Missed Breast Cancers: Identifying Blind Spots and Improving Detection in Mammography

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1

Why Missed Breast Cancers Matter?

Our Patients



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Why Missed Breast Cancers Matter?

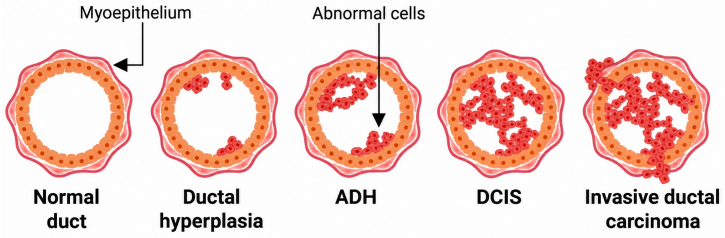
Early detection matters:

- Some breast cancers can grow over time
- Earlier diagnosis may affect treatment options and patient outcomes

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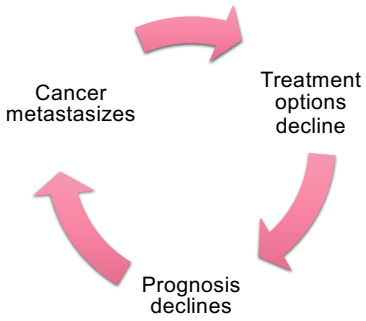
Breast Cancer Growth Over Time



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Some Breast Cancers Worsen Over Time



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Why is Image Quality So Important in Mammography?

TO FIND SMALL BREAST CANCERS!

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What is a Missed Breast Cancer on Mammography?

A cancer diagnosed after a negative mammogram:

- A cancer may have been visible in retrospect
- A cancer that was not visible on the mammogram



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Key Terms for Missed Breast Cancers

- False-negative
- Interval cancer
  - True interval cancer
  - Missed interval cancer
- Mammographically occult cancer

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False-Negative

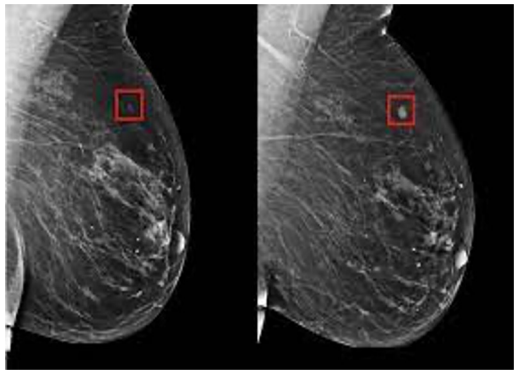
- Looks normal on mammogram even though breast cancer is present
- May delay follow-up when symptoms or concerns continue
- Cancer may be diagnosed later, after cancer has grown or spread
- Can give the patient false sense of security, even though cancer is present



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False-Negative Mammogram



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Interval Cancer

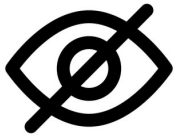
- Diagnosed between scheduled screenings
- May grow quickly between screening exams
- Often detected after symptoms develop or a person notices a change in their breast

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True Interval Cancer

- Not visible on the previous screening mammogram, even on retrospective review
- Diagnosed between scheduled screening exams
- More likely to be larger, higher grade, and have features associated with faster growth



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Missed Interval Cancer

- Tumors that were overlooked or misread
- Found retrospectively after re-examination of the images
- Tend to be larger and more advanced than screen-detected cancers
- Can cause a delay in diagnosis

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Mammographically Occult Cancer

- Not visible on mammography
- May be obscured by dense breast tissue
- May not form a distinct mass or typical calcifications



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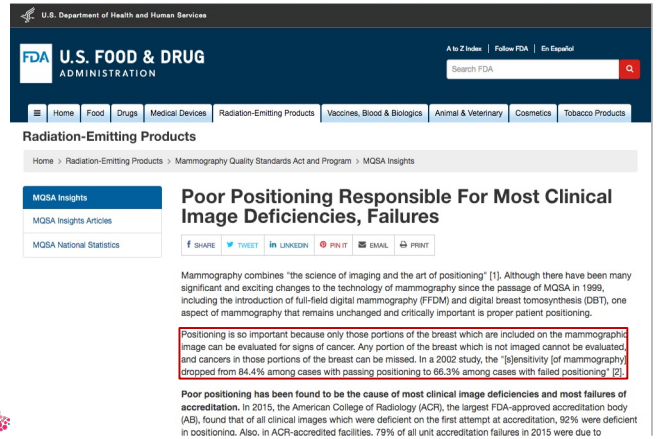
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Factors That Can Limit Mammographic Detection

- Improper Positioning Techniques
- Different Cancer Characteristics and Features
- Dense Breast Tissue Composition

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Source: U.S. Food & Drug Administration, 2017

16

US Food and Drug Administration

- "In a 2002 study, the '[s]ensitivity [of mammography] dropped from 84.4% among cases with passing positioning to 66.3% among cases with failed positioning'."
- "Poor positioning has been found to be the cause of most clinical image deficiencies and most failures of accreditation." (92%)

Source: U.S. Food & Drug Administration, 2017

17

Decreased Sensitivity

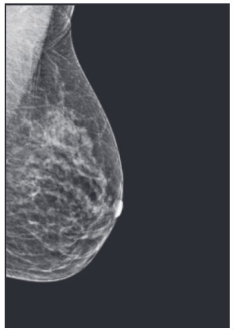
- 84.4% with proper positioning
- 66.3% with failed positioning

= 18.1% decreased sensitivity

18

Improper Positioning Techniques

- Incomplete Breast Tissue Coverage
- Inadequate Compression



19

Improper Positioning Techniques

- **Incomplete Breast Tissue Coverage**
- Inadequate Compression

20

Potential Blind Spots in Mammography

Incomplete Breast Tissue Coverage:

- Posterior tissue
  - Near the chest wall/pectoralis muscle
  - Inframammary fold
- High axillary tissue



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Potential Blind Spots in Mammography

Incomplete Breast Tissue Coverage:

- **Posterior tissue**
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  - Inframammary fold
- High axillary tissue

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Possible Causes of Missing Posterior Tissue

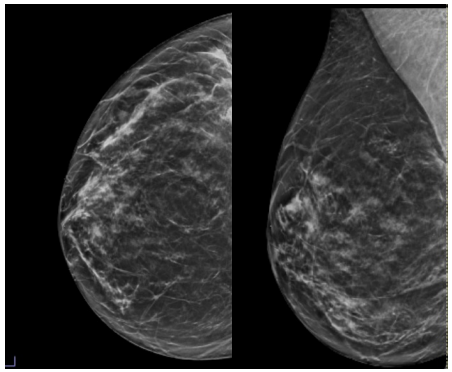
- Inadequate pulling of posterior tissue onto the image
  - Poor pectoralis muscle visualization
  - Poor visualization of the inframammary fold
- Lack of standardized positioning training

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Missing Posterior Tissue

SCREENING MAMMOGRAM

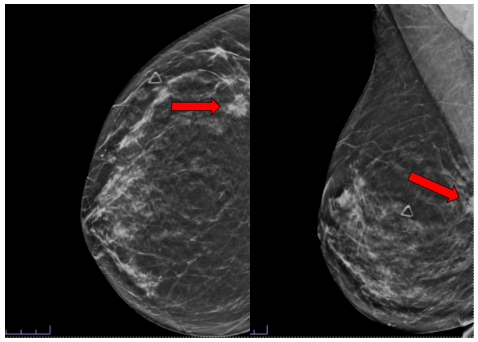


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Missing Posterior Tissue

1 MONTH LATER

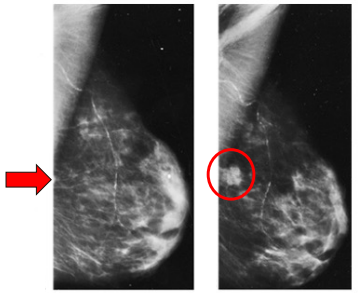


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Missing Posterior Tissue on the MLO View

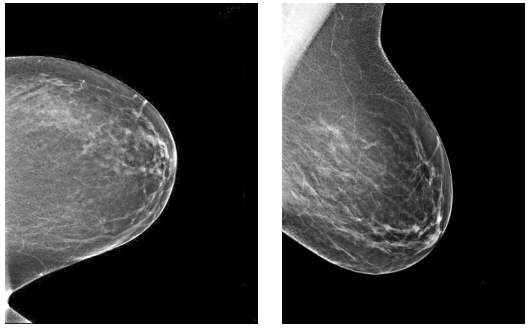
Cancer hidden near pec muscle



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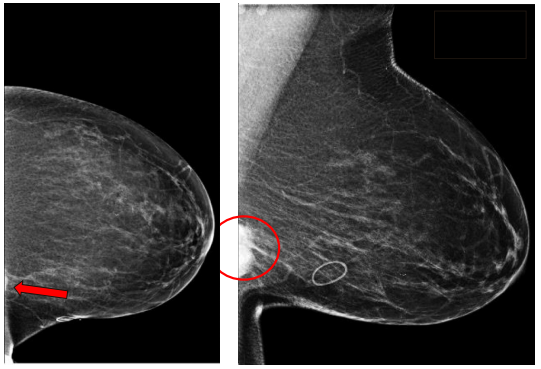
Missing Posterior Tissue Near the Chest Wall and IMF



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Cancer Hidden Near the Chest Wall and IMF



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Potential Blind Spots in Mammography

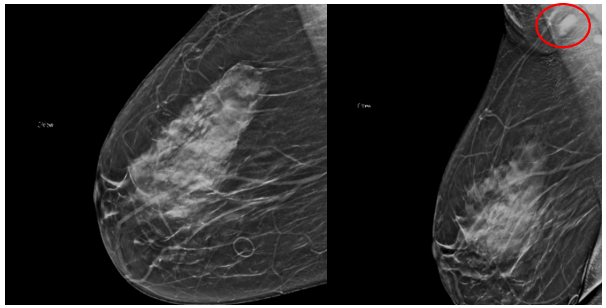
Incomplete Breast Tissue Coverage:

- Posterior tissue
  - Near the chest wall/pectoralis muscle
  - Inframammary fold
- **High axillary tissue**

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High Axillary Tissue

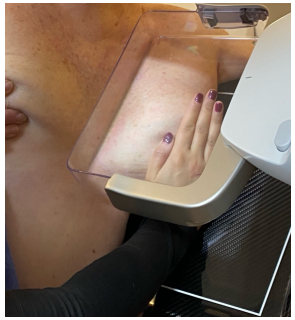


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Avoid Tissue Cut Off

- Select the proper compression paddle size
- Keep breast tissue within the detector
- Consider additional views, if needed



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Why Standardized Positioning Matters

- Includes more posterior breast tissue
- Reduces potential blind spots
- Supports consistent image quality



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Quick Steps for the CC (Left)

___ 1. Elevate breast/IMF (until the PNL is perpendicular to the chest wall)
___ 2. Adjust IR height (so top edge is parallel with elevated IMF)
___ 3. Pull the breast onto the IR with both hands (left hand on top; right hand on bottom) and at the same time ask the patient to step forward into the machine (no leaning) and have them turn their face towards you
___ 4. Switch hands, so your right hand is on the top (palm down) and anchor the breast with the base of your right thumb.
___ 5. Lift the opposite/contralateral breast onto the IR with your left hand, palm facing up; then ask the patient to turn their right hip forward.
___ 6. Guide the patient's head forward and around the face shield, if possible
___ 7. Place your left elbow and forearm at the mid thoracic region (where their bra clasp would be) and gently push the patient forward
___ 8. Relax patient's left shoulder with your left hand, if possible
___ 9. Pull superior breast tissue forward by placing the base/edge of your right thumb on top of the breast against the chest wall, then apply compression while continuing to "push" the patient forward

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Source: Mammography Educators

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Positioning the CC View

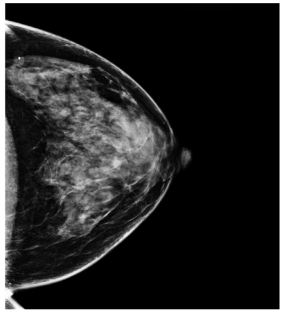


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CC View

- Visualization of glandular tissue back to the retromammary fat space
- Visualization of all posterior breast tissue
- PNL within 1cm of PNL measurement on the MLO
- Visualization of medial breast tissue (cleavage)
- Visualization of pectoralis muscle on approximately 50% of all CCs



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Quick Steps for the MLO (Left)

___ 1. Stand perpendicular to the patient with your sternum pressing against patient's right humerus
___ 2. Lift patient's left shoulder/arm up over the corner of the IR with your right hand in the patient's axilla. At the same time, your right hand should "meet" your left hand in the axilla and help to lift the patient's left shoulder up and over the IR
___ 3. IR is placed in back of axilla (just interior to latissimus dorsi)
___ 4. Patient's left hand should be resting on bar, with their elbow bent behind the IR
___ 5. Place your left hand on patient's left shoulder (if possible) to keep their shoulder relaxed and down
___ 6. Your right hand, with palm facing up, slides down lateral side of the breast to pull on lateral breast tissue and smooth out any skin folds
___ 7. Once your right hand is at the bottom of the breast, turn your hand over so that your hand is now palm down on the breast with the base of your thumb just anterior to the IMF
___ 8. Push the breast up and out with the base of your thumb, keeping continuous contact with the breast
___ 9. At the same, ask the patient to lift and flatten their other breast, as needed
___ 10. Continue to hold the breast in the up and out position until compression is complete

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Source: Mammography Educators

36

Positioning the MLO View

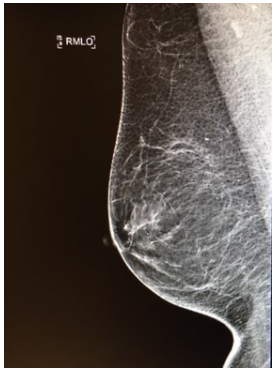


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MLO View

- Inclusion of all breast tissue within perimeter
- Pectoralis muscle fully visualized
- Tissue well separated
- Tissue visualized back to retromammary fat space
- PNL within 1 cm of PNL measurement on CC
- Visualization of the IMF
- No excessive sagging

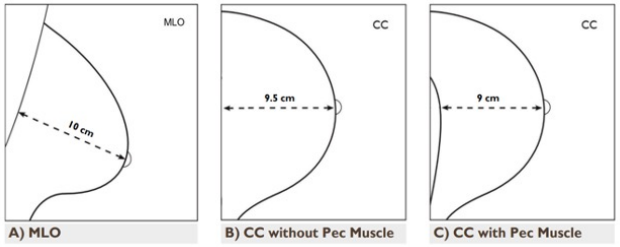


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How to Properly Measure the PNL

PNL measurement of CC should be within 1cm of the PNL measurement on the MLO



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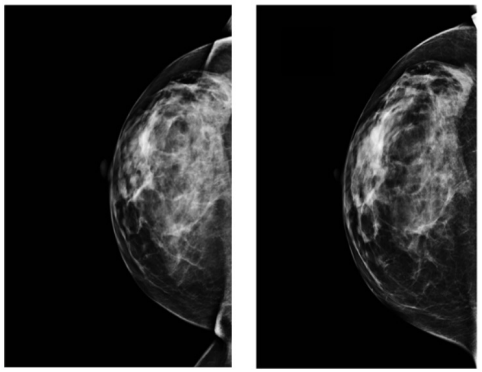
Improper Positioning Techniques

- Incomplete Breast Tissue Coverage
- **Inadequate Compression**

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Inadequate Compression



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Possible Causes of Inadequate Compression

- Patient in pain, breast tenderness
- Patient anxious
- Previous breast surgery
- Iatrogenic devices:
  - Pacemakers
  - Loop recorder
  - Defibrillator
  - Ports



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Compression Criteria

- General rule of thumb: 10% difference between side to side
- Higher compression reading (approximately 15-20% higher) between view to view
- Compress until “taut”– or until less than painful
- Glandular tissue should be well separated



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Source: Huppe et al., 2017

43

Importance of Adequate Compression

- Improves image quality (increased visualization of posterior tissue)
- Reduces motion blur
- Lowers radiation dose
- Decreases scatter radiation
- Reduces repeat images



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Lack of Standardized Positioning Training

Leads to:

- Less consistency and reproducibility
- More accreditation failures
- **MISSED BREAST CANCERS**

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Factors That Can Limit Mammographic Detection

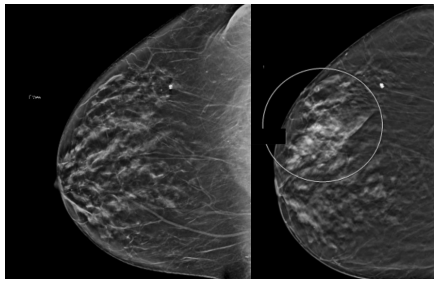
- Improper Positioning Techniques
- **Different Cancer Characteristics and Features**
- Dense Breast Tissue Composition

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Different Cancer Characteristics and Features

- Cancer was too small or not visible at time of exam
- Some cancer features are difficult to detect on mammography



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Breast Cancer Features That Can Be Hard to See

- Cancers that grow without forming a clear lump
- Subtle changes in tissue pattern
- No visible calcifications



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Factors That Can Limit Mammographic Detection

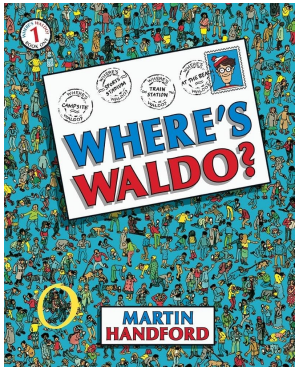
- Improper Positioning Techniques
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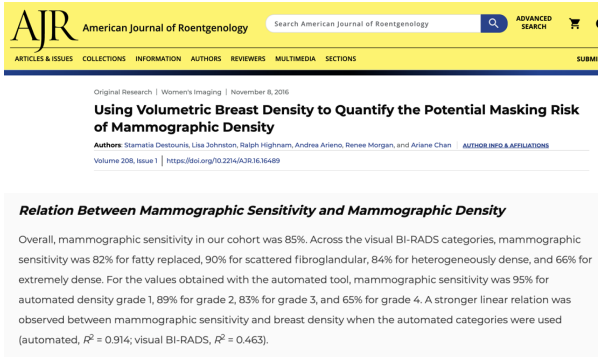
Dense Breast Tissue Composition

- Dense tissue can mask cancers
- Decreased sensitivity



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Original Research | Women's Imaging | November 8, 2016

Using Volumetric Breast Density to Quantify the Potential Masking Risk of Mammographic Density

Authors: Stamatia Destounis, Lisa Johnston, Ralph Highnam, Andrea Arieno, Renee Morgan, and Ariane Chan | AUTHOR INFO & AFFILIATIONS

Volume 208, Issue 1 | https://doi.org/10.2214/AJR.16.16489

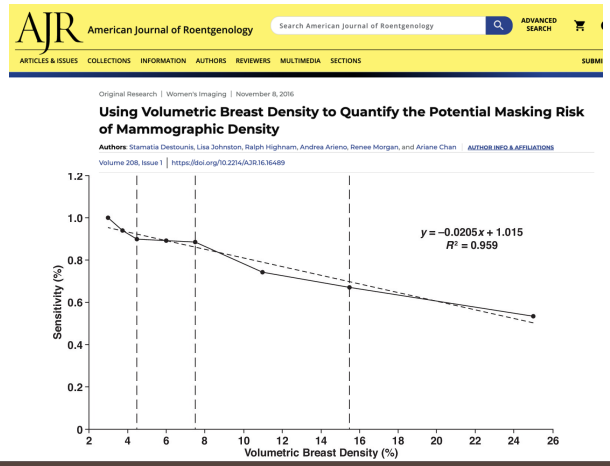
Relation Between Mammographic Sensitivity and Mammographic Density

Overall, mammographic sensitivity in our cohort was 85%. Across the visual BI-RADS categories, mammographic sensitivity was 82% for fatty replaced, 90% for scattered fibroglandular, 84% for heterogeneously dense, and 66% for extremely dense. For the values obtained with the automated tool, mammographic sensitivity was 95% for automated density grade 1, 89% for grade 2, 83% for grade 3, and 65% for grade 4. A stronger linear relation was observed between mammographic sensitivity and breast density when the automated categories were used (automated, $R^2 = 0.914$; visual BI-RADS, $R^2 = 0.463$).

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Source: Destounis, 2016

51


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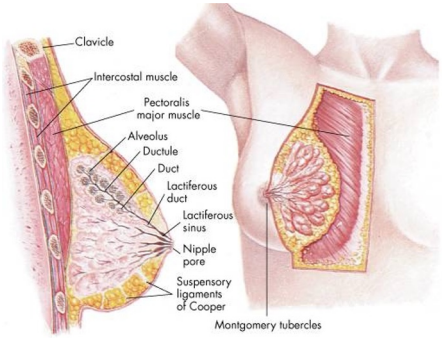
Volume 208, Issue 1 | https://doi.org/10.2214/AJR.16.16489

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Source: Destounis, 2016

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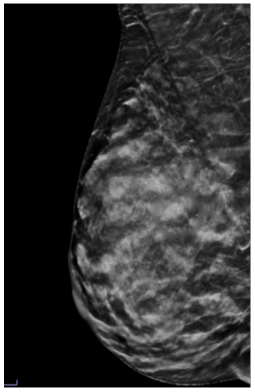
Breast Anatomy – Dense Breast Tissue



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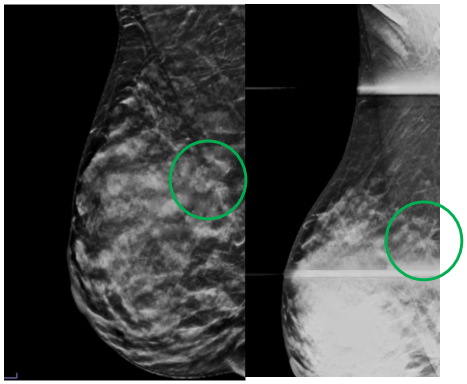
Dense Breasts



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Dense Breasts



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What can we do to address mammography blind spots?



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56

Digital Breast Tomosynthesis (DBT)

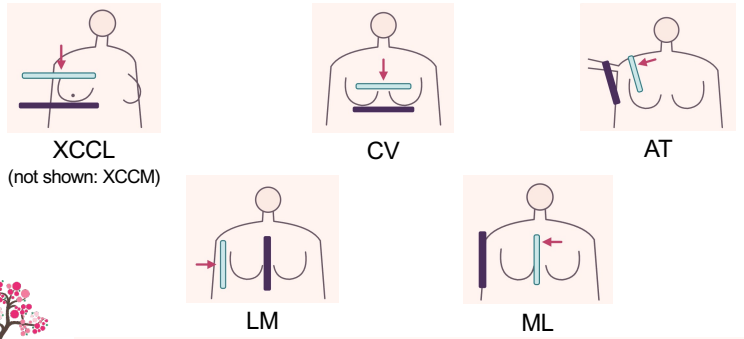
- Takes low-dose X-ray images from multiple angles
- Reconstructs images into thin slices
- Helps separate overlapping structures
- Can reduce tissue overlap as a source of masking



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Additional Views



Source: Mammography Educators

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Supplemental Screening

- Adds a different way to look for cancer in selected patients
- Based on individual risk and breast density
- Used in addition to mammography
- Does not replace mammography

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Reasons for Supplemental Screening

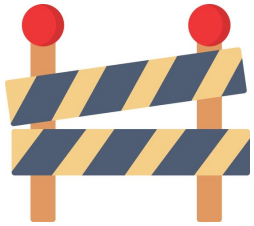
- Dense breast tissue can hide cancers
- Overlapping tissue can mimic or hide abnormalities
- Symptomatic patients still need evaluation even though the mammogram appears normal

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Barriers to Supplemental Screening

- Cost and insurance coverage
- Availability of equipment and trained staff
- Distance to a facility offering the exam



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Types of Supplemental Screening

- Breast MRI
- Breast Ultrasound
- Contrast-Enhanced Mammography (CEM)

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Types of Supplemental Screening

- **Breast MRI**
- Breast Ultrasound
- Contrast-Enhanced Mammography (CEM)

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Breast MRI

- No ionizing radiation
- Uses radio waves and powerful magnets
- Gadolinium-based contrast dye is used to enhance the appearance of abnormal breast tissue

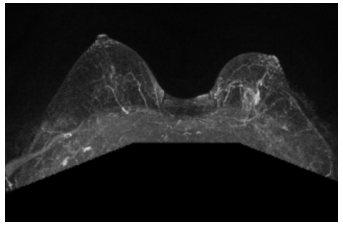


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Breast MRI

- Highly sensitive supplemental screening tool, used in addition to mammography
- Recommended for high-risk individuals
- May be considered for dense breast evaluation
- May be used as surveillance in women previously diagnosed with breast cancer



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Types of Supplemental Imaging

- Breast MRI
- **Breast Ultrasound**
- Contrast-Enhanced Mammography (CEM)

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Breast Ultrasound

- No ionizing radiation
- Uses high-frequency sound waves
- Can be performed handheld or with Automated Breast Ultrasound (ABUS)
- May reveal cancers that are difficult to see on a mammogram

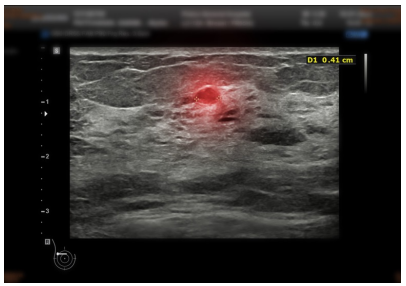


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Breast Ultrasound

- For selected patients with dense breasts
- Option for patients who cannot undergo contrast-enhanced imaging, such as MRI
- Not a replacement for mammography



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Types of Supplemental Imaging

- Breast MRI
- Breast Ultrasound
- **Contrast-Enhanced Mammography (CEM)**

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69

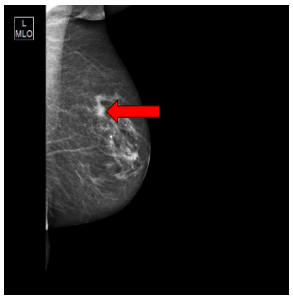
Contrast-Enhanced Mammography (CEM)

- Involves injecting iodine-based dye shortly before a mammogram
- Creates dual-energy images highlighting areas of contrast enhancement
- May be used for diagnostic evaluation and supplemental screening in selected patients
- Considered for selected patients who are unable to have an MRI

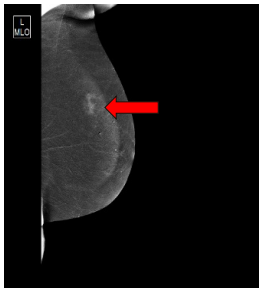
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70

Contrast-Enhanced Mammography (CEM)



2D



CEM

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Courtesy of: Belinda Zaparinuk R.T.(M),BS,CRT,ARRT,CBEC,FNCBC

71

What Can We Do As Technologists to Help Reduce Mammography Blind Spots?

Quality Improvement Strategies

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72

Quality Improvement Strategies

- Thorough Image Review
- EQUIP (Enhancing Quality Using the Inspection Program)
- Standardized Positioning Training and Education



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73

Quality Improvement Strategies

- **Thorough Image Review**
- EQUIP (Enhancing Quality Using the Inspection Program)
- Standardized Positioning Training and Education

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Thorough Image Review

- Technical quality check
- Anatomy and positioning check
- Compare with prior imaging
- Use AI software, if available



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AI is here to help!



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Quality Improvement Strategies

- Thorough Image Review
- **EQUIP (Enhancing Quality Using the Inspection Program)**
- Standardized Positioning Training and Education

77

EQUIP

- FDA initiative under MQSA Act
- Performed at least annually, can be done monthly or quarterly
- Ongoing image-quality feedback
- Requires corrective action when image quality concerns are identified



78

Quality Improvement Strategies

- Thorough Image Review
- EQUIP (Enhancing Quality Using the Inspection Program)
- **Standardized Positioning Training and Education**

79

Standardized Positioning Training and Education



80

Key Takeaways to Reducing Blind Spots in Mammography

- Include as much breast tissue as possible when positioning
- Recognize that dense breast tissue and subtle cancer features can limit mammography
- Perform additional views, as needed
- Consider supplemental screening for selected patients
- Build image quality through improvement strategies

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Importance of Standardized Positioning



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Every Mammogram Tells a Story



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Thank You!

Services we offer, include:
Onsite Positioning Training
Assistance with Accreditation & Inspection
Live Webinars and Conferences
On-Demand Continuing Education

For questions or more information:

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84

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