2019 Chicago International Breast Course

Advancing the Art of Breast Imaging

Cancers Missed on Mammography and How to Avoid Them

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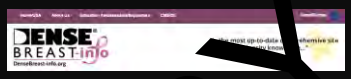
Disclosures

Consultant, General Electric Company Educator, ABUS

Noncorporate Member of Medical Advisory Board of Volpara Solutions

European Liaison for DenseBreast-Info E[illegible]ope



Acknowledgments

Thank you to :

Ellen B. Mendelson, MD, FACR, FSBI, FSRU
Georgia Giakoumis Spear, MD

Learning Objectives

- Identify the most common factors that may lead to missed breast lesions on mammography.
- Enhance the appropriate steps when interpreting mammography.
- Tips and tricks on how to avoid missing a suspicious lesion.

In[illegible]duction - [illegible]acts about mammography

Method of choice for early detection of breast cancer

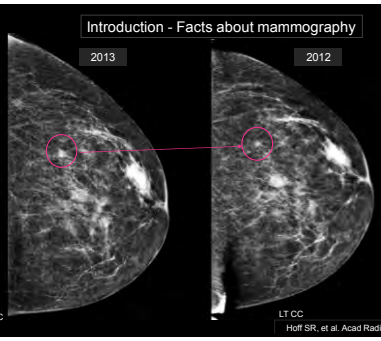
Overall sensitivity of 75%-85%!

The only screening test shown to reduce mortality rates

Approximately 10-30% of breast cancers are not detected on screening mammography!

1. Ciatto S, et al. Breast 2007;16(6):646–652.
2. Hofvind S, et al.. Radiology 2005;237(2):437–443.
3. Hoff SR, et al. Acad Radiol 2011;18(4):454–460.

Introduction - Facts about mammography



Two-thirds of missed cancers are evident in retrospect!

Hoff SR, et al. Acad Radiol 2011;18(4):454–460.

Implications of delayed diagnosis of breast cancer

More aggressive therapies needed!

Increased number of deaths!

How prevalent are breast cancer – related claims?

The most common cause of medical malpractice

Radiologists are the top physicians involved in breast cancer - related claims

Berlin L. AJR 2009;192:334-336.

Understanding the factors responsible for missing cancers

Minimize the imperfection of mammography

Reduce avoidable mistakes….

resulting in diagnosing smaller canc s with subtle appea nce!

Definition of missed cancer vs false negative mammogram

Definition of a missed cancer: → A cancer identified in retrospect

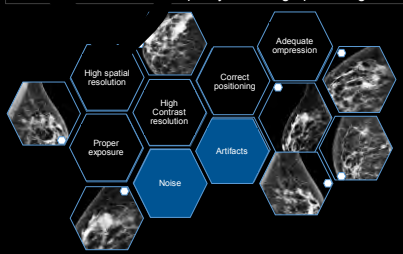
Definition of a false negative mammogram: → Cancer diagnos within 1 year of mammography report o RADS 1, 2,

ain factors which may lead to missed cancers - false negative mammograms

I. Technical fa… mammographic technique	II. Radiologist factors	III. Biological factors	IV. Perception and interpretation error
▪ Poor positioning ▪ Inadequate compression Motion artifacts …correct exposure (underexposed and overexposed images)	▪ Insufficient training ▪ Lack of experience ▪ Fatigue ▪ Inattention ▪ Distractions ▪ Poor viewing conditions	▪ Dense breast parenchyma (masking effect)	▪ Subtle features of malignancy ▪ Small size of lesion ▪ Site where visualization is difficult ▪ Visualization in only one view ▪ Slow growth ▪ Benign appearing lesions ▪ Lobular carcinoma

I. …hnical factors-

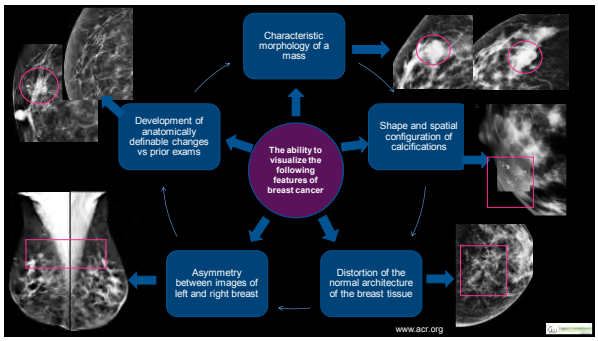
…erminants of h…-quality mammographic images

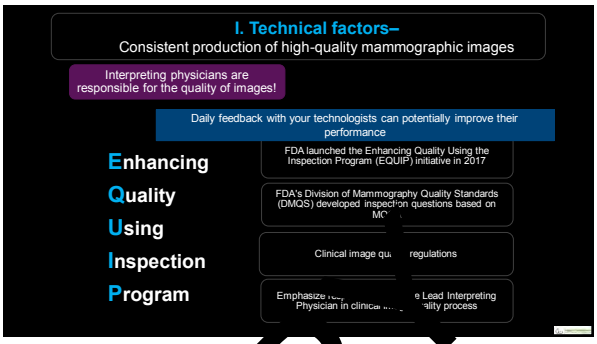


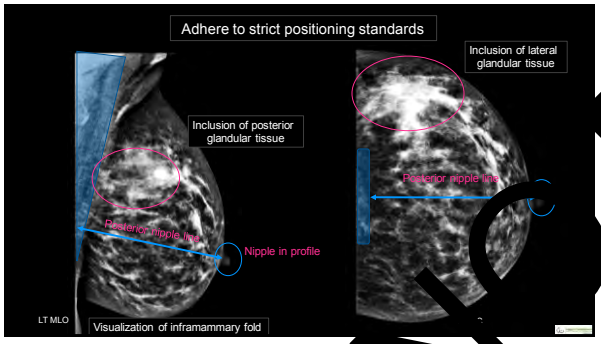
ACR-AAPM-SIIM Practice Guideline for Determinants of Image Quality in Digital Mammography revised 2012

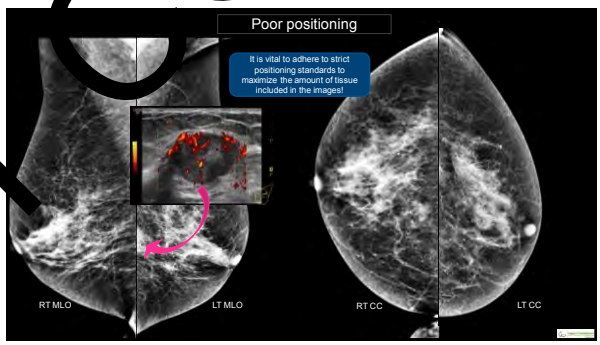
Clinical Question #1

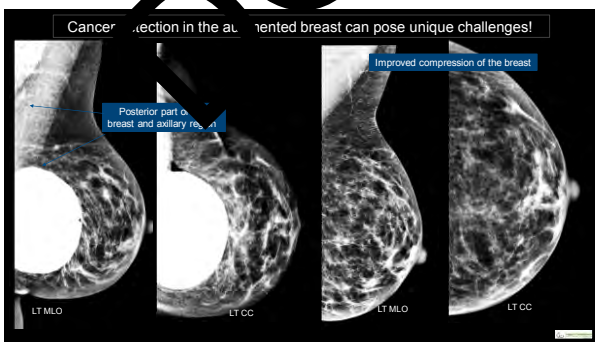
What are the essential imaging characteristics the radiologists ought to use for the assessment of the quality of mammograms?

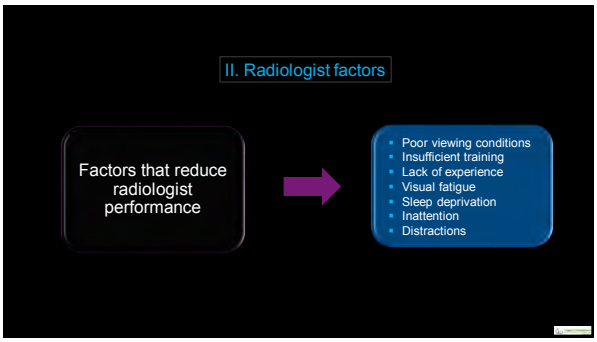

Characteristic morphology of a mass
Development of anatomically definable changes vs prior exams
The ability to visualize the following features of breast cancer
Shape and spatial configuration of calcifications
Asymmetry between images of left and right breast
Distortion of the normal architecture of the breast tissue
www.acr.org

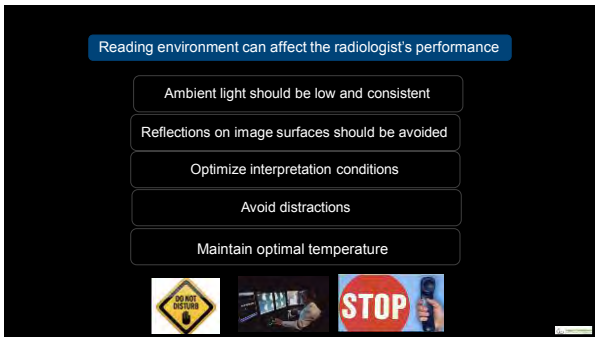

I. Technical factors–
Consistent production of high-quality mammographic images
Interpreting physicians are responsible for the quality of images!
Daily feedback with your technologists can potentially improve their performance
Enhancing
Quality
Using
Inspection
Program
FDA launched the Enhancing Quality Using the Inspection Program (EQUIP) initiative in 2017
FDA's Division of Mammography Quality Standards (DMQS) developed inspection questions based on MQ
Clinical image qu regulations
Emphasize Physician in clinical
e Lead Interpreting ality process

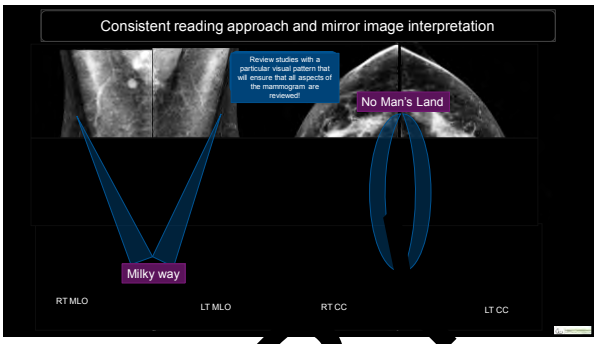

Adhere to strict positioning standards
Inclusion of lateral glandular tissue
Inclusion of posterior glandular tissue
Posterior nipple line
Posterior nipple line
Nipple in profile
LT MLO
Visualization of inframammary fold

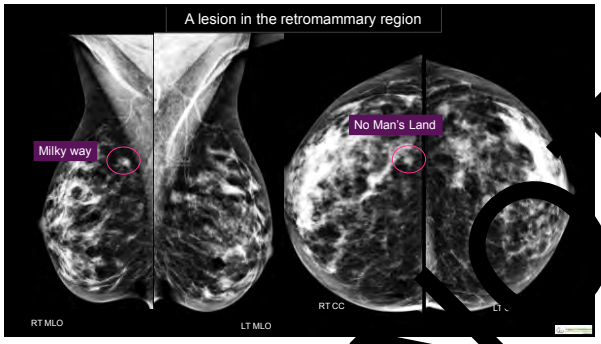

Poor positioning
It is vital to adhere to strict positioning standards to maximize the amount of tissue included in the images!
RT MLO
LT MLO
RT CC
LT CC

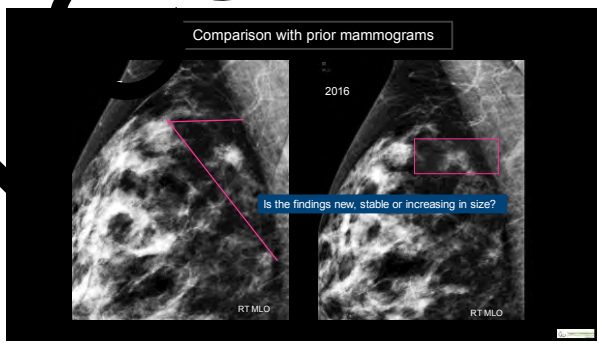

Cancer ection in the au nented breast can pose unique challenges!
Improved compression of the breast
Posterior part o breast and axillary re
LT MLO
LT CC
LT MLO
LT CC

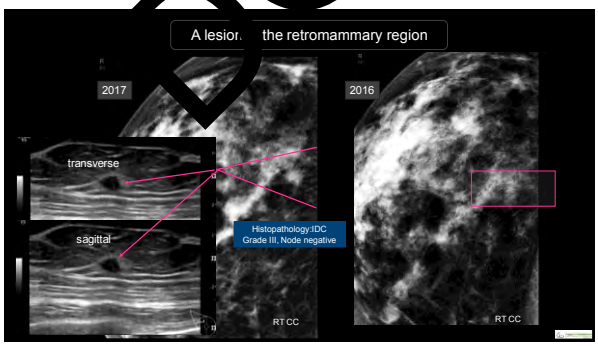

II. Radiologist factors
Factors that reduce radiologist performance
Poor viewing conditions
Insufficient training
Lack of experience
Visual fatigue
Sleep deprivation
Inattention
Distractions











Double reading of mammography

Journal	CDR per 1000	Type of study
AJR Am J Roentgenol. 2003; 180 (5):1461-7	0.4	Blinded double reading
Radiol Med. 2011;116(4):575-83	0.9	Informed (not independent) double reading
Eur J Cancer 2015;51(3);391-9	0.9	Blinded double reading
Eur Radiol. 2016;26(9):3262-71	0.4	Blinded double reading
Eur J Radiol. 2017;96:40-49	0.4	Meta-analysis

Single reading along with CAD

Authors	Journal	CDR per 1000
Cupples TE, 2005	AJR 185(4):944-950	0.6
Freer TW, 2001	Radiology 220(3):781-786	0.6
Lehman C, 2015	JAMA Intern Med 175(11):1828-1837	No difference
Morton MJ, 2006	Radiology 2006;239(2):375-383	0.4

Requirements for radiologist good performance

Number of good performance in mammography depends on the number of annual readings. M. Rawashdeh et al Radiology 2013;289:61-67.

Country	Required number of screens	Time period
United States	960	2-years
Australia	2000	1-year
Canada	2000	1-year
Province of British Columbia	2500	1-year
United Kingdom	5000	1-year

Read as many mamm[illegible] poss[illegible].
Practice increases skill

Threshold for radiologist acceptable interpretive performance

Performance measure	Threshold of low performance
Sensitivity %	<75
Specificity %	<88 or >95
Recall rate %	<5 or >12
Cancer detection rate	<2.5 per 1000
PPV1 %	<3 or >8
PPV2 %	<20 or >40

Additional training should be considered for radiologists with l[illegible]erforma[illegible]

Carney PA, et al. Radiology 2010;255(2):354-

RADS 3 Strictly follow the BI-RADS criteria

Short (6 month) interval follow-up mammography and then periodic mammography surveillance!

- Non-calcified circumscribed solid mass (new).
- Focal asymmetry that spreads out with spot views.
- Solitary group of punctate calcifications if no prior mammograms are available.

Improve your p[illegible]formance by adopting the concept o[illegible]oot cause analysis"

Adopt a sys[illegible]-cent[illegible]d approach, focusing on identifying

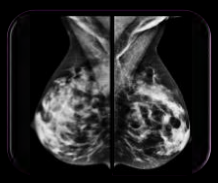
- what happ[illegible]d
- why it happened and
- what can be done to prevent it from happening again!

Accelerate your learning process

- Review mammograms of cancer patients at time of diagnosis
- Use this as educational material to gain experience from numerous images of subtle malignancies

Murphy JFA Irish Med J 2008;101:36.

III. Biological Factor – Breast density



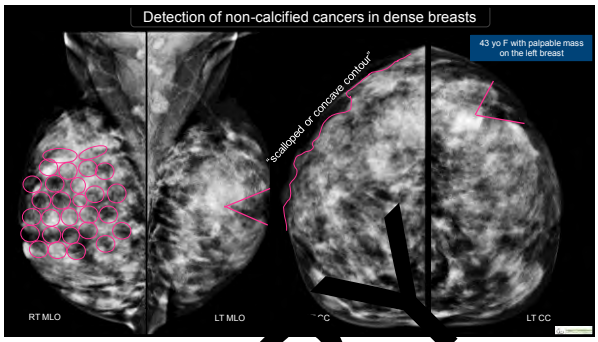
- Higher risk of developing breast cancer
- Decreased sensitivity 40.0%-68.1%
- Higher interval cancer rate (reduced sojourn time)
- Smaller mortality reduction

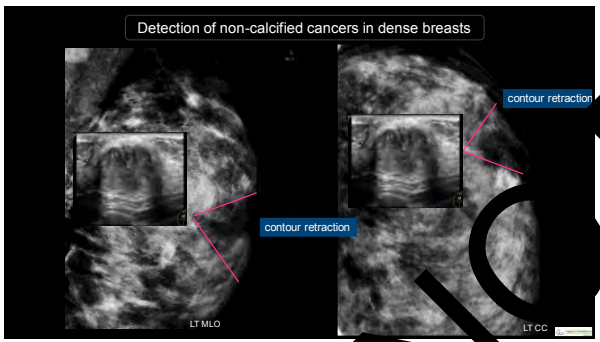
1. Van der Waal D, et al. Int J Cancer 2017;140:41-49.
2. Arora N, et al. Ann Surg Oncol 2010;17 Suppl 3:211-218.

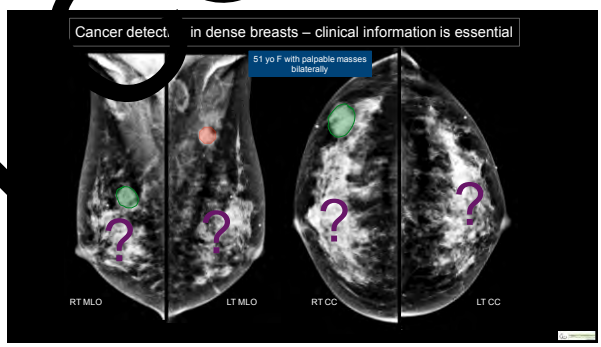
Clinical Question #2

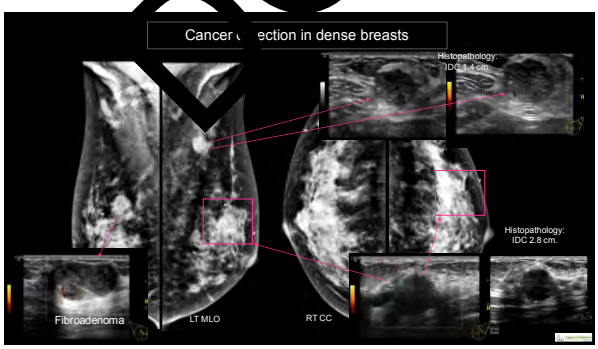
How to improve radiologist performance when interpreting dense breasts?

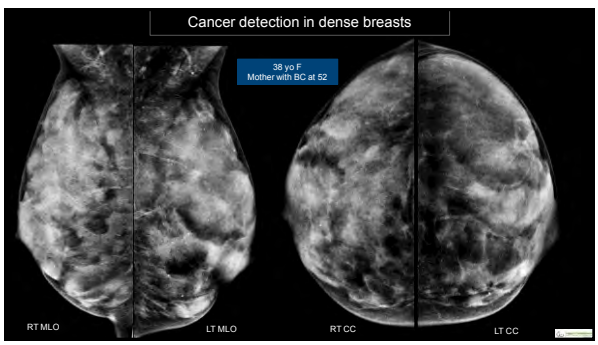
- Evaluate the contour of the fibroglandular tissue - identify a contour deformity of the breast parenchyma (protrusion, retraction or straightening of Cooper ligaments).
- Thoroughly evaluate the fibroglandular tissue, areas of increased density, a subtle architectural distortion.
- Microcalcifications – assessment with magnification views.
- Retromammary region and area behind the nipple.
- Axilla.

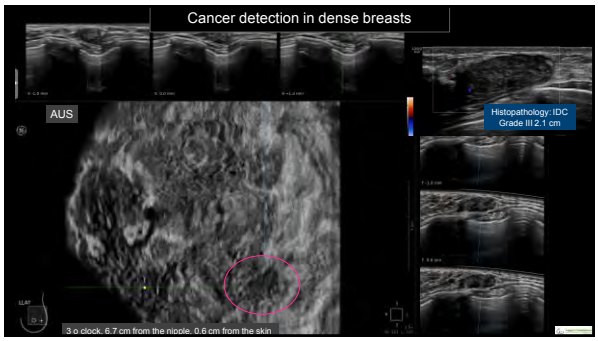


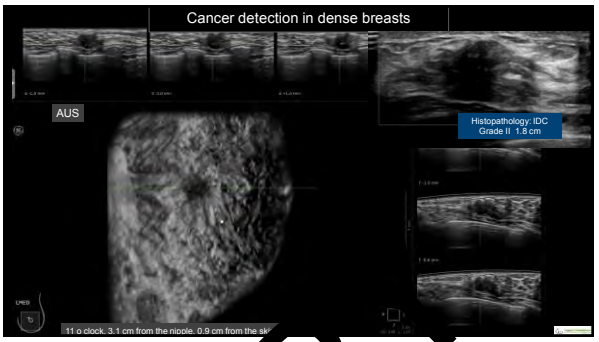


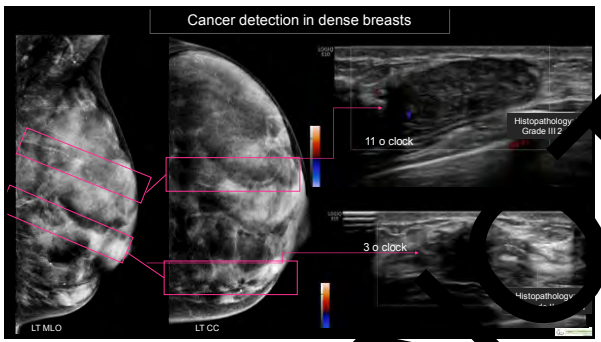


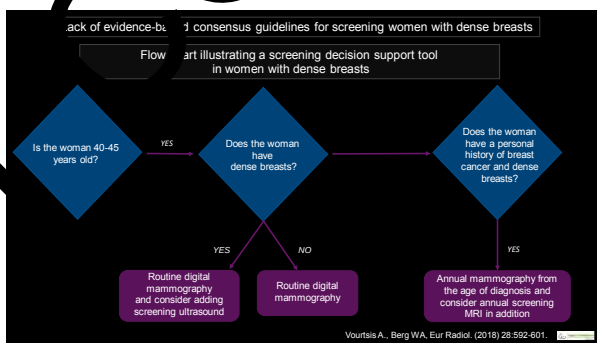


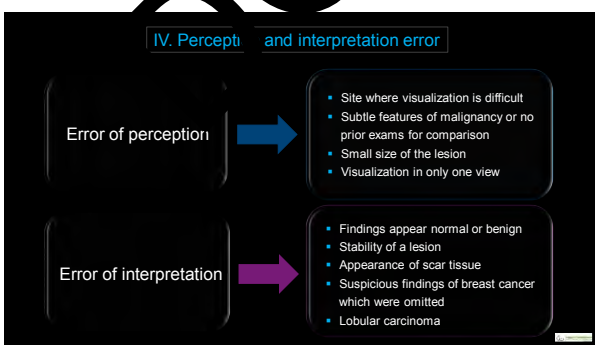


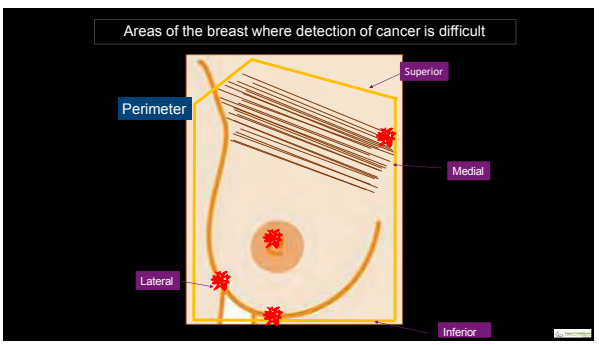

Cancer detection in dense breasts
AUS
Histopathology: IDC
Grade III 2.1 cm
3 o clock. 6.7 cm from the nipple. 0.6 cm from the skin

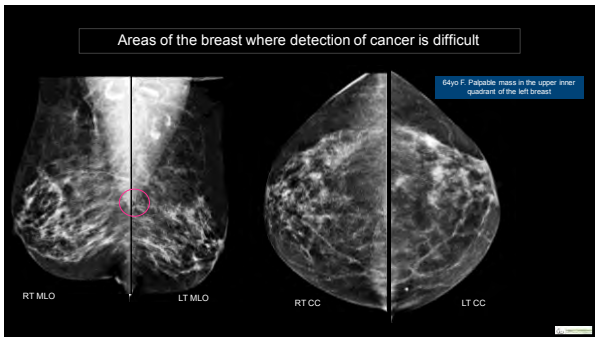

Cancer detection in dense breasts
AUS
Histopathology: IDC
Grade II 1.8 cm

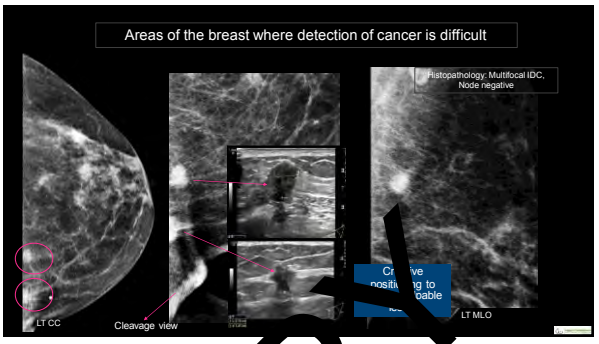

Cancer detection in dense breasts
11 o clock
3 o clock
LT MLO
LT CC

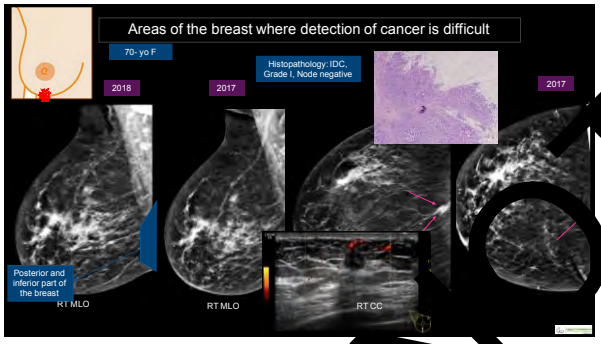

Flow art illustrating a screening decision support tool
in women with dense breasts
Is the woman 40-45 years old?
YES
Does the woman have dense breasts?
Does the woman have a personal history of breast cancer and dense breasts?
YES
NO
YES
Routine digital mammography and consider adding screening ultrasound
Routine digital mammography
Annual mammography from the age of diagnosis and consider annual screening MRI in addition
Vourtsis A., Berg WA. Eur Radiol. (2018) 28:592-601.

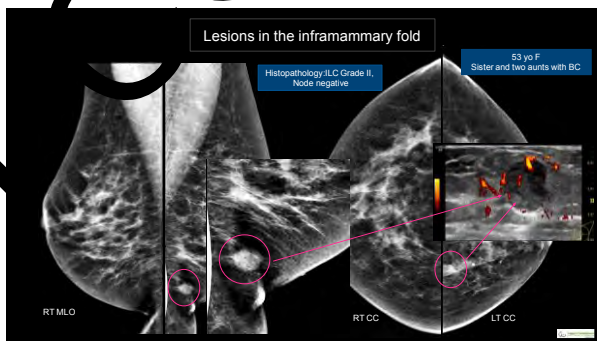

IV. Percepti and interpretation error
Error of perception
Site where visualization is difficult
Subtle features of malignancy or no prior exams for comparison
Small size of the lesion
Visualization in only one view
Error of interpretation
Findings appear normal or benign
Stability of a lesion
Appearance of scar tissue
Suspicious findings of breast cancer which were omitted
Lobular carcinoma

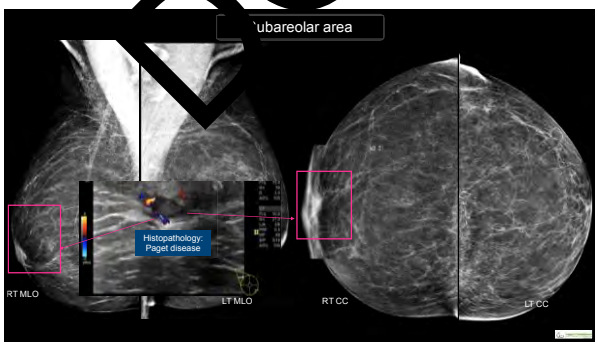

Areas of the breast where detection of cancer is difficult
Perimeter
Superior
Medial
Lateral
Inferior

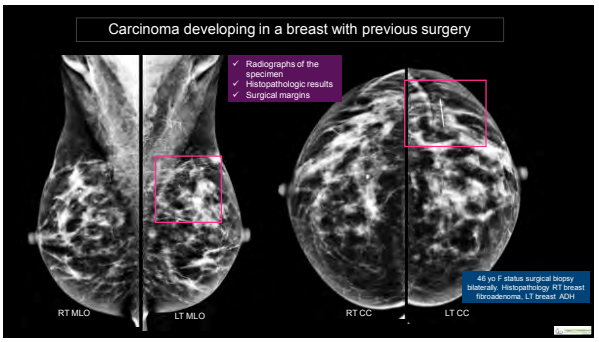

Areas of the breast where detection of cancer is difficult
64yo F. Palpable mass in the upper inner quadrant of the left breast
RT MLO
LT MLO
RT CC
LT CC

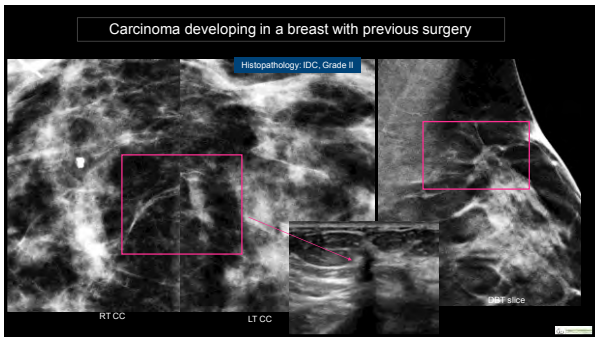

Areas of the breast where detection of cancer is difficult
Histopathology: Multifocal IDC, Node negative
LT CC
Cleavage view
LT MLO

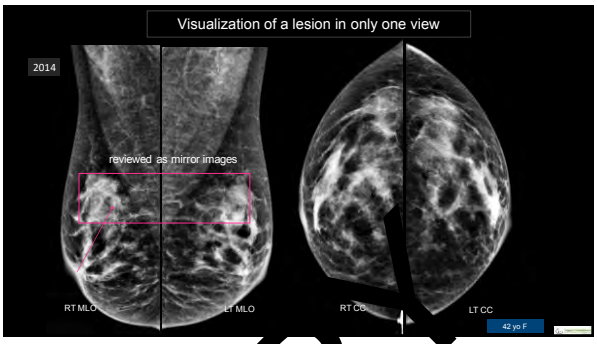

Areas of the breast where detection of cancer is difficult
70- yo F
2018
2017
Histopathology: IDC, Grade I, Node negative
2017
Posterior and inferior part of the breast
RT MLO
RT MLO
RT CC

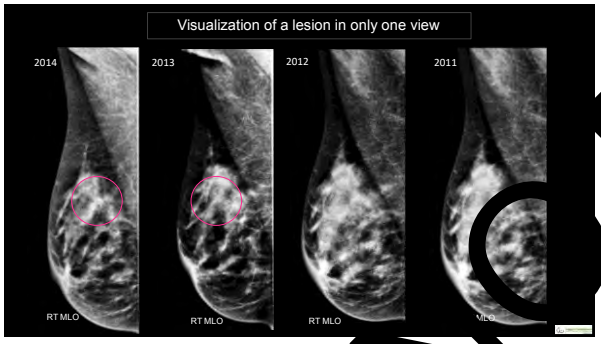

Lesions in the inframammary fold
Histopathology:ILC Grade II, Node negative
53 yo F
Sister and two aunts with BC
RT MLO
RT CC
LT CC

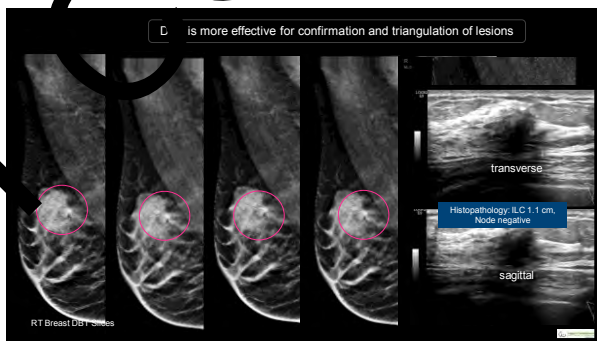

ubareolar area
Histopathology: Paget disease
RT MLO
LT MLO
RT CC
LT CC

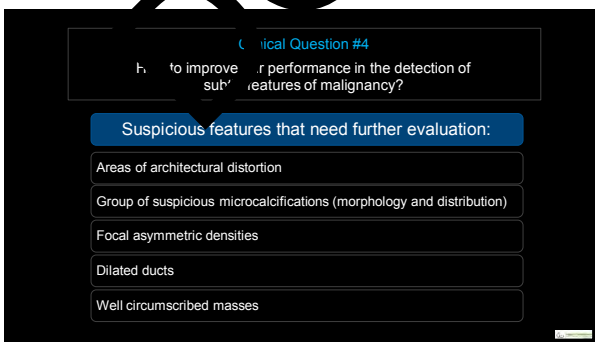

Carcinoma developing in a breast with previous surgery
✓ Radiographs of the specimen
✓ Histopathologic results
✓ Surgical margins
46 yo F status surgical biopsy bilaterally. Histopathology RT breast fibroadenoma, LT breast ADH
RT MLO
LT MLO
RT CC
LT CC

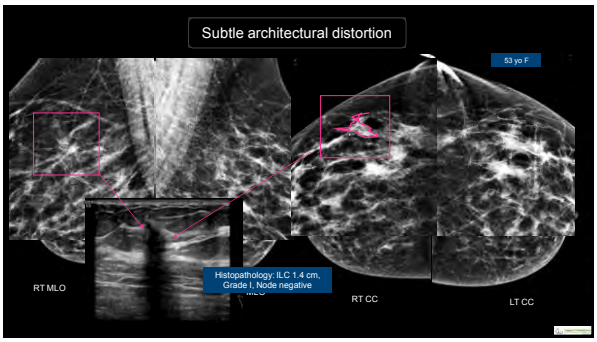

Carcinoma developing in a breast with previous surgery
Histopathology: IDC, Grade II
RT CC
LT CC
DBT slice

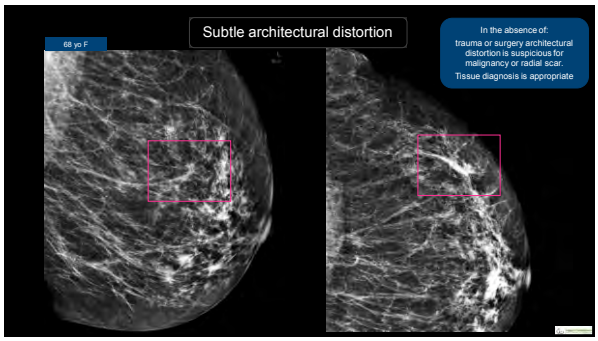

Visualization of a lesion in only one view
2014
reviewed as mirror images
RT MLO
LT MLO
RT CC
LT CC
42 yo F

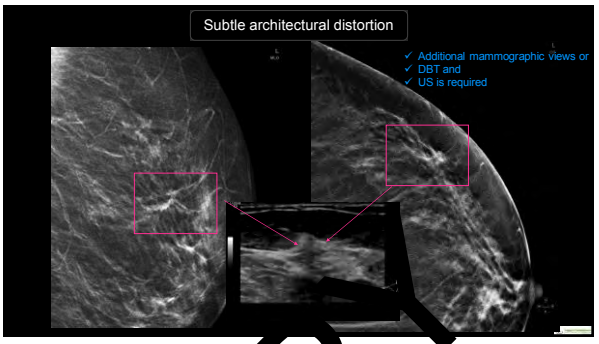

Visualization of a lesion in only one view
2014
2013
2012
2011
RT MLO
RT MLO
RT MLO

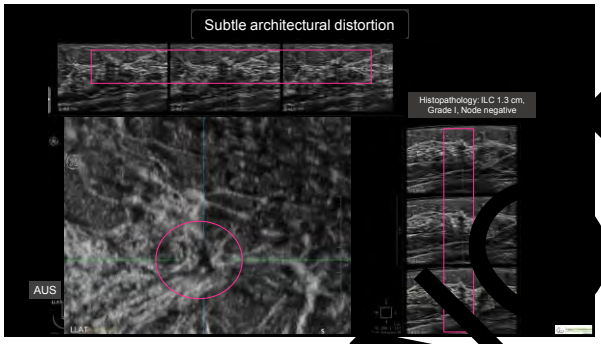

is more effective for confirmation and triangulation of lesions
transverse
Histopathology: ILC 1.1 cm, Node negative
sagittal
RT Breast DBT Slices

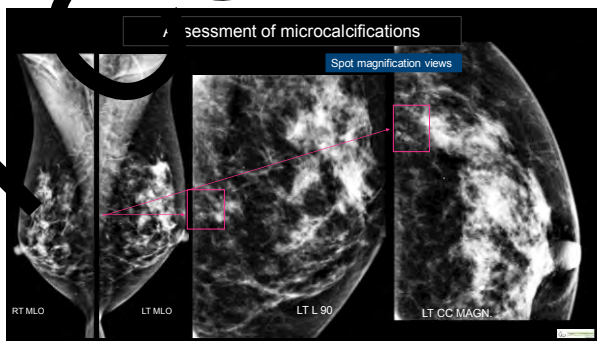

ical Question #4
to improve r performance in the detection of
features of malignancy?
Suspicious features that need further evaluation:
Areas of architectural distortion
Group of suspicious microcalcifications (morphology and distribution)
Focal asymmetric densities
Dilated ducts
Well circumscribed masses

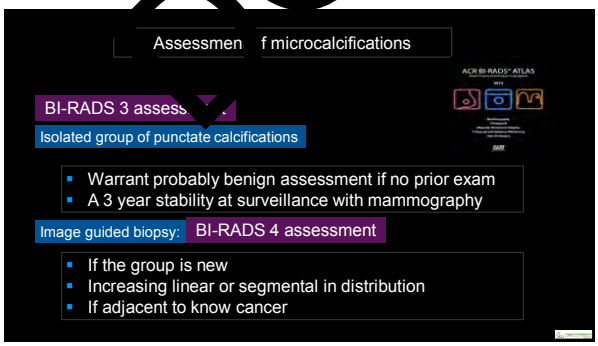

Subtle architectural distortion
53 yo F
RT MLO
Histopathology: ILC 1.4 cm, Grade I, Node negative
RT CC
LT CC

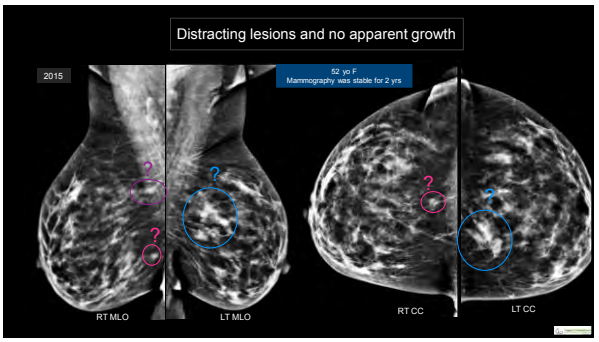

Subtle architectural distortion
68 yo F
In the absence of:
trauma or surgery architectural distortion is suspicious for malignancy or radial scar.
Tissue diagnosis is appropriate

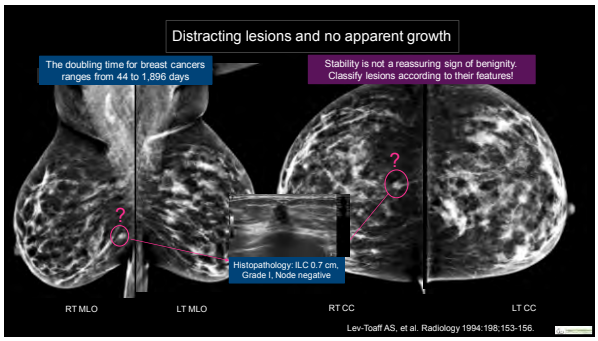

Subtle architectural distortion
✓ Additional mammographic views or
✓ DBT and
✓ US is required

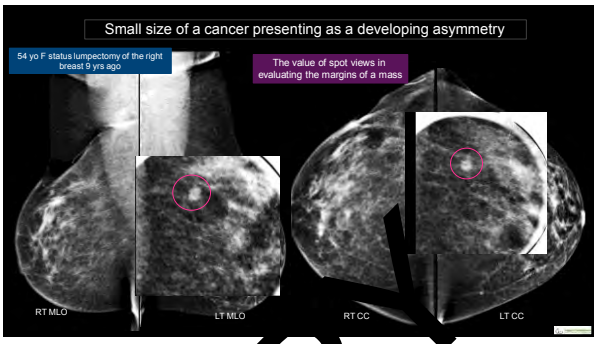

Subtle architectural distortion
Histopathology: ILC 1.3 cm, Grade I, Node negative
AUS

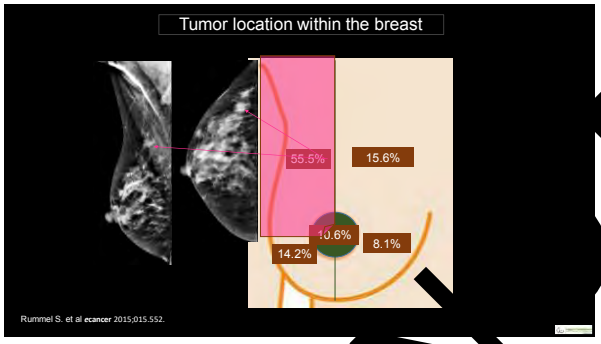

sessment of microcalcifications
Spot magnification views
RT MLO
LT MLO
LT L 90
LT CC MAGN

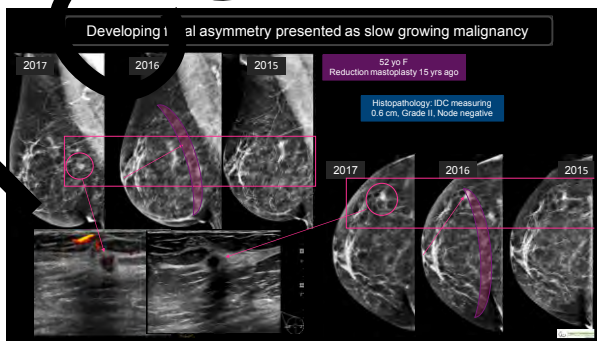

Assessmen f microcalcifications
ACR BI-RADS® ATLAS
BI-RADS 3 assess
Isolated group of punctate calcifications
Warrant probably benign assessment if no prior exam
A 3 year stability at surveillance with mammography
Image guided biopsy: BI-RADS 4 assessment
If the group is new
Increasing linear or segmental in distribution
If adjacent to know cancer

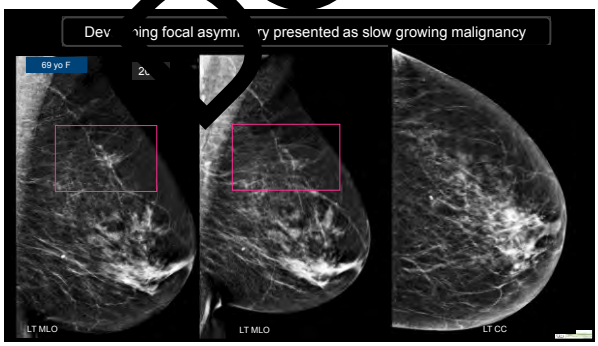

Distracting lesions and no apparent growth
2015
62 yo F
Mammography was stable for 2 yrs
RT MLO
LT MLO
RT CC
LT CC

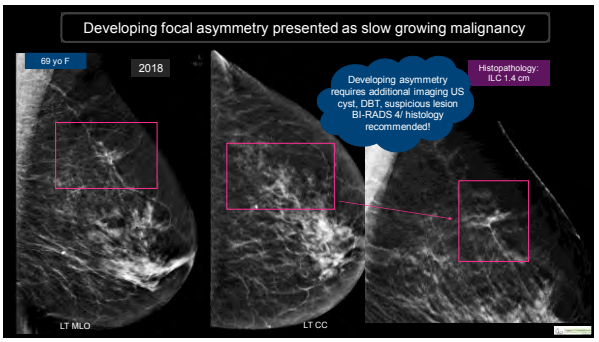

Distracting lesions and no apparent growth
The doubling time for breast cancers ranges from 44 to 1,896 days
Stability is not a reassuring sign of benignity. Classify lesions according to their features!
Histopathology: ILC 0.7 cm, Grade I, Node negative
RT MLO
LT MLO
RT CC
LT CC
Lev-Toaff AS, et al. Radiology 1994;198;153-156.


Small size of a cancer presenting as a developing asymmetry
54 yo F status lumpectomy of the right breast 9 yrs ago
The value of spot views in evaluating the margins of a mass
RT MLO
LT MLO
RT CC
LT CC


Tumor location within the breast
55.5%
15.6%
10.6%
8.1%
14.2%
Rummel S. et al ecancer 2015;015:552.


Developing focal asymmetry presented as slow growing malignancy
2017
2016
2015
52 yo F
Reduction mastoplasty 15 yrs ago
Histopathology: IDC measuring 0.6 cm, Grade II, Node negative


69 yo F
LT MLO
LT MLO
LT CC

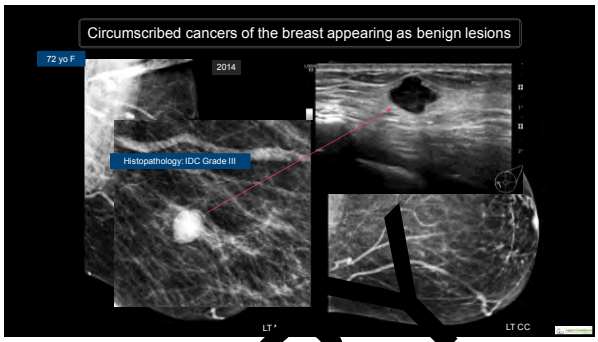

Developing focal asymmetry presented as slow growing malignancy
69 yo F
2018
Developing asymmetry requires additional imaging US cyst, DBT, suspicious lesion BI-RADS 4/ histology recommended!
Histopathology: ILC 1.4 cm
LT MLO
LT CC

Circumscribed cancers of the breast appearing as benign lesions

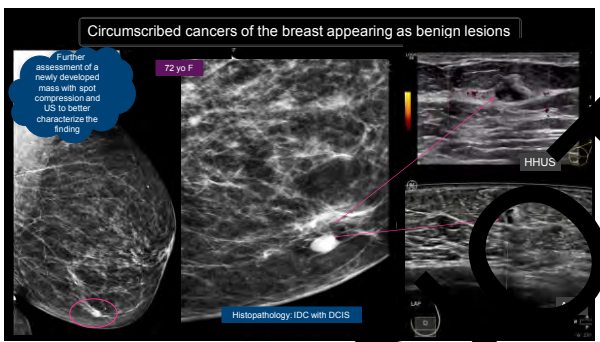
Further assessment of a newly developed mass with spot compression and US to better characterize the finding

- Invasive ductal Ca (NOS)
- Medullary carcinoma
- Mucinous carcinoma
- Papillary carcinoma
- Adenoid cystic carcinoma

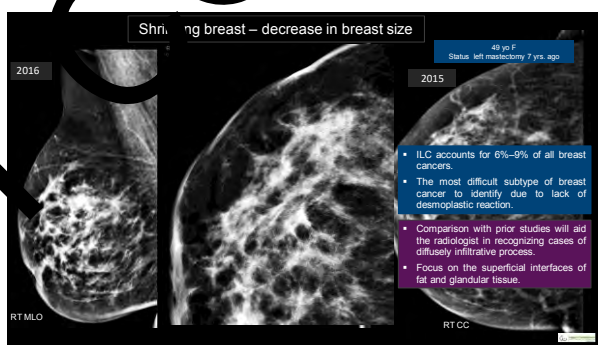
Circumscribed cancers of the breast appearing as benign lesions



Circumscribed cancers of the breast appearing as benign lesions



Shri… ng breast – decrease in breast size



- ILC accounts for 6%–9% of all breast cancers.
- The most difficult subtype of breast cancer to identify due to lack of desmoplastic reaction.
- Comparison with prior studies will aid the radiologist in recognizing cases of diffusely infiltrative process.
- Focus on the superficial interfaces of fat and glandular tissue.

Ta… home messages

How can we i… ve our perfo… ance and eliminate the possibility of missing lesi… in mammography?

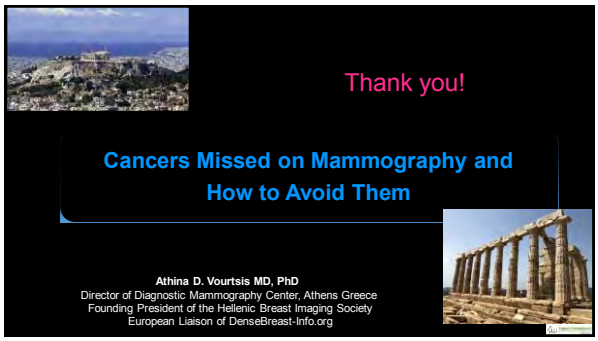
Consistent production of high-quality mammographic images	Use a consistent reading protocol and adopt mirror image interpretation	Adopt supplemental screening in women with dense breasts	Accelerate your experience with various images of subtle malignancies
• Proper positioning. • Adequate compression. • Keep compliance with the FDA's regulations. • Responsibility of the physician for the production of high quality images.	• Use a complete diagnostic work-up for any suspicious lesion. • Apply double reading and / or CAD. • Avoid interpreting mammogram under inappropriate conditions. • Correlate imaging with prior mammograms, US and patient's history.	• Understand the implications of breast density. Look for subtle findings when evaluating a dense breasts. • Perform biopsy when a suspicious lesion is detected.	• Use magnification or spot views. • Cancer may present as a circumscribed mass. • Stability does not indicate a benignity. • ILC – may appear as a shrinking breast.

Take home messages

Mistakes are inevitable when practicing in medicine
Mammography is not a perfect modality!

Minimize our mistakes as much as possible!

SAVE MORE LIVES!


Thank you!
Cancers Missed on Mammography and How to Avoid Them
Athina D. Vourtsis MD, PhD
Director of Diagnostic Mammography Center, Athens Greece
Founding President of the Hellenic Breast Imaging Society
European Liaison of DenseBreast-Info.org