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Dense Breasts: Imaging, Masking, and Risk



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Mammography Reduces Deaths due to Breast Cancer

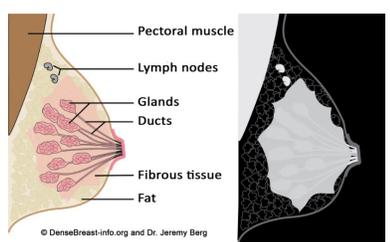
- BUT, not all women benefit equally
- Let's talk about what you need to know about dense breasts and the screening and risk implications of dense breast tissue

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What are Dense Breasts?

- Dense tissue: Glands and fibrous tissue ("fibroglandular" tissue)



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Why Does Breast Density Matter?

- Can mask cancer detection on mammography
 - False reassurance from a negative mammogram
 - More advanced stage at diagnosis
 - Consider supplemental screening in addition to MMG
- Increased risk of developing cancer
- Higher risk of death from breast cancer

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How is Breast Density Determined?

- Breast density is usually determined by a radiologist's visual evaluation of the mammogram
- Other methods to determine breast density:
 - From mammograms by computer software
 - Computed tomography (CT scan) and MRI imaging
- Breast density cannot be determined by the way breasts look or feel

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What Categories Are Used to Describe Breast Density on a Mammogram?

(A) Fatty; (B) Scattered fibroglandular density; (C) Heterogeneously dense; (D) Extremely dense
(Scales EA et al. BI-RADS 5th edition, ACR, 2013; Sprague BL et al JNCI 2014)



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Which Categories of Breast Density are Considered "Dense Breasts?"

(C) Heterogeneously dense and (D) Extremely dense

A. Fatty B. Scattered C. Heterogeneously Dense D. Extremely Dense

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Masking: Dense Tissue Can Hide Cancer

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Are Dense Breasts a Disease? Are They Common? Should I Worry?

Dense breasts are normal.

MORE THAN **50%** of women under 50

40% of women in their 50s

25% of women 60 and over

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Why Does Breast Density Matter on a Mammogram?

- Dense breast tissue can hide cancer on a mammogram → reduce effectiveness of mammography screening
- As breast density increases, the ability to see cancer on mammography decreases
- In women with dense breasts:
 - Negative or benign mammogram ≠ no cancer
 - Additional screening beyond mammography should be considered

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Four Breasts With Cancer

A B C D

Courtesy Dr. Sally Friedewald in Berg WA et al. JIR 2020; epub 9/11/20

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The denser the breast, the more likely a cancer will be masked

Category of Breast Density	Percent of Cancers That Will <u>Not</u> Show on a Mammogram
Extremely dense	40%
Heterogeneously dense	25%
Scattered fibroglandular	15%
Fatty breasts	10%

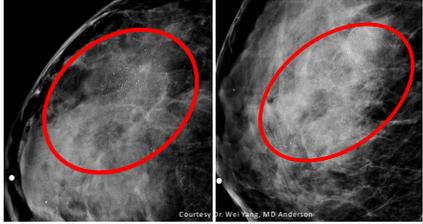
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Rev. March 2022

Wanders et al., Breast Cancer Res. 2017; Destounis et al., AJR, 2017; Kerlikowski et al., Ann Intern Med, 2015

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Value of Mammography in Dense Breasts



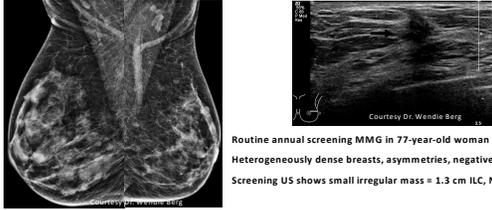
Courtesy Dr. Wee Jang, MD Anderson

48F with suspicious calcifications, dense breasts; extensive high grade DCIS with microinvasion, ER/PR(-), HER2(+)

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Invasive Lobular Carcinoma Likely to be Missed on Mammography



Courtesy Dr. Wendie Berg

Routine annual screening MMG in 77-year-old woman
Heterogeneously dense breasts, asymmetries, negative
Screening US shows small irregular mass = 1.3 cm ILC, NO

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Supplemental Screening Should Not Replace Mammography

- Supplemental screening in women with dense breasts should be done as an adjunct – **not a replacement** for mammography in women with dense breasts
 - Exception:** high-risk women < age 30, MRI alone is recommended. Add annual mammography to annual MRI at age 30+ (same visit or alternating 6-month intervals)

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Dense Breasts and Mammography Callbacks

- Average overall mammography callback rate = 10%
- Women with dense breasts are **more likely to be called back** for additional testing than are women with fatty breasts
- The vast majority (about 95%) of callbacks for additional imaging will not show cancer (false positive)
- The denser the breast, the more likely a false positive is to occur

McCarthy et al., JNCI 2014; Lehman et al., AJR 1999

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Dense Breasts and Interval Cancers

- Interval cancers are those found due to symptoms before the next screen
- Odds of interval cancer increase with increasing density
- Women with extremely dense breasts have 13 to 18 times greater odds of experiencing an interval cancer than women with fatty breasts**
- Interval vs. screen-detected cancers
 - More aggressive
 - Worse outcomes

Boyd et al., N Engl J Med 2007; Ciatto et al., Br J Cancer 2004

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Cancers in Dense Breasts

- Outcomes in dense breasts differ from those in fatty breasts:
 - Greater risk of interval cancer
 - More often advanced stage (IIb and III)
 - More often multifocal or multicentric
 - Mastectomy more often needed for treatment
 - Greater risk of recurrence in women with history of breast cancer (especially if no radiation therapy is given)

Arora et al., Ann Surg Oncol 2010

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Increased Risk of Developing Breast Cancer

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Breast Cancer Risk by BI-RADS Breast Density Category

BI-RADS Category	Relative Risk
A (Fatty)	1.0
B (Scattered)	2.0
C (Heterogeneously Dense)	2.8
D (Extremely Dense)	4.1

Epidemiol Biomarkers Prev, 2006

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How Does Density Compare to Other Risk Factors?

Prevalence

Risk Factor	Prevalence (approx.)
BRCA1 or 2 Mutation	2
Prior DCIS	5
Prior ADH	2
Mother/Sister Dx by AD	5
Estrogen/Progestin use	5
Heterogeneously Dense	35
Extremely Dense Breasts	8

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Similar Magnitude of Risk as Atypical Biopsy

Relative Risk

Risk Factor	Relative Risk (approx.)
BRCA1 or 2 Mutation	15
Prior DCIS	10
Prior ADH	5
Mother/Sister Dx by AD	2
Estrogen/Progestin use	1
Heterogeneously Dense Breasts	2.8
Extremely Dense Breasts	4.1

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Population Attributable Risk

- More breast cancers can be attributed to dense breasts than family hx (1st-degree relatives), hx of benign bx, BMI (≥ 25), nulliparity, or late first birth (≥ 30)
 - 39% of premenopausal and 26% of postmenopausal breast cancer attributed to dense breasts

Engmann NJ et al JAMA Onc 2017 epub Feb 2, 2017

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Glandular Tissue/Breast Cancer Risk Relationship

- **The more glandular the breast tissue, the greater the breast cancer risk**
 - Cancers arise microscopically in glandular tissue: the more glandular tissue, the more susceptible tissue where cancer can develop
 - Glands divide with hormonal stimulation; “mistakes” possible with each division
 - Local environment around glands may produce growth hormones that stimulate cell division. More common in fibrous than fatty breast tissue.

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Breast Cancer Risk Factors

- Most women who develop breast cancer have no additional risk factors other than being female and aging.

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Supplemental Screening

- Tomosynthesis ("3D"), now becoming standard of care instead of 2D mammography
- Ultrasound
- Molecular breast imaging (MBI)
- Contrast-enhanced digital mammography (CEDM)
- MRI

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Expected Added Cancer Detection and change in false positive recall rates after Standard Mammography by Screening Modality

Method	Breast Density	Added Cancer Detection (from 2D 2-7 per 1000)	Projected change in False Positive Recall Rate (from 2D 100-120 per 1000)
Tomosynthesis (3D mammography)	Scattered fibroglandular density or Heterogeneously dense	1-2 per 1000 [3-5]	-15 to -44 per 1000* [3-5]
Tomosynthesis (3D mammography)	Extremely dense	Negligible [3, 8, 9]	No significant reduction [3, 8, 9]
Ultrasound (first round)	Heterogeneously or Extremely dense	2-3 per 1000 [10]	+75 to 117 per 1000 [10, 11]
Ultrasound (subsequent rounds)	Heterogeneously or Extremely dense	3-4 per 1000 [11, 12]	+70 to 98 per 1000 [11, 12]
Ultrasound after tomosynthesis	Heterogeneously or Extremely dense	2-3 per 1000 [15, 16]	Increase in false positive recalls with US
MBI	Heterogeneously or Extremely dense	7-9 per 1000 [17-19]	+54 to 77 per 1000 [17-19]
Contrast-Enhanced Mammography	Heterogeneously or Extremely dense	8-13 per 1000 [20, 21]	+34 to 144 per 1000 [20, 21]
MRI (first round)	Extremely dense	16 per 1000 [22]	+80 per 1000 [22]
MRI (subsequent rounds)	Extremely dense	6 per 1000 [23]	+26 per 1000 [23]
Abbreviated ("fast" or "mini") MRI after tomosynthesis	Heterogeneously or Extremely dense	10 per 1000 [24]	+107 per 1000 [24]

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High-Risk Women Should Have Screening MRI Regardless of Breast Density

- Known or disease-causing mutation in *BRCA1/2* or other disease-causing mutation in patient or in 1st degree relative if patient untested
- Chest/mantle radiation therapy by age 30 and at least 8 years prior
- Personal history of breast cancer and dense breasts OR diagnosed by age 50
- Calculated lifetime risk of ≥ 20-25% by risk models based largely on family history
- History of LCIS/ADH on prior biopsy [consider MRI]

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Screening for Dense Breasts and not Otherwise High Risk

For a woman with extremely dense breasts and not otherwise at increased breast cancer risk:

- Screening MRI in addition to mammogram/tomosynthesis
- If MRI not an option, consider ultrasound or contrast-enhanced mammography
- Same considerations for heterogeneously dense breasts; however, capacity may be limited
- Abbreviated MRI protocols may address barriers

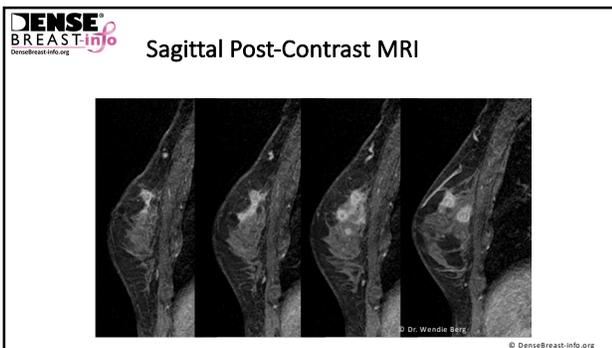
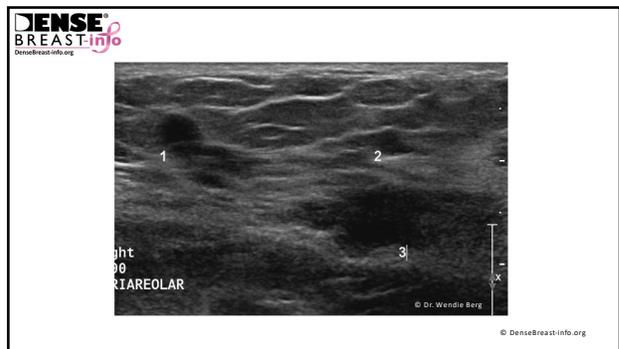
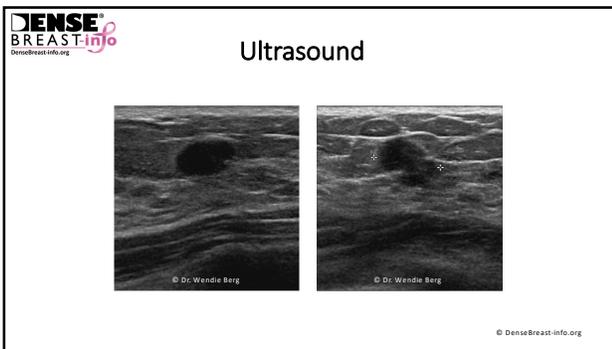
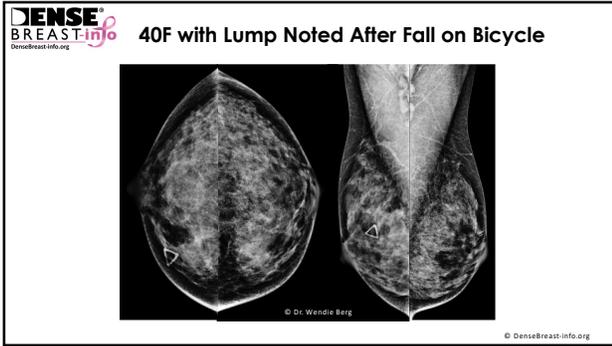
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51-year-old with Extremely Dense Breasts and Right Breast Pain

Courtesy Dr. Betty Kalfert in Berg WA, et al. AJK epub Sept. 2020

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Patient Resources

DENSE BREAST-info What's Required in Your State?

Map Legend

- Some density notification required (38 states)
- States for which education notification not required
- Active bill
- Inactive bill/no notification required
- Insurance coverage for supplemental screening

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Medically-sourced Website DenseBreast-info.org

World's Leading Website About Dense Breasts

How Cancer Shows in a Fatty or Dense Breast

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How Cancer Shows in a Fatty or Dense Breast

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Providers Home

Flow Chart: Who Needs More Screening?

Health Care Provider FAQs

Risk Model Tutorial

Table: Screening Guideline Comparison

DB-I Research

Patient Resources

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CME/CE, "Dense Breasts and Supplemental Screening"

A certified educational program for physicians, midlevel providers, and nurses practicing in obstetrics and gynecology, internal medicine, family medicine, radiology, and surgery; and radiologic technologists.

Provider	Access Course	Credits/Tuition
MD, DO, NP, PA Nurse	AMA Credits*	1.5 AMA PRA Cat 1 Tuition: FREE
RT	ASRT Credits**	1.5 ASRT Cat A Tuition: FREE

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For more information, please visit:

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Dense Breasts: Imaging Masking and Risk

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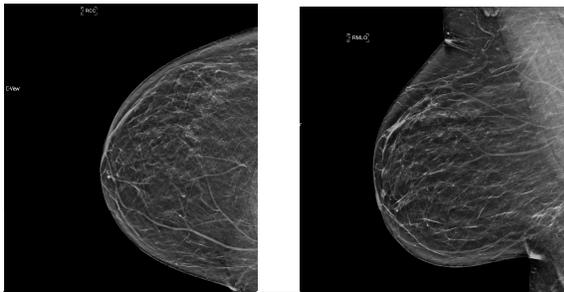
Why is Image Quality So Important for Dense Breasts

- Abnormalities are more difficult to visualize
- More superimposition of structures
- Often more difficult to position
- Often more difficult to compress



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Easy Peasy

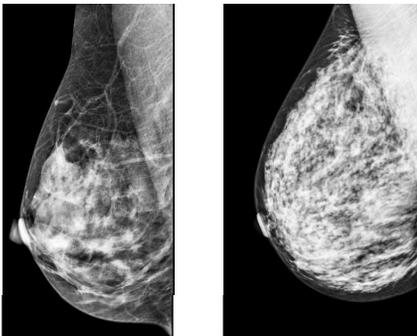


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Hide-a-truck Breast

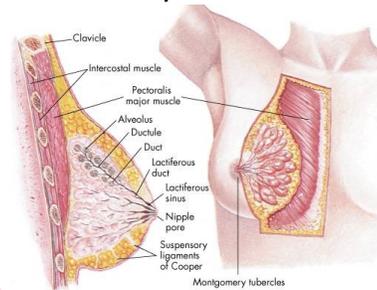


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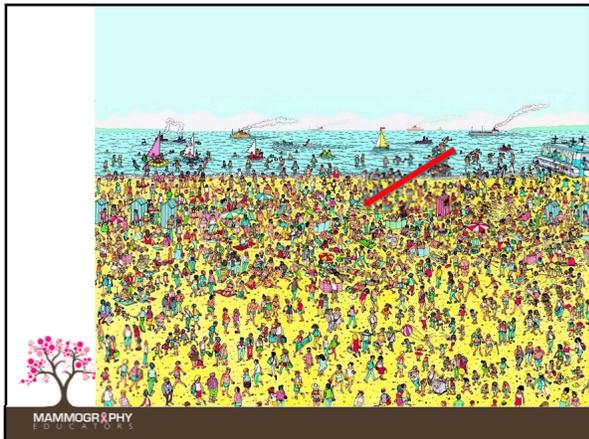


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Anatomy of the Breast



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Positioning Challenges

- Penetration of glandular breast tissue
- Immobility
- Equal Compression
- Visualization of posterior glandular breast tissue
- Use of additional views

Penetration of Glandular Breast Tissue (Historically)

- Hot light
- Crank up the kVp
- Long exposure times

Hot Lights!



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Turn the Knobs!



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Crank up the kVp



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Increase the time.



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Thank You Modern Technology!!



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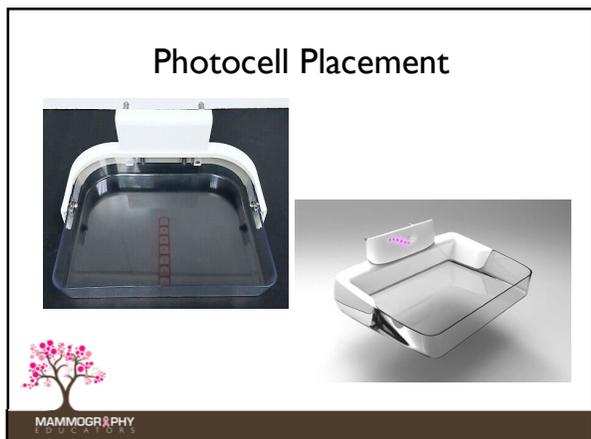
ANCIENT HISTORY



FFDM - DBT

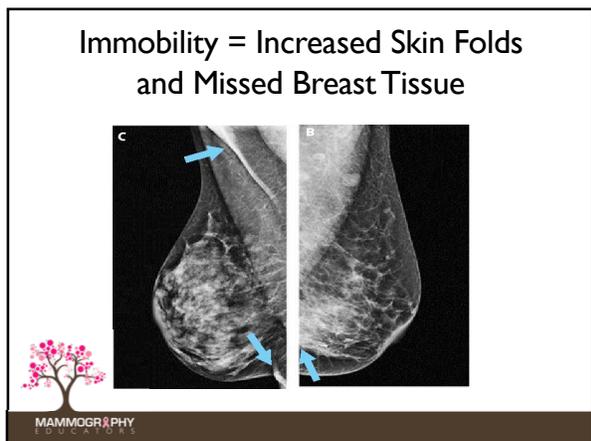


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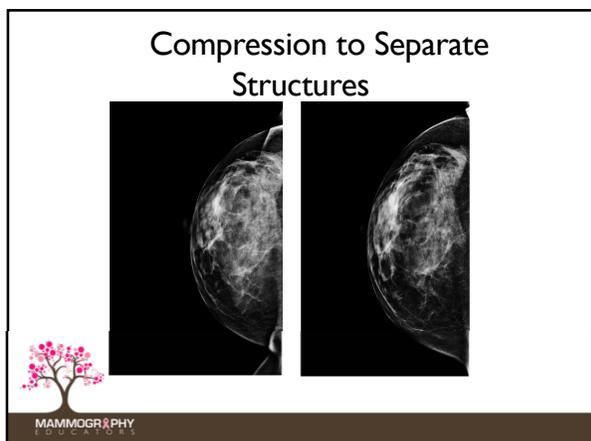
Positioning Challenges

- Penetration of glandular breast tissue
- **Immobility**
- Equal Compression
- Visualization of posterior glandular breast tissue
- Use of additional views



Positioning Challenges

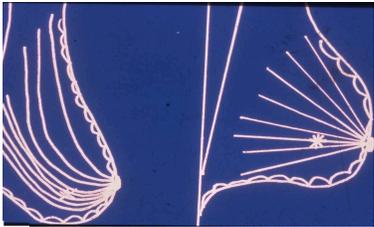
- Penetration of glandular breast tissue
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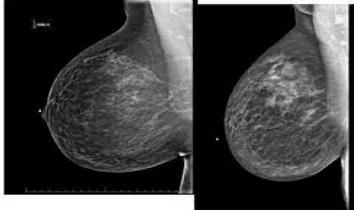
Compression

Criteria:
 Breast should be compressed until taut or less than painful. Glandular tissue should be well separated.

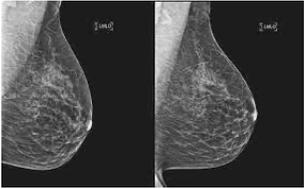
Compression to Separate Structures



Drooping Breast



Drooping Breast



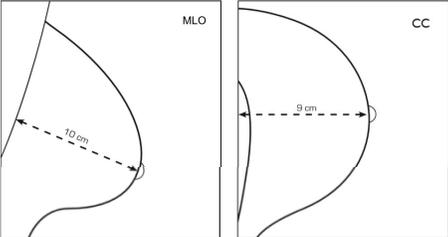
Positioning Challenges

- Penetration of glandular breast tissue
- Immobility
- Equal Compression
- **Visualization of posterior glandular breast tissue**
- **Use of additional views**



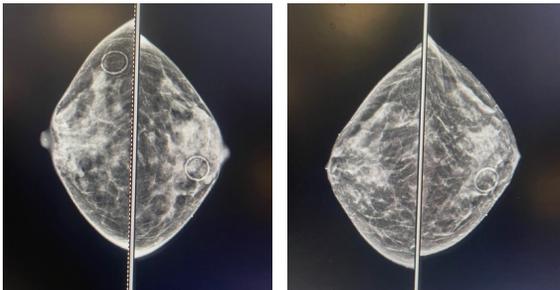
PNL Measurements

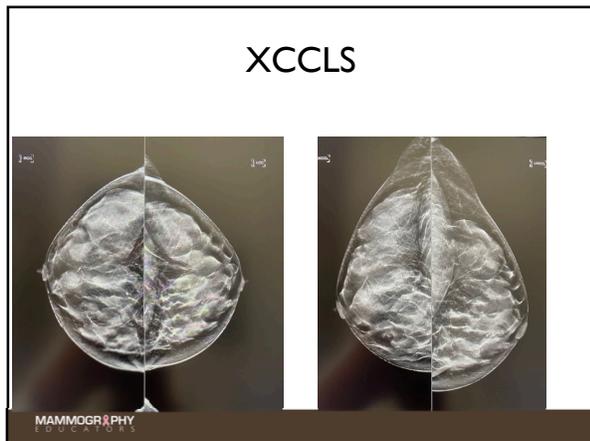
The measurement of the PNL on one view should be no less than 1 cm when comparing view to view



PNL + 1 cm

Before After





XCCL

- For visualization of lateral breast tissue in a CC projection
- Used on baseline mammogram when lateral, posterior glandular breast tissue is not visualized on the CC view
- On subsequent exams if the glandular breast tissue is visualized back to the retromammary fat space on the MLO and XCCL does not need to be performed.

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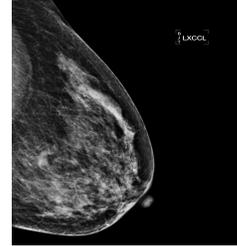
Use of the XCCL

- Should be performed on less than 10% of all patients
- No angling the tube: Performed at 0 degrees angulation
- No angling the patient: Patient's body should be straight but turned at 45 degree angle to the IR
- Nipple should be pointing towards the upper corner of the image receptor



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Visualization of pectoralis muscle is NOT preferable as it may indicate patient was leaning to the side. Direction of the beam should be superior to inferior or inferior to superior. It is NOT a less steep MLO



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Summary

- Mammography image quality is even more important for women with dense breasts
- Positioning techniques are important to include posterior breast tissue
- Proper compression is critical to separate structures in the breast
- Patients with dense breasts have options



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Thank you!

For questions or more information, contact us at:

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