Why breast CT?

Avice M O'Connell MD,FACR,FSBI.
Director, Women's Imaging
Professor, Imaging Sciences
University of Rochester

AAPM 8/3/2016

Why do we need Breast CT?

- Who does not have a loved one who had breast cancer ?
- Breast cancer #1 cancer in US women (excluding skin cancer)
- #2 cause of cancer death in US women
- 44,000 women die each year

We screen for breast cancer

- Small <1cm
- Early-no nodes (>98% 5 year survival)

Small cancers

- Less invasive surgery
- Less axillary lymph node surgery
- Less radiation
- Less or no chemotherapy

Gold standard

- Mammography
- Deaths down >30 % past 20 years
- Unchanged for prior 50 years

Design an imaging device

- Object : to find small white cancers
- In a breast which is a 3D object
- Where fat is black
- everything else is white

…glandular tissue, connective tissue cysts ,fibroadenomas …and cancer

Current imaging of the breast

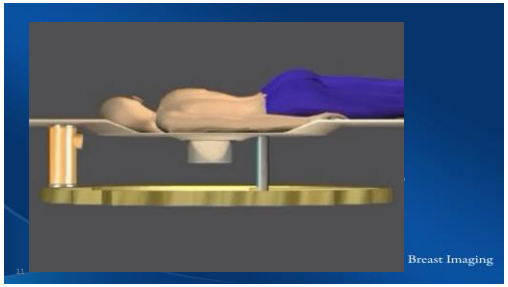
- First transform it from 3D to 2D
- Then use compression- >25 pounds
- That's uncomfortable !
- Do it at least twice (2 views minimum)
- Find something -need spots,mags, laterals, all extra views, all with compression

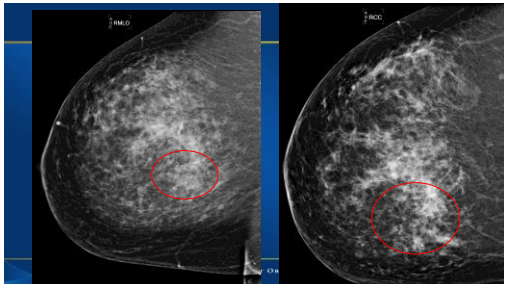
To image the breast

- Then maybe do ultrasound
- And maybe needle biopsy
- Now, how's the patient doing?

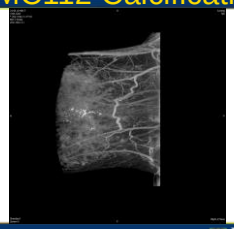
Consider dedicated breast CT

- one acquisition
- “manipulate the image, not the patient”
- Can do high res 0.122 mm
  -(standard 0.273mm)
- Co-register all findings
- correlate a finding seen on one view





URMC112 Calcifications



Mammo sensitivity

- 85% at best
- <50% in dense breasts
- >40 % women in the US have dense breasts
- Increased risk of cancer in dense vs fatty (4-6x relative risk)

Problems with mammography

- Dense tissue
- Compression
- Uncomfortable
- Need something better

We need 3 D imaging

- Breast is a 3D structure
- Compression causes tissue overlap
- Mammography has distortion –false positives and false negatives
- Women don't like it!

We have tomosynthesis

- Tomo is a better mammogram
- But tomo is not truly 3 D
- It is 2D reconstructed to "3D"
- It still needs compression and 2 views per breast
- Doubles radiation dose of mammogram

We have 3D ultrasound

Whole breast

Reconstructed to 3D

Need to correlate with mammo

ACRIN 6666 (2008)

- Sensitivity of mammography- 50%
- Ultrasound added to mammography- 77.5%
- But PPV for biopsy<10%
  -(91.4% biopsies were benign)
- Cost >$60,000 per cancer

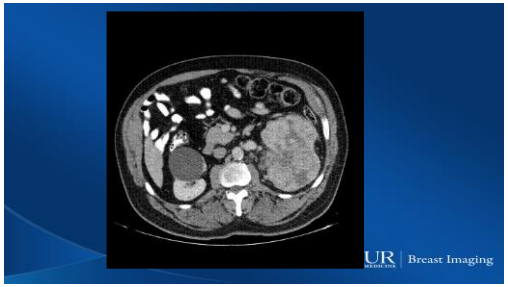
We have MRI

- Prone, no compression
- Contraindications
- Claustrophobia
- Contrast
- Cost

Imaging as a science evolves

- Roentgen invented Xrays 1895
- We had plain radiographs
- Linear Tomo
- CT
- MRI
- Molecular imaging- BSGI,PET

eg Renal imaging



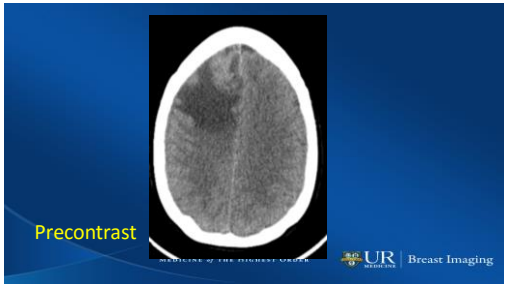
We need contrast

Most cancer imaging needs contrast

MRI most sensitive-uses contrast

But costly and time consuming

Cancer Imaging- eg Brain



Contrast mammography ?

- Good idea but ….
- Upright patient
- Still Need 2 views per side
- One side at a time
- Compression may affect vascular
- Timing

Dedicated breast CT

- Better for dense breasts
- Contrast ready
- Can reduce recalls -BIRADS 0
- Reduce need for ultrasound -BIRADS 0
- Reduce short interval follow ups -BIRADS 3
- Reduce number of biopsies - BIRADS 4

Dedicated breast CT

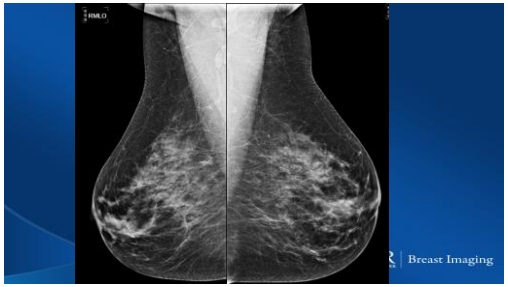
- One “view”/acquisition (10 sec 360 degree)
- Contrast ready
- May substitute for MRI
- More comfortable
- Less costly

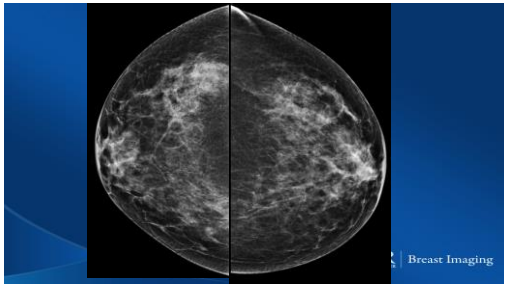
Capabilities of CBCT

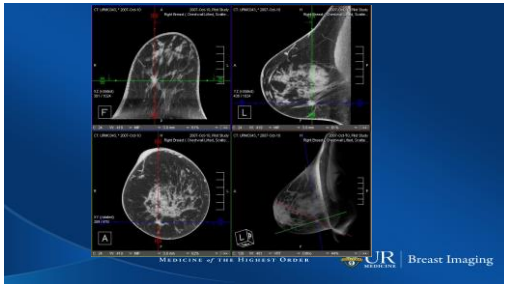
- Good for dense (4-6x risk of dense vs fatty)
- Good for calcs -standard res. 0.273 mm
  -hi res. 0.122mm
- Microcalcs <0.5mm-0.1mm
- Good for masses

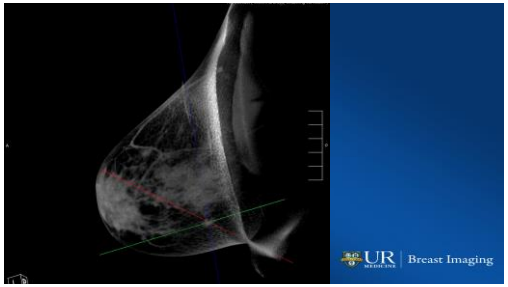
Examples -dense

- Screening with small cancer




Breast Imaging


Medicine of the Highest Order
UR
Breast Imaging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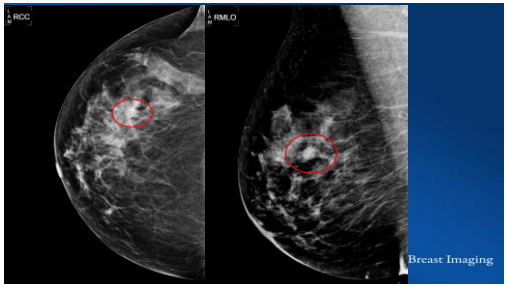
Breast Imaging

Dense with asymmetry

- BIRADS 0



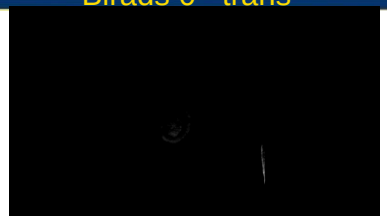
Dense with asymmetry

- Is it real?

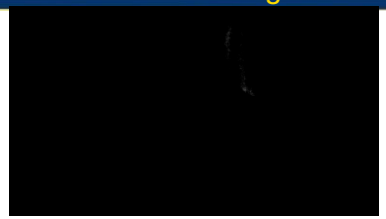
Work up

- Spot CC,spot MLO,90 degree lateral
- Ultrasound
- So, which quadrant?

Birads 0 trans



Birad 0-sag

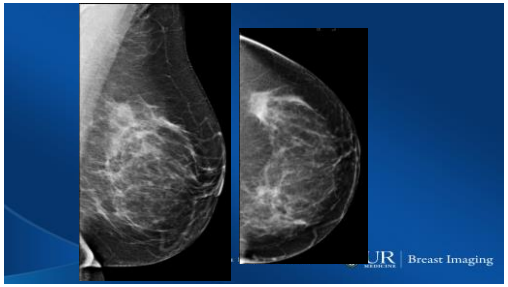


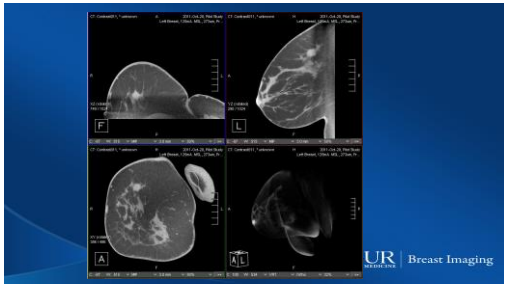
Final

- Negative-not real
- “False positive” mammogram

This one is real

- But which quadrant?

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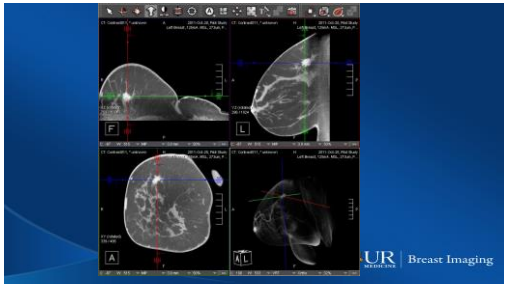
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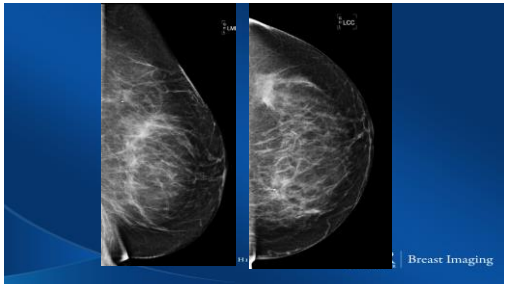
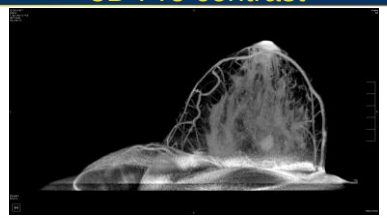
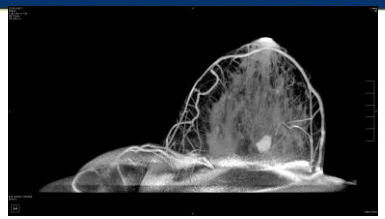

Breast Imaging

3D Pre contrast



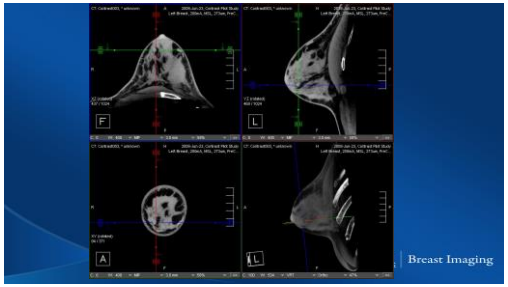
Post contrast

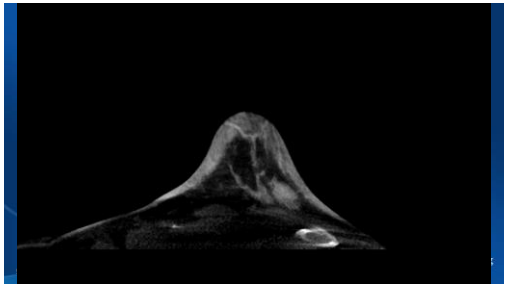


Example avoid biopsy

Palpable mass

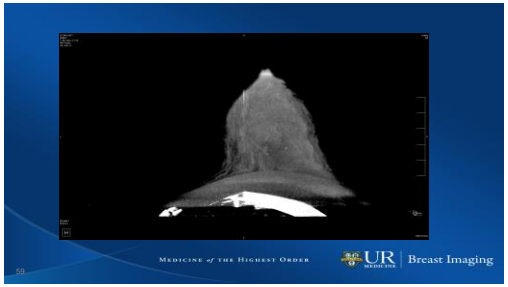
- 4 mammo views-CC,MLO tan mag and 90
- targeted ultrasound
- CT one “view”

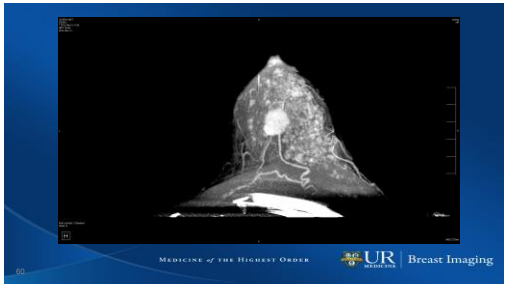




“Extent of disease” evaluation

- Compare with MRI





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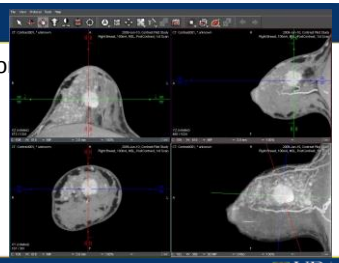
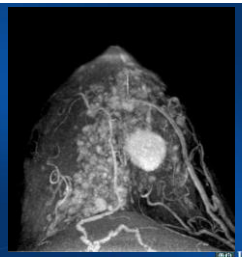


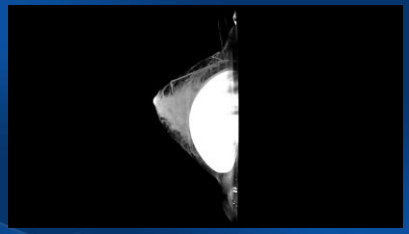


Something different

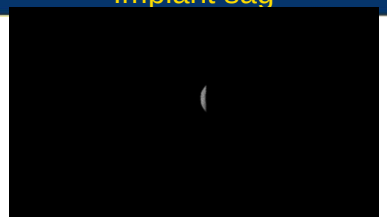
- Implants

Routine screening with Implant

- CC, MLO
- ID views-CC,MLO
- Add tomo?



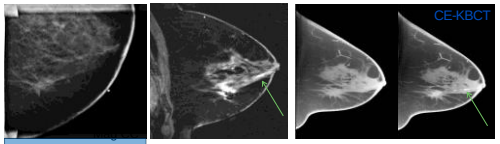
Implant sag



Example CT vs MRI

- Occult cancers:
- After diagnosis or high risk screen
- Cost x10
- Both prone
- Both iv
- MRI 40 mins table time CBCT ~10 mins

CE-CBCT vs MRI



Case 2: 45 y/o female presents with left breast lump at 6:00 position

Stereo core biopsy:

MRI | CE-KBCT Pre contrast | CE-KBCT Post contrast

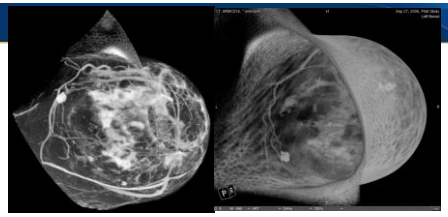
CE-KBCT correlates well with MRI but with higher resolution and more detail

Resolution of MRI

- 3T: in plane spatial resolution can be 0.8mm x0.8mm
  Slice thickness down to 1.8 mm
- 1.5T : Spatial res can be 1.03x1.03mm
  Slice thickness down to 2mm
- CBCT: isotropic 0.273mm down to 0.155mm

More…

- Biopsy capability-accurate targeting of asymmetry
- Evaluate vasculature around tumors



3D volume rendering of a breast illustrating a fibroadenoma and blood vessels as small as ~1 mm without IV contrast.
Images have different Window/Level values to bring out different breast tissue densities.

Why do we need Breast CT?

- It's better than mammogram
- Better than tomosynthesis
- At least as good as MRI
- It is the latest in the evolution of breast imaging for breast cancer

40,000 women need us