

The Importance of Standardized Positioning: The Basics of Mammography That You Were Never Taught

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MQSA Insights

Poor Positioning Responsible For Most Clinical Image Deficiencies, Failures

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Mammography combines "the science of imaging and the art of positioning" [1]. Although there have been many significant and exciting changes to the technology of mammography since the passage of MQSA in 1996, including the introduction of full-field digital mammography (FFDM) and digital breast tomosynthesis (DBT), one aspect of mammography that remains unchanged and critically important is proper patient positioning.

Positioning is so important because only those portions of the breast which are included on the mammography image can be evaluated for signs of cancer. Any portion of the breast which is not imaged cannot be evaluated and cancers in those portions of the breast can be missed. 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" [2].

Poor positioning has been found to be the cause of most clinical image deficiencies and most failures of accreditation. In 2015, the American College of Radiology (ACR), the largest FDA-approved accreditation body (AB), found that of all clinical images which were deficient on the first attempt at accreditation, 92% were deficient in positioning. Also, in ACR-accredited facilities, 79% of all unit accreditation failures in 2015 were due to



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Source: U.S. Food & Drug Administration

3

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%)



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Decreased Sensitivity

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

= 18.1% decreased sensitivity



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Quality Standards – Why?

ALL industries have established *standardized* methods in the performance of tasks to:

- Establish and maintain quality
- Increase consumer satisfaction
- Increase profit
- Reduce possibility of litigation
- Reduce errors



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How do we reduce medical errors?

- Standardization
- Consistency
- Reproducibility



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Standardized Technologist Training for General Radiology



9

Standardization

We all:

- Position the same way for every body part
- Position in the same sequence
- Set up the machine before we bring in the patient
- Position the whole patient, not just the body part



10

In General Radiology...

All training is competency based and a technologist's skills will be evaluated for *positioning techniques*, as well as *clinical image evaluation*.



11



12

Consistency and Ergonomics

- **M**achine
- **P**atient
- **B**ody Part (Breast)



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We position the **whole patient**,
not just the body part!



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All exams are done using the *same*
positioning technique, in the *same* sequence.



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Why???

- Consistency
- Reproducibility
- Efficiency
- Proficiency
- Use of proper body mechanics



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But in mammography... We are "all over the map"

- LCC, LMLO, RMLO, RCC
- RCC, LCC, RMLO, LMLO
- RMLO, RCC, LMLO, LCC
- LCC, RCC, LMLO, RMLO
- RCC, RMLO, LMLO, LCC
- LCC, LMLO, RCC, RMLO
- LMLO, LCC, RCC, RMLO



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My Suggestion

- CCs first
- Then do the MLO on the side you just finished the CC
- Finish with the other MLO

Example: RCC, LCC, LMLO, RMLO



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So why is this true for all body parts in radiology **EXCEPT** in Mammography???



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In Mammography...

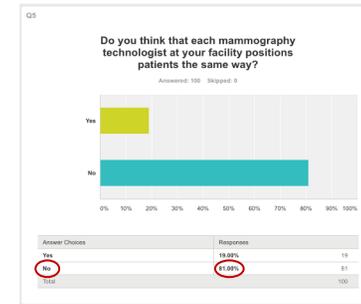
- Most technologists have not been taught a standardized method of positioning
- Most technologists have been taught various positioning methods by various technologists



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Most technologists *do not* practice a standardized method of positioning or position the same way.



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No Standards for Mammography Positioning

There are standards for *WHAT* images should look like, but not *HOW* you get to that point!



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So the problem is...

No standardization or follow-through, which means:

- Less consistency and reproducibility
- More repeats and rejects
- More accreditation failures
- Increased radiation exposure
- MISSED BREAST CANCERS



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How can we make things better?

Consistency and Reproducibility



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Mammography Positioning Techniques

Should be:

- Consistent
- Reproducible
- Efficient
- Proficient
- Based on sound ergonomic principles



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Common Work-Related Injuries

- Wrists
- Shoulders
- Back
- Knees
- Hips



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YES!!!



NO!!!



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YES!!!



NO!!!





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YES!!!



NO!!!





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Do Standardized Positioning Techniques for Mammography Work?

- Scientific studies prove that standardized positioning techniques improve quality
 - Visualization of more posterior and lateral breast tissue, IMF and pectoralis muscle on the CC
- Unpublished data showed that standardized positioning techniques decrease repeats, rejects and technical callbacks by up to 50!



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Mammography Positioning Standards in the Digital Era: Is the Status Quo Acceptable?

Ashley L. Huppe¹
Kelly L. Overman²
Jason B. Gatewood¹
Jacqueline D. Hill¹
Louise G. Miller¹
Marc F. Inciardi¹

OBJECTIVE. The objective of our study was to evaluate positioning of full-field digital mammography (FFDM) and digital breast tomosynthesis (DBT) compared with film-screen (FS) mammography positioning standards.

MATERIALS AND METHODS. A retrospective study was conducted of consecutive patients who underwent screening FFDM in 2010–2012 and DBT in 2012–2013 at an academic institution. Examinations were performed by five experienced technologists who underwent updated standardized positioning training. Positioning criteria were assessed by consensus reads among three breast radiologists and compared with FS mammography data from a 1993 study by Bassett and colleagues.

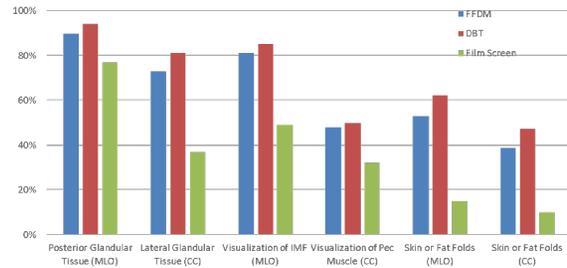
RESULTS. One hundred seventy patients (n = 340 examinations) were analyzed, showing significant differences between FFDM and DBT examinations (p < 0.05) for medial or inferior skin folds (FFDM vs DBT: craniocaudal [CC] view, 16% [n = 56] vs 23% [n = 77]; mediolateral-oblique [MLO] view, 35% [n = 118] vs 45% [n = 154]), inclusion of lateral glandular tissue on CC view (FFDM vs DBT, 73% [n = 247] vs 83% [n = 274]), and concave pectoralis muscle shape (FFDM vs DBT, 36% [n = 121] vs 28% [n = 95]). In comparison with Bassett et al. data, all positioning criteria for both FFDM and DBT examinations were significantly different (p < 0.05). The largest differences were found in visualization of the pectoralis muscle on CC views and the inframammary fold on MLO views, inclusions of posterior or lateral glandular tissue, and inclusion of skin folds, with DBT and FFDM more frequently exhibiting all criteria than originally reported Bassett et al. findings.

➔ **CONCLUSION:** DBT and FFDM mammograms more frequently include posterior or lateral tissue, the inframammary fold on MLO views, the pectoralis muscle on CC views, and skin folds than FS mammograms. Inclusion of more breast tissue with newer technologies suggests traditional positioning standards, in conjunction with updated standardized positioning training, are still applicable at the expense of including more skin folds.

Source: American Journal of Roentgenology; 2019, December 2017

32

Criteria Met After Standardized Training



Source: American Journal of Roentgenology- 209, December 2017

33

Reasonable Expectations for the CC

Positioning Criteria	FFDM	DBT	Bassett
Pec Muscle Visualized	48%	50%	32%
No Motion	100%	98%	-
Lateral Glandular Tissue Included	73%	81%	37%
Nipple in Profile	83%	85%	89%
Skin or fat folds	39%	47%	10%
Medial Location	16%	23%	-
Lateral Location	29%	32%	-
Visualization of Cleavage	41%	34%	-
Requires More Than One View	5%	7%	-

Source: American Journal of Roentgenology- 209, December 2017

34

Reasonable Expectations for the MLO

Positioning Criteria	FFDM	DBT	Bassett
Visualization of Pec Muscle to PNL	86%	87%	81%
Concave Pec	36%	28%	-
Straight Pec	41%	46%	-
Convex Pec	23%	26%	-
Wide Margin at Top of Pec	95%	93%	-
No Motion	98%	97%	99%
Posterior Glandular Tissue Included	90%	94%	77%
Nipple in Profile	89%	92%	88%
Skin or fat folds	53%	62%	15%
Upper Location	25%	27%	-
Lower Location	35%	45%	-
Visualization of Inframammary Fold	81%	85%	49%
Requires More Than One View	13%	17%	-

Source: American Journal of Roentgenology- 209, December 2017

35

Reasonable Expectations

- Our patients have different and often challenging body habitus
- Their breast size, shape, mobility and tenderness are hugely variable

36

Reasonable Expectations

Even the “perfect” patient, in terms of body habitus, breast mobility, etc. may provide a challenge that inhibits the technologist’s ability to position and compress properly.



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But regardless of these variables, we CAN improve image quality by **using standardized positioning techniques** and developing a strong knowledge-based foundation that depends on the technologist's understanding of correlative anatomy.



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RCC: Steps 1-9 (Front)



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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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RMLO: Steps 1-10



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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

45

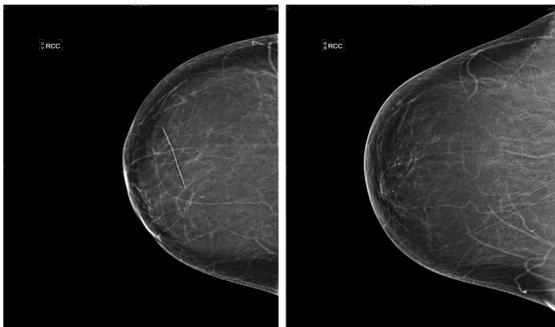
Does it work??



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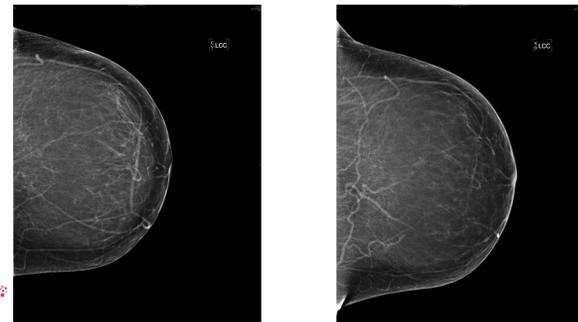
BEFORE 13.6 cm **STANDARDIZED POSITIONING** + 3.0 cm **AFTER** 16.6 cm



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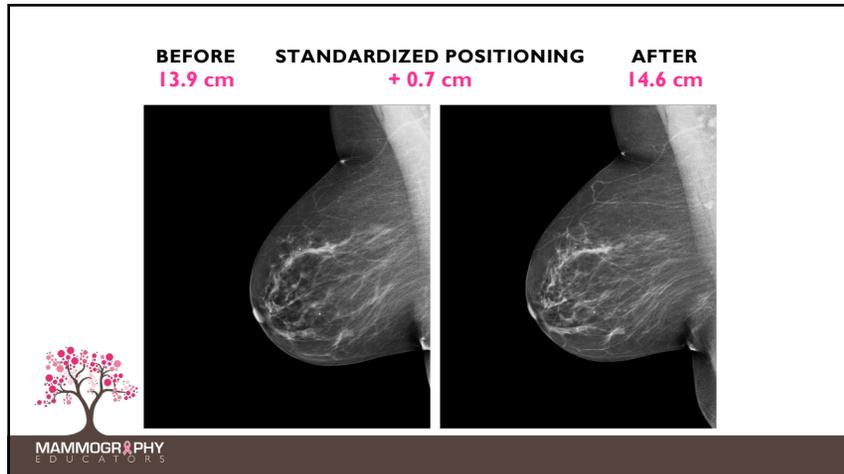
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BEFORE 14.8 cm **STANDARDIZED POSITIONING** + 2.0 cm **AFTER** 16.8 cm

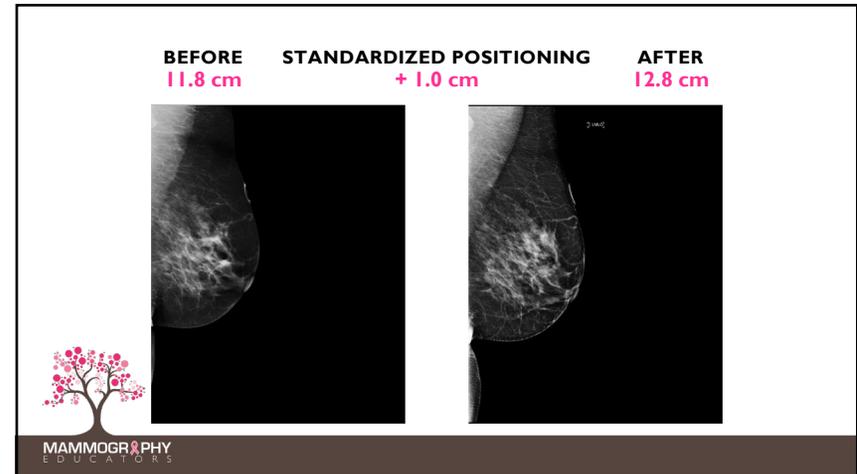


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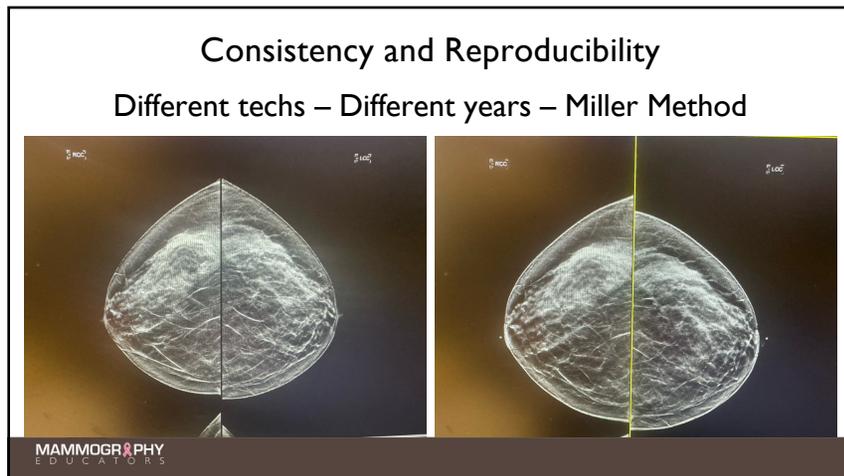
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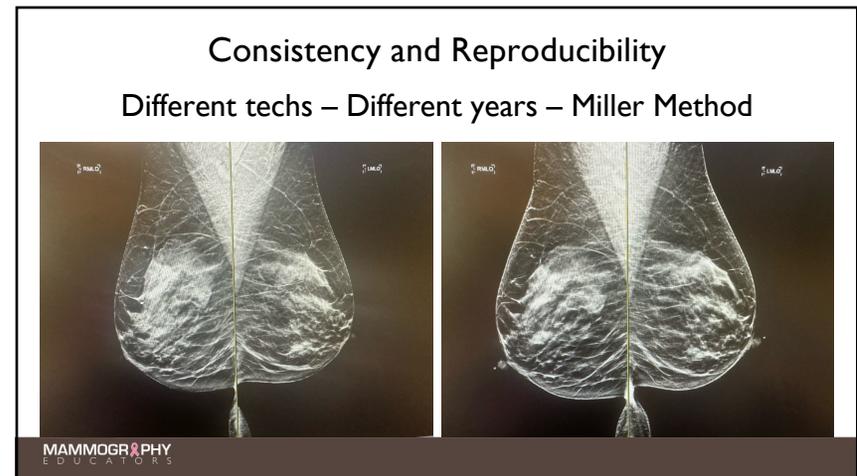
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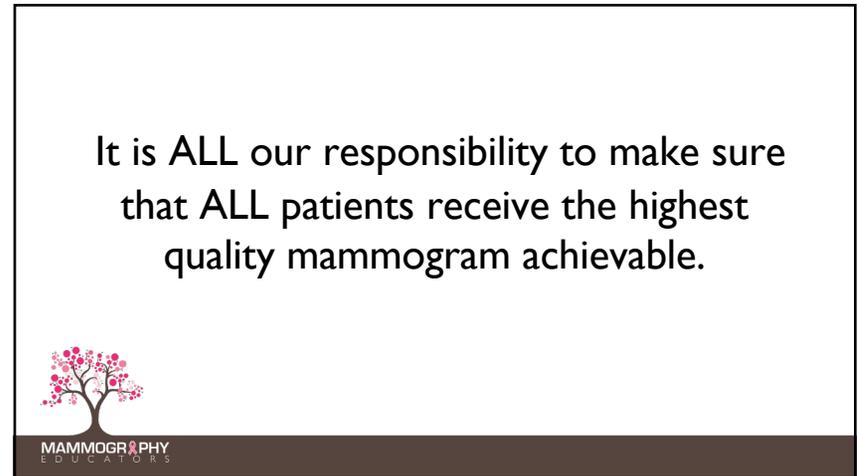
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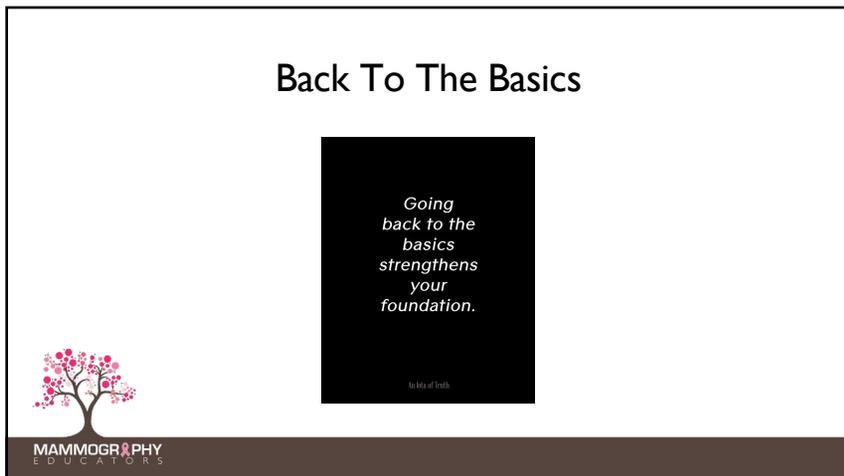
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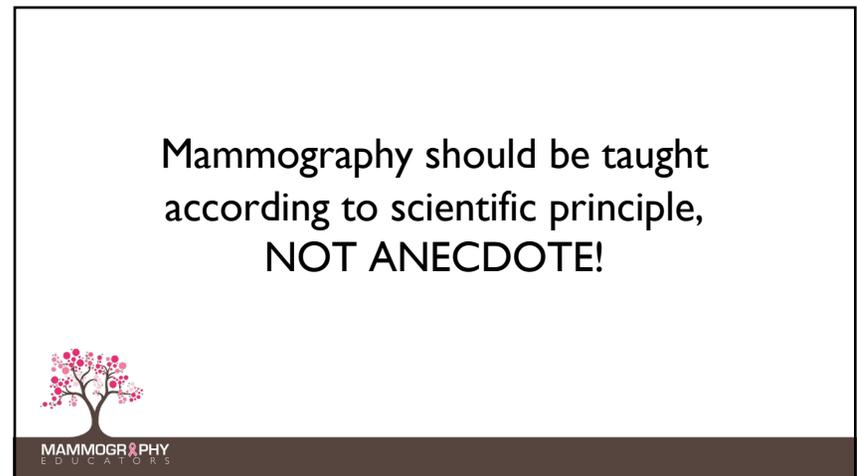
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54



55



56

Anecdote vs. Science



57

Anecdote vs. Science



58

SCIENCE:

ANATOMY – PHYSIOLOGY – PHYSICS



59

You lucked out...



60

Except...

- Newton's Third Law: for every action there is reaction
- Law of gravity



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Anatomy and Physiology

- As they relate to mammography positioning, using general radiology principles...



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Goals for **General Radiology** Positioning

- Bring the body part back to its true anatomical position OR the position that will best visualize the body part
- Use palpable and visible anatomical landmarks for positioning and clinical image evaluation
- Use consistent and reproducible methods



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Goals for **Mammography** Positioning

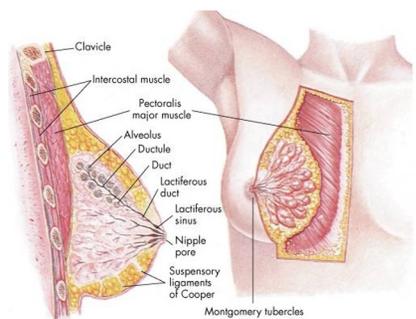
Bring the breast back to its natural anatomical position (*with the nipple perpendicular to the chest wall as possible*) on both screening views to maximize visualization of breast tissue and to avoid superimposition of structures.



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Anatomy of the Breast



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Normal or natural position of the breast is when the nipple is perpendicular to the chest wall.



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When positioning for mammography we need to bring the breast back to its 'normal' position.



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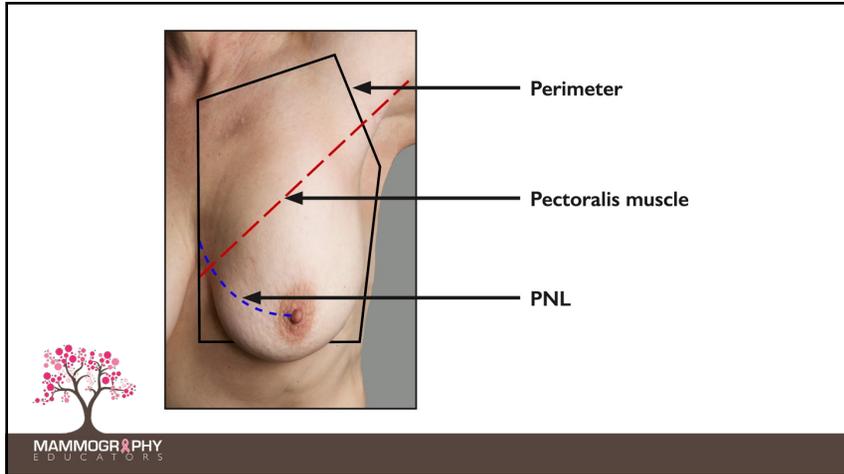
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In order to accomplish this and include the maximum amount of breast tissue, we must consider the anatomical landmarks that will be used for positioning and clinical image analysis.

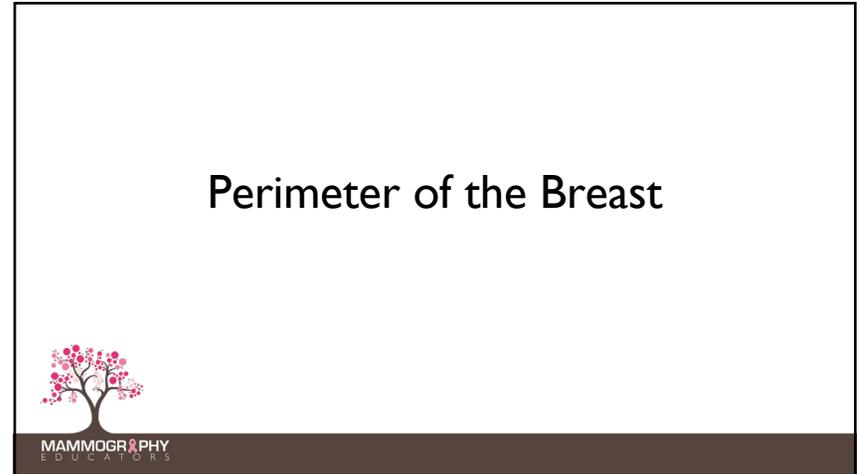


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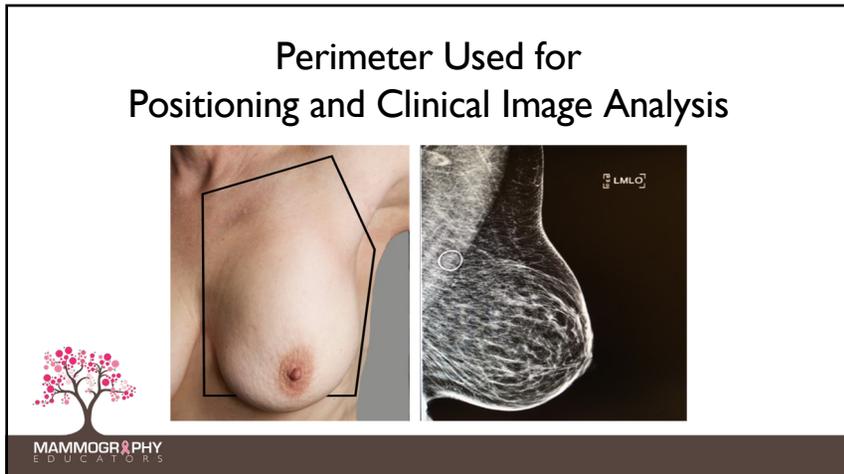
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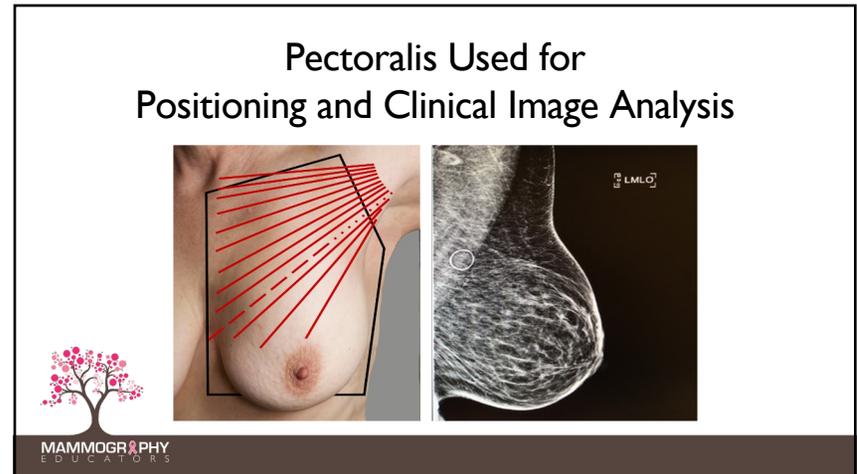
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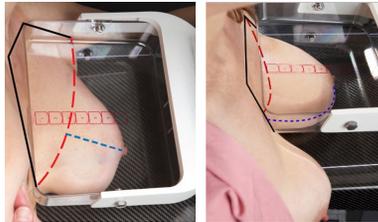
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72

PNL Used for Positioning

Elevate the breast so that the PNL is as close as possible to perpendicular to the chest wall.

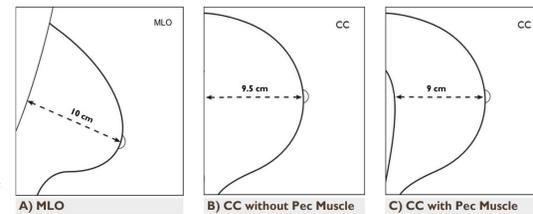


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PNL Used for Clinical Image Analysis

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



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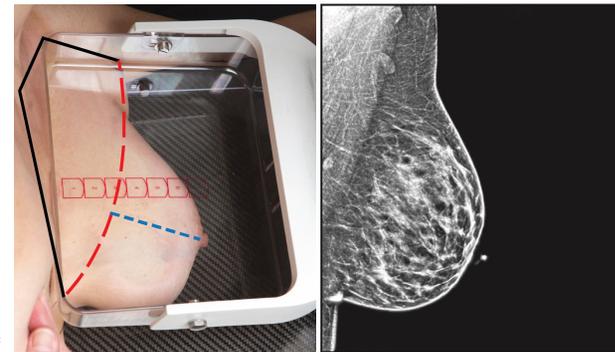
The MLO

- Inclusion of all breast tissue within perimeter
- Pectoral muscle fully visualized
- Tissue well separated
- Tissue visualized back to the retromammary fat space
- IMF



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The MLO

Visualization of the pectoral muscle:

- The pectoralis muscle is not really part of the breast
- However, it serves as an important anatomical landmark for positioning and image evaluation



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The absence or presence of these characteristics will tell you exactly what you did right or wrong when positioning and therefore, whether you included or excluded breast tissue!



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Remember

There are only two margins for error:

- 1) The way the **machine** is set up (i.e., height, angle, compression paddle size, etc.)
- 2) The way the **patient** is “set up”: both feet, hips, and shoulders facing forward

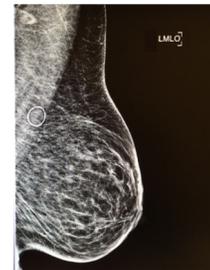


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The MLO

- **Width:** wide margin at the top
- **Length:** down to the level of the PNL
- **Shape:** convex/straight



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The MLO

WIDTH of the Muscle

There should be a wide margin of the pectoralis muscle at the top of the image (in the axilla).



81

The MLO

EQUIPMENT: Width of the muscle is related to the placement of the IR in the axilla.

The back corner of the IR should be placed just anterior to the latissimus dorsi.



82



83

The MLO

PATIENT: Width of the muscle is related to the position of the patient.

The patient must be turned into the machine with both feet, hips and shoulders as far forward as possible. The patient's shoulder should be down and relaxed and if possible, held in position by the technologist.



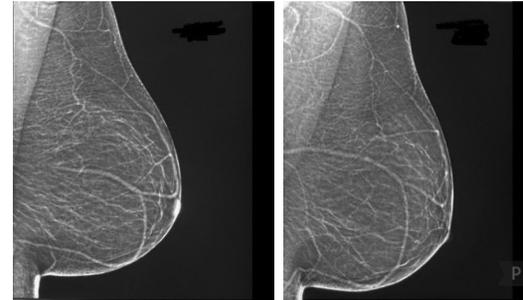
84



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Width of the Muscle



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The MLO

LENGTH of the Muscle

Should be visualized down to the level of the PNL.



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The MLO

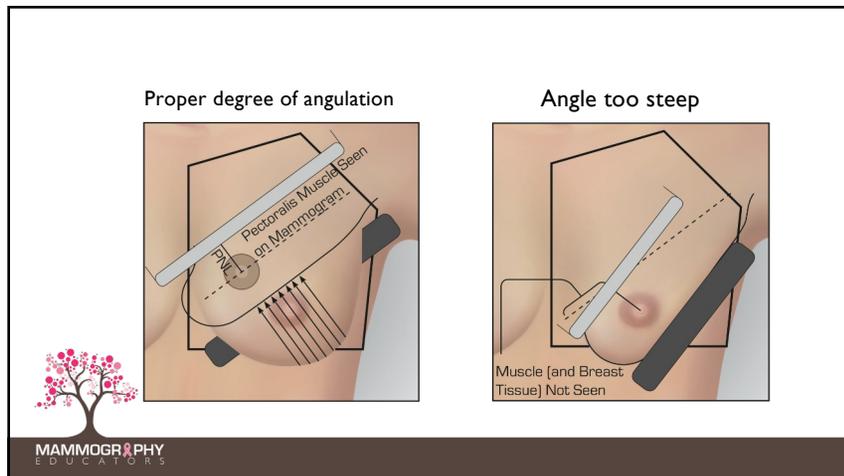
EQUIPMENT: Angle for the MLO

- Angle to the free margin of the pectoralis muscle
- Keep angulation consistent
- Steeper angle for patients with longer thoraxes and small breasts
- Lesser angles for shorter thoraxes and larger breasts



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89

Recommended Angulation for the MLO

- Depends on body habitus
- Maintain consistency from year to year*

*An MLO angled at 56-degrees one year will look markedly different than an MLO angled at 42-degrees the next year.



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Keep Angles Consistent

Use 5-degree increments – no more 43, 48, 52 degrees

- 40 degrees for shorter, heavier patients with large breasts
- 45 degrees for average patients
- 50 degrees for tall, thinner patients with smaller breasts
- 35 degrees for patients who have undergone reduction



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The MLO

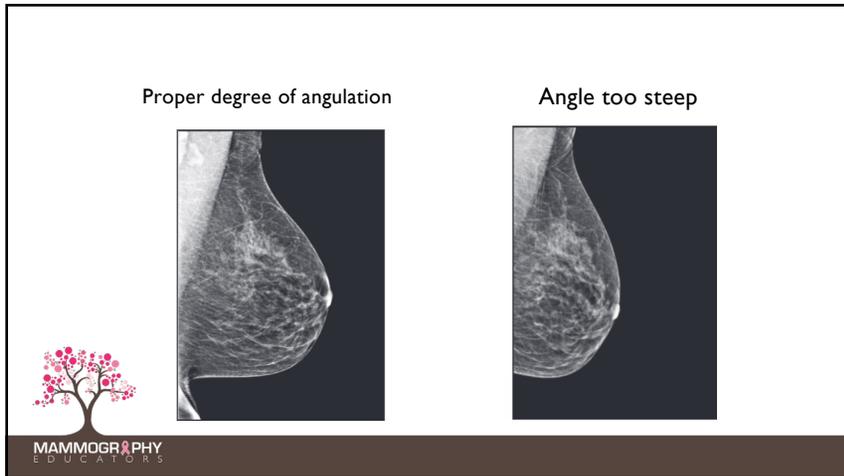
PATIENT: Length of the muscle is related to the position of the patient.

The patient must be turned into the machine with both feet, hips and shoulders as far forward as possible, as not to impede the progress of the compression paddle.

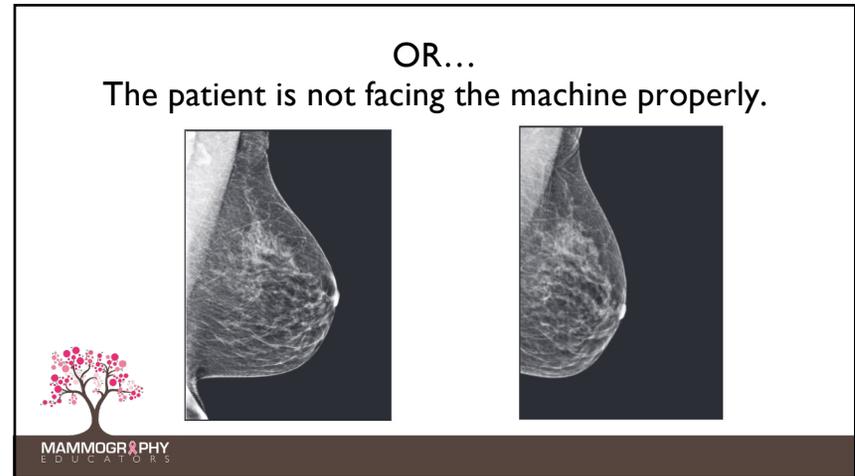


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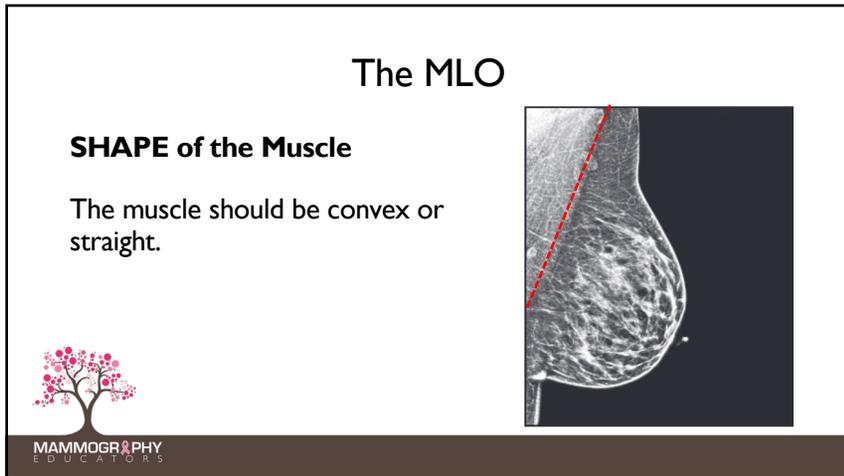
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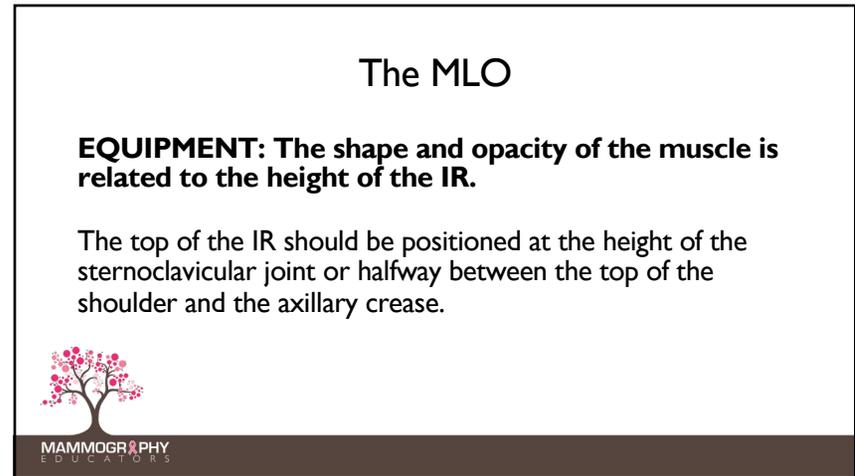
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94



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96

The MLO

PATIENT: The shape and opacity of the muscle is related to the relaxation of the pectoralis muscle.

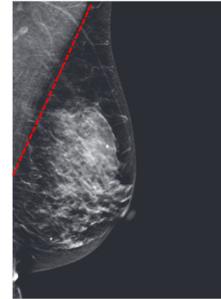
Patient's shoulder, arm and hand must be relaxed with the elbow bent and relaxed behind the IR.



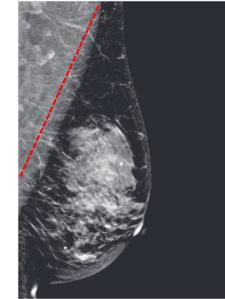
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Concave



Convex



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The MLO

Common problems:

- No visualization of the IMF
- Breast drooping



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No IMF



IMF



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Keep Angles Consistent

The position of the patient related to the bottom, front corner of the IR is critical.

- Patient must be facing forward with both feet also forward
- Lower, front corner of the IR should be directly below the patient's nipple or halfway between their ASIS and umbilicus
- This requires the patient taking a side step towards you

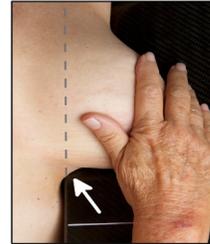


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101

Improper

Edge of IR in front of IMF



Proper

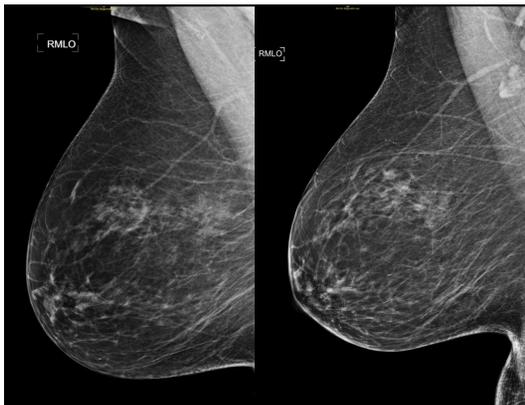
Edge of IR behind IMF



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Top edge of IR indicated by vertical dotted line.

102



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103

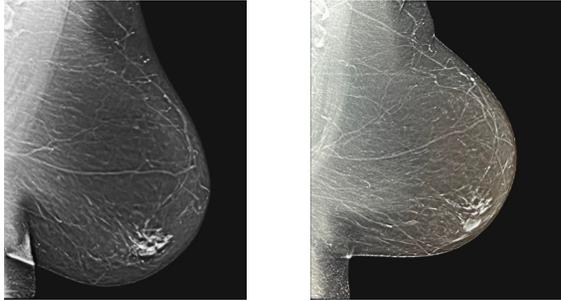
The "Sagging" Breast



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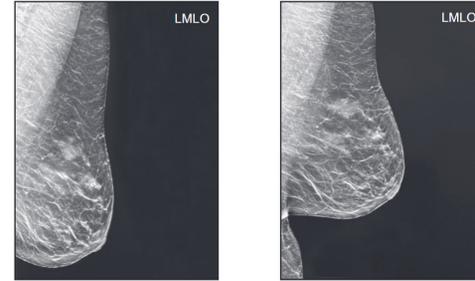
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The “Sagging” Breast



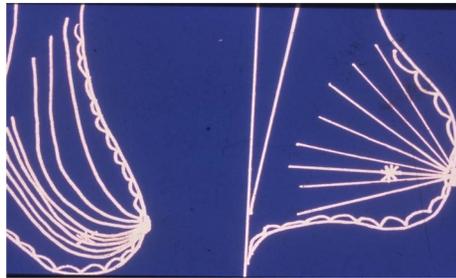
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The “Sagging” Breast



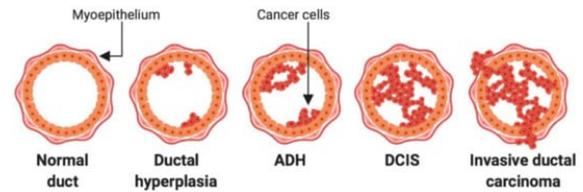
106

The “Sagging” Breast



107

Stages of Breast Cancer Development



108

Position of the Breast

- Breast must be held in the “up and out” position to bring the breast back to its “normal” position (nipple perpendicular to the chest wall)
- Maintained by adequate compression
- Don’t let go until compression is complete



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109

Solution for the “Sagging” Breast



Hold the breast in up and out position.

Compress.

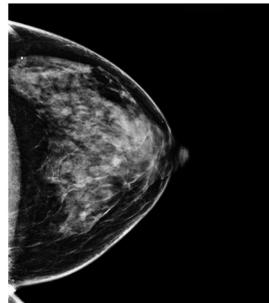


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110

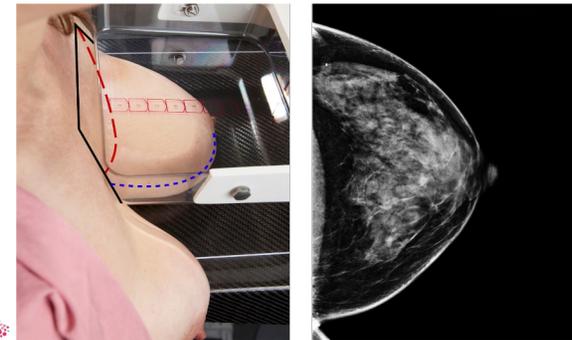
The CC

- Include maximum amount of breast tissue in the axial/transverse plan
- Visualization of medial breast tissue
- Visualization of pectoralis muscle on approximately 50% of all CCs
- PNL within 1cm of PNL on MLO



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The CC

- The CC is done to provide an “orthogonal” view from the MLO
- When added to the MLO, it increases breast cancer detection
- While the CC is not primarily done to visualize medial breast tissue (cleavage), it is a “by-product” of a good CC
- If you miss breast tissue on the MLO, it will be medial tissue, so it’s important to try to include that on the CC view



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The CC

Is it the equipment or the patient?

Equipment:

- IR too high or too low
- Compression paddle size

Patient:

- Facing towards the machine with both feet, hips and shoulders forward



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114

Due to lack of anatomical landmarks,
positioning techniques are extremely important!!



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115

The CC

Common problems:

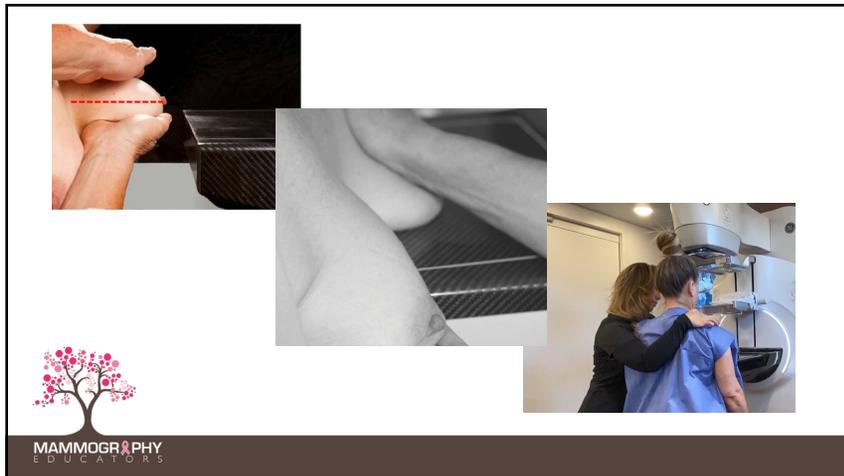
- Short CC (PNL measurement on CC is less than 1 cm of PNL measurement on the MLO)
- No pec muscle (remember the 50% rule!)
- No visualization of deep medial breast tissue (cleavage)

All of these are most often related to positioning
technique vs. equipment and patient position.
(Although they are still important!)

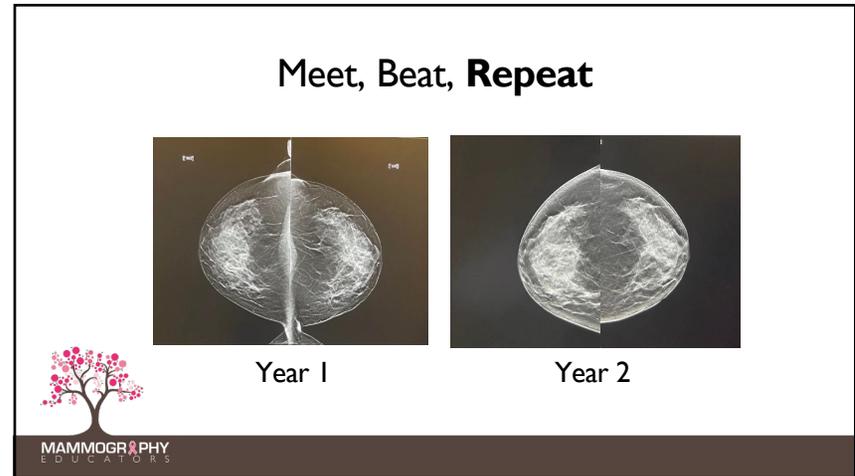


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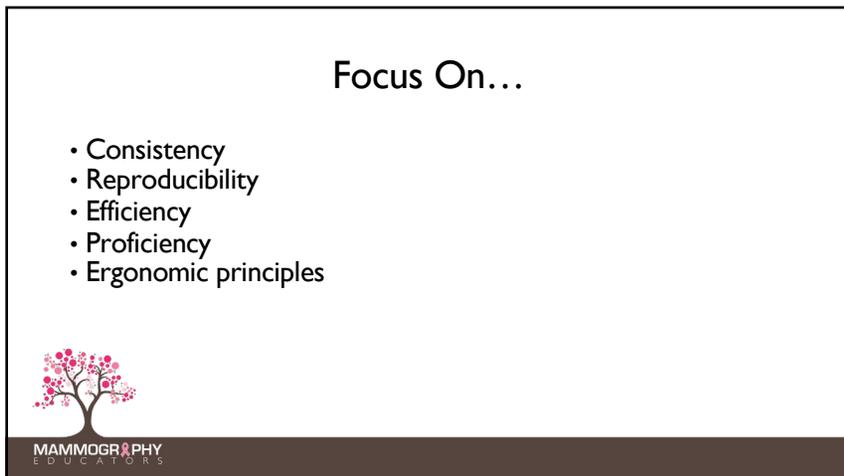
116



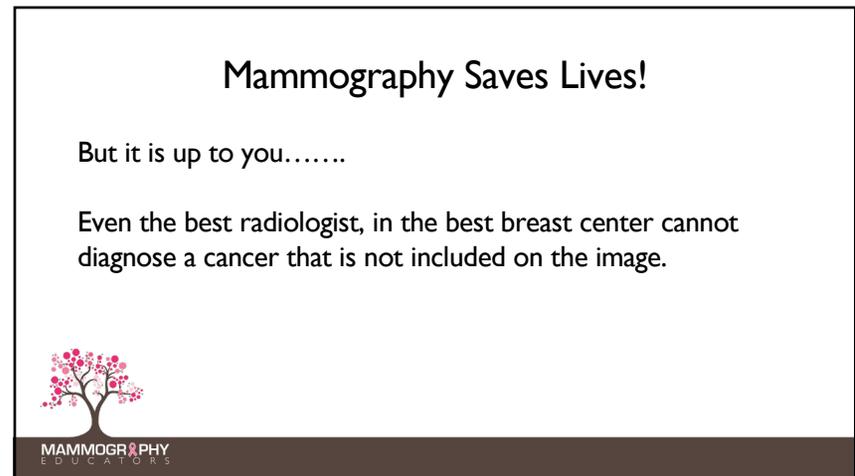
117



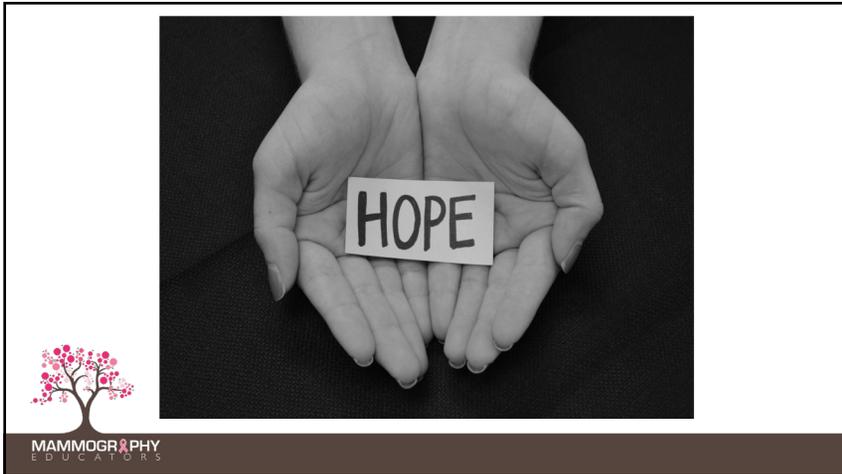
118



119



120



121

References

"Poor Positioning Responsible For Most Clinical Image Deficiencies, Failures." U.S. Food and Drug Administration, 29 November 2017.
<https://public.fda.gov/drugs/monitoring/clinical-image-deficiencies-failures>

Miller, Louise C., "A Technologist's Perspective of the FDA Report 'Poor Positioning for Most Clinical Image Deficiencies, Failures.'" SBI News, 3 June 2016.
<https://mammographyeducation.com/a-technologists-perspective-of-the-fda-report/>

Miller, Louise C., "What Every Mammography Technologist Would Like Their Radiologist to Know About: Our Patients." SBI Newsletter, 2015.
<https://mammographyeducation.com/what-every-mammography-technologist-would-like-their-radiologist-to-know-about-the-role-of-the-technologist/>

James, John T. PhD. "A New, Evidence-based Estimate of Patient Harms Associated with Hospital Care." Journal of Patient Safety, September 2013.
https://journals.lww.com/journalofpatientsafety/Fulltext/2013/09000/A_New_Evidence_based_Estimate_of_Patient_Harms_2.aspx



122

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123