEN-FILM MAMMOGRAPHY FOR DETECTION OF BREAST CANCER.

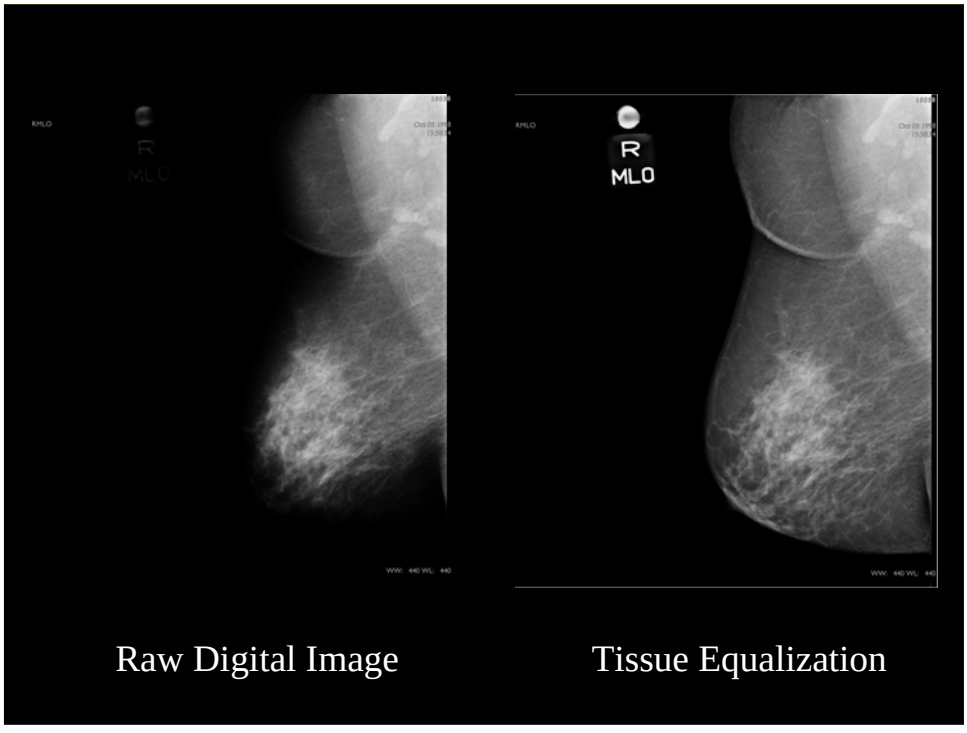
Lewin JM. AJR: 2002;179:671-677

6,736 Patients

	S-F	FFDM
Recall rate	14.9%	11.8%
Biopsy rate	48%	21%
Cancers detected	33/42	27/42

CONCLUSION

Fewer workups and biopsies with FFDM.
Cancer detection rate is not statistically different.

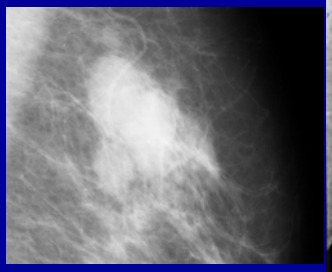


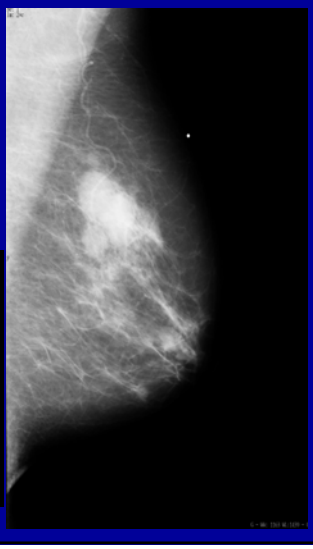
Raw Digital Image

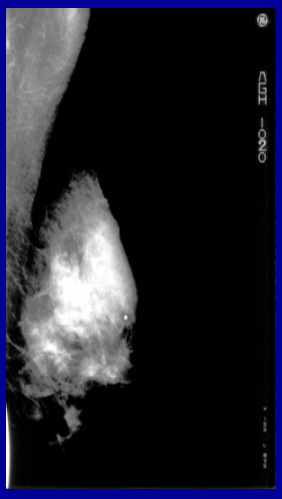
Tissue Equalization

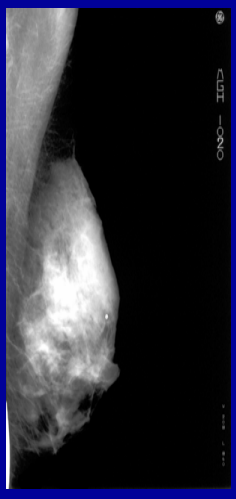
Several ways to get a “second” look

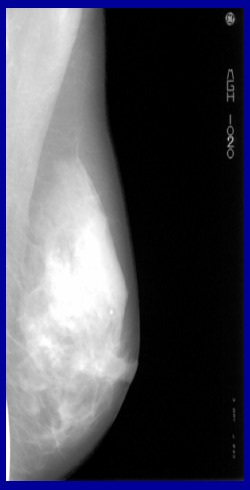
- After the exam, with no additional exposures, no additional time
- Ability to electronically zoom
- Specialized software for automatic detection of micro-calcifiactions



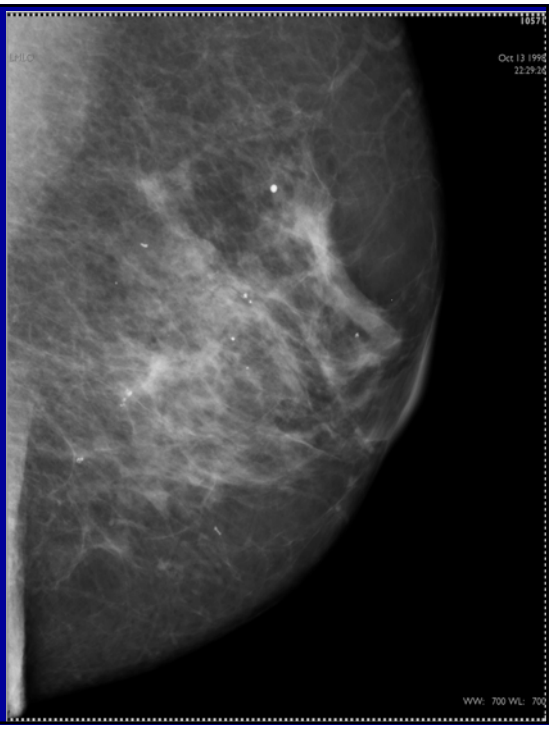








LMLO -
Full Zoom
No Invert



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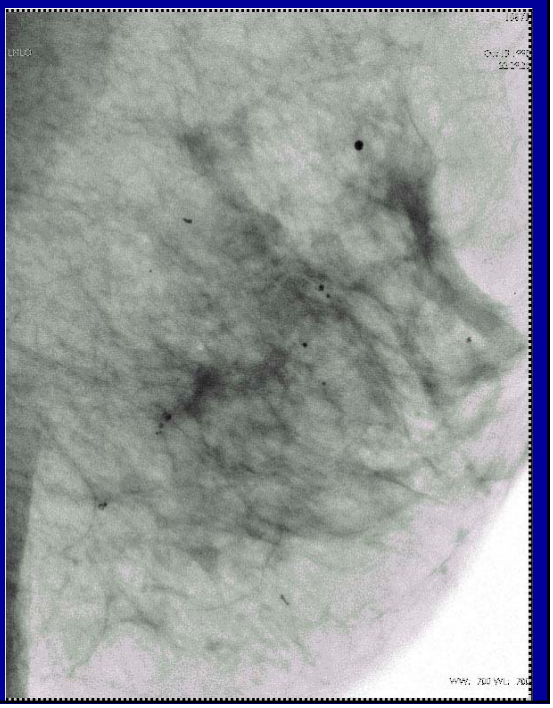

COMPUTER AIDED DETECTION AND DIAGNOSIS (CAD)

Digital mammograms are scanned into a computer and abnormal calcifications and masses are marked.

The intent is to improve the sensitivity of mammography without increasing the recall rate.

FDA approved and reimbursed by Medicare and some Insurance Companies.

Based on retrospective studies which suggested an increase in cancer detection rates by approximately 20% without increasing the recall rates substantially.

Double reading of screening by a second radiologist increases cancer detection by 9-10%.

Improvement in detection of calcifications using CAD is 5-10% and 5% for masses.

Average false positive areas marked by CAD is 2.4 per patient

CHANGES IN BREAST CANCER DETECTION AND MAMMOGRAPHY RECALL RATES AFTER THE INTRODUCTION OF A COMPUTER-AIDED DETECTION SYSTEM.

Gur, D. **J Natl Cancer Instit 2004;96:185-190**

24 experienced radiologists read 56,432 screening mammograms before, and 59,139 after, the introduction of a CAD system

RESULTS

Recall rates were similar for mammograms read with and without a CAD system for all radiologists
(11.4% versus 11.39%).

Breast cancer detection rates
(3.55% versus 3.49%)

7 high volume radiologists the recall rates and cancer detection rates were similar for mammograms interpreted with and without CAD.

Will CAD save lives and decrease malpractice suits?