

# Good Morning!!




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## The Basics of Mammography That You Were Never Taught

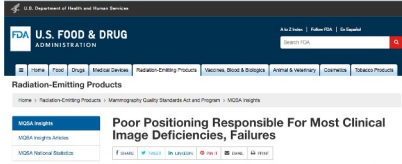
Louise Miller, R.T.(R)(M)(ARRT), CRT(M), FSBI, FNCBC  
Director of Education, Mammography Educators



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U.S. Department of Health and Human Services  
FDA U.S. FOOD & DRUG ADMINISTRATION

Radiation-Emitting Products

MDA Insights

### Poor Positioning Responsible for Most Clinical Image Deficiencies, Failures

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 MDSA in 1988, 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 mammographic 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 2020 study, the "typicality" of mammography dropped from 64% in the average cases with passing positions to 35.3% 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 2020, the American College of Radiology (ACR), the largest FDA-recognized accreditation body (3), found that of all clinical images which were deficient on the first attempt at accreditation, 90% were deficient in positioning. Also, in ACR-recognized facilities, 79% of all first accreditation failures in 2015 were due to (4).

Source: U.S. Food & Drug Administration

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The Member Newsletter of the Society of Breast Imaging  
Click on the tree to return to "Index of Contents"

### A Technologist's Perspective of the FDA Report "Poor Positioning Responsible for Most Clinical Image Deficiencies, Failures"

By Louise Miller, #155348

**R**egently I received a call from a radiologist asking me to provide 8 hours of positioning training for his technologists. They had failed American College of Radiology (ACR) accreditation for positioning and needed to document the training in order to resubmit new images, which was due a week. A side note here if you fail, get help EARLY! When I met the radiologist in his office on the morning of the training, he began to tell me that his techs obviously didn't know how to position correctly. This is a common assumption that I not receive correct. I met with the techs, who were all experienced mammographers with varying years of experience. I presented a lecture on standardized positioning and conventional anatomy and then gave a hands-on demonstration with a model. Almost all were surprised by the way I positioned, which was based on the tenets of consistency, reproducibility, and sound ergonomics. I learned these principles way back in the 1980s and have modified them to accommodate the changes in technology over the years. They all agreed, obviously because none of them positioned the way, in fact, their positioning techniques were all different from each other's. This is a scenario I see in hundreds of facilities throughout the country I cannot take repeat. "What has changed?" What did they miss that I did not? These were all women who were proud of their work and were often embarrassed by their failures. They were asking the best they knew how. Fortunately, most technologists want to learn techniques, and they want to improve and do their best possible work for the patients. These technologists were lacking essential training updates for positioning or had insufficient continuing training using a standardized method.



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Source: Mammography Educators

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You have been assigned this mountain to show others it can be moved.



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Now is the time to make a collaborative effort to establish, improve and maintain quality in mammography positioning.




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## QUALITY

ALL industries have established standardized methods performance of tasks to:


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



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400,000 deaths per year due to medical errors... How many mistakes were made??




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Source: Journal of Patient Safety

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## How do we reduce medical errors?

- Standardization
- Consistency
- Reproducibility

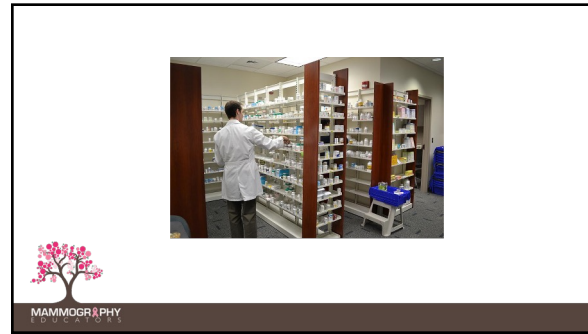


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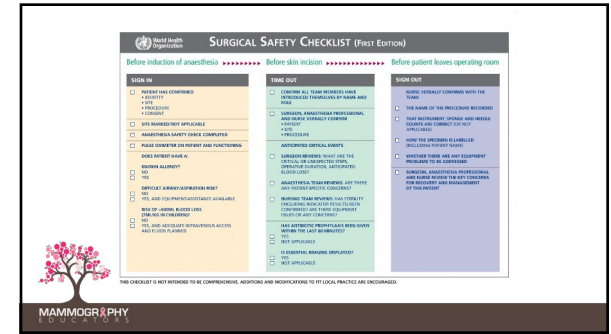
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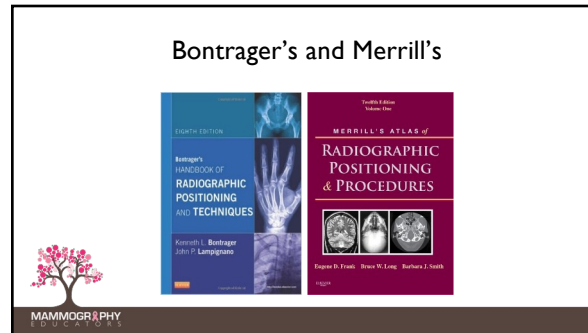
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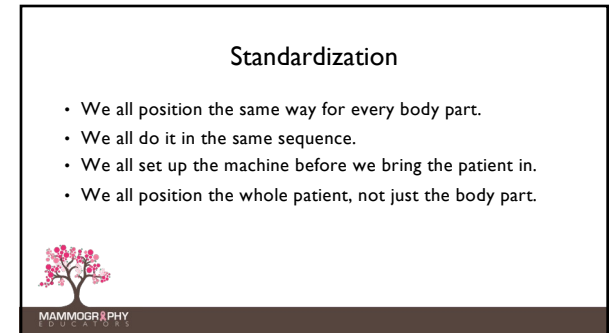
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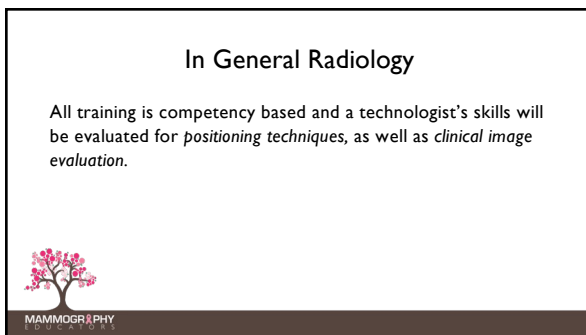
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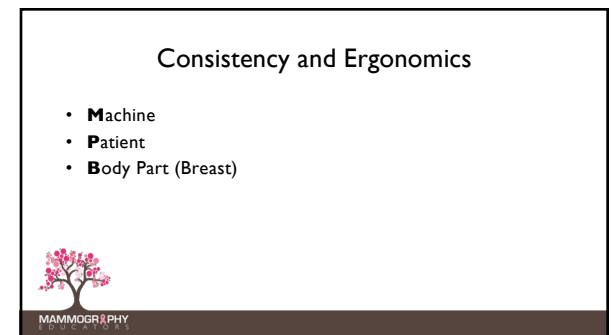
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## Consistency and Ergonomics

- **M**aking
- **P**ositioning
- **B**etter



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



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## In General Radiology...

We use anatomical landmarks that are visible and palpable:

- Radial head
- Humeral head
- Sternal-clavicular notch
- CL
- OML
- ASIS
- Umbilicus



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## In Mammography...

We *should also* use anatomical landmarks that are visible and palpable:

- Perimeter of the breast
- Humeral head
- Sternal-clavicular notch
- IMF
- PNL



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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:

- Do CC's first
- Then, do the MLO on the side you just finished the CC
- Then, do the other MLO

**Example:** RCC, LCC, LMLO, RMLO



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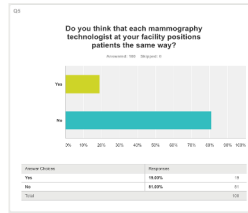
So why is this true for all body parts in radiology **EXCEPT** in Mammography???



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Most technologists *do not* practice a standardized method of positioning.



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In Mammography

- Most technologists have not been taught a standardized method of positioning
- Most technologists have not been trained by a qualified trainer



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In general radiology, sequence of views is standardized!!



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How did this happen?

- No current standardization for positioning for FFDM and DBT
- CEUs for hands-on positioning not required
- Initial 25 mammograms required but under whose supervision?



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How did this happen?

- Technologists are getting most CEUs online (no actual education for positioning)
- Radiologists are passing inadequate images and/or can only give feedback regarding positioning criteria



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How did this happen?

- Updated positioning trainings are not provided by employers
- There is no current published data available to establish parameters for positioning criteria



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How did this happen?

- No updates for positioning with FFDM or DBT (and the new equipment design requires a modification of positioning techniques used for FS)



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FS/FFDM/DBT

- Increased length of the IR by up to 40%
- Increased thickness of the IR by up to 80%
- Increased width of face shield up to 50%



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How can we make things better?

## Consistency and Reproducibility



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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 exposure
- MISSED BREAST CANCERS???



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## Mammography Positioning Techniques Should Be:

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



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## Common Work-Related Injuries

- Wrist problems
- Shoulder problems
- Back
- Knees
- Hips



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## Do standardized positioning techniques work?

- Used consistently for 50+ years in Sweden
- Was taught by ACR in the 1990s
- Results published by Bassett et al in 1993 showed an improvement of 68% in image quality after ACR standardized positioning training
- Current preliminary data regarding standardized positioning techniques is impressive



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## Standardized Training

Northwestern University 2012\*

- After standardized training, they showed a **50%** reduction in technical call backs (for positioning, blur, etc.)



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\*This is published study.

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## What They Did to Affect Change

- Developed a Train-the-Trainer<sup>®</sup> (T3) Program
- Technologists applied to participate in the program and were chosen by specific criteria
- Received specialized training so they can provide effective and proven positioning techniques to other technologists in underserved areas
- Train-the-Trainer program successfully in place for 4+ years
- Plans for expansion to other major urban areas in US



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\*Program designed and presented by Louise C. Miller, RT(R)

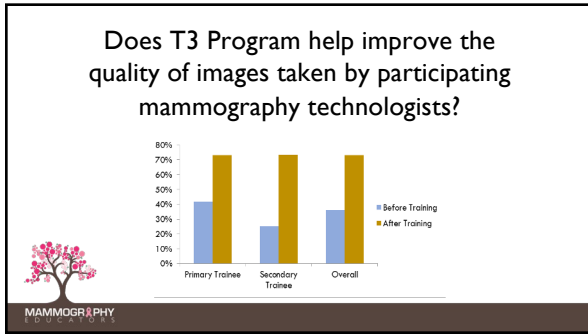
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Metropolitan Chicago  
Breast Cancer Task Force

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### USE DATA!!!

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

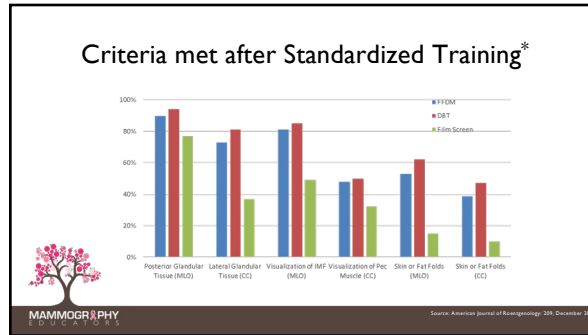
Positioning criteria following training for updated standardized positioning techniques for FFDM and DBT far exceeds data on Bassett study.\*

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

*(This slide contains a full-page article snippet with text and a small tree logo.)*

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### Reasonable Expectations

View	Criterion	FFDM	DBT	Film Screen
MLO View	Visualization of Pte Muscle to Pte	85%	87%	83%
	Clavicle Pte	83%	88%	-
	Scapula Pte	41%	46%	-
	Clavicle Pte	23%	26%	-
	Wrist Margin at Top of Pte	55%	59%	-
	No Scapula	5%	5%	9%
	Posterior Glanular Tissue Included	92%	94%	77%
	Apex in Profile	89%	92%	88%
	Distal Fat Fold	33%	32%	32%
	Upper Location	23%	27%	-
CC View	Visualization of Mammary Axilla	81%	85%	49%
	Resolves More Than One View	13%	17%	-
	Pte Muscle Visualized	46%	50%	32%
	No Motion	100%	100%	-
	Lateral Glanular Tissue Included	73%	81%	37%
	Apex in Profile	83%	86%	88%
	Wrist at Top	83%	47%	10%
	Medial Location	16%	23%	-
	Lower Location	23%	32%	-
	Visualization of Clavicle	41%	34%	-
Resolves More Than One View	3%	7%	-	

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### Reasonable Expectations

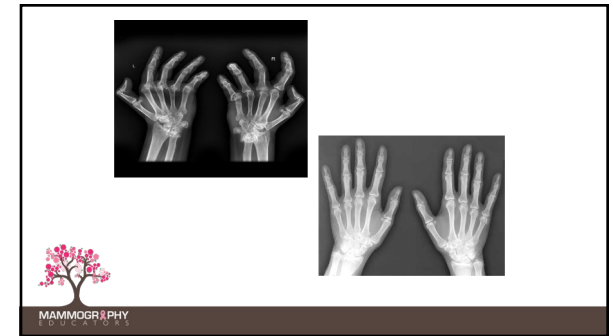
- Our patients have different and often challenging body habitus
- Their breast size, shape, mobility and tenderness are hugely variable

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### 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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Not every mammogram can be ACR perfect!

**“What Every Technologist Would Like Their Radiologist to Know”, 3 Part Series\***

About Our Patients  
About Our Images  
The Role of the Technologist

\*Published in the SBI Newsletter 2015



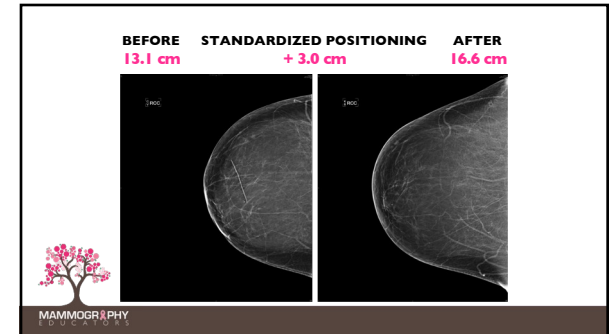
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But we CAN improve image quality by using standardized positioning techniques that are applicable for FFDM and DBT *and* developing a strong knowledge-based foundation that depends on the technologist’s understanding of correlative anatomy.

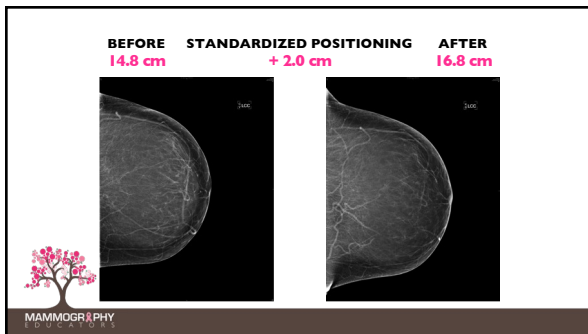
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**Does it work??**

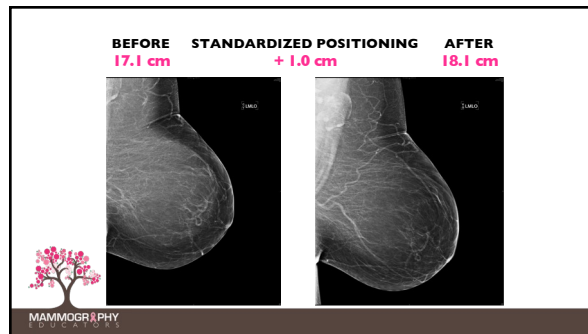
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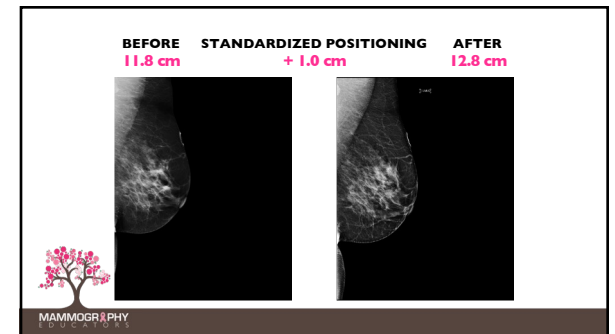
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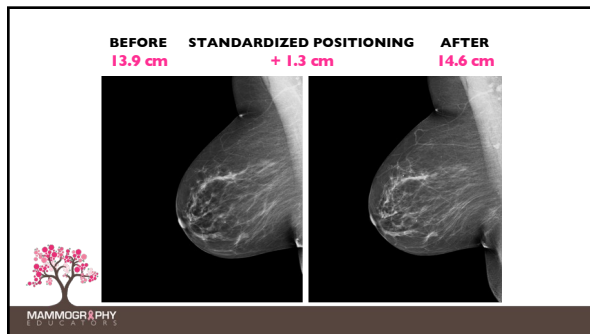
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We need:

- Accurate methods for determining the actual number of images taken
- Accurate methods for analyzing positioning standards
- The ability to provide corrective action plans for *improving* positioning errors (EQUIP)
- The establishment of standardized positioning techniques that are efficient, consistent and ergonomically sound

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It is ALL our responsibility to make sure that ALL women receive the highest quality mammogram achievable.

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Back To The Basics

*Going back to the basics strengthens your foundation.*

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Mammography should be taught according to scientific principle, NOT ANECOTE!

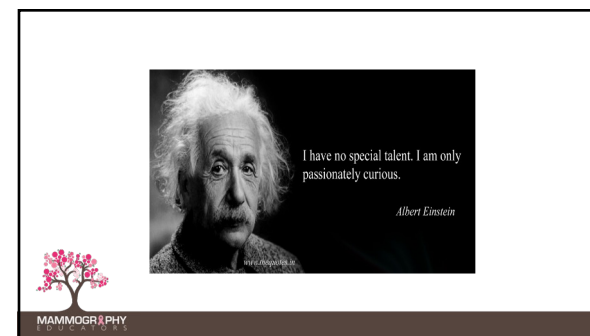
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**ANATOMY - PHYSIOLOGY - PHYSICS**

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You lucked out...



Except...

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

Anatomy and Physiology

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

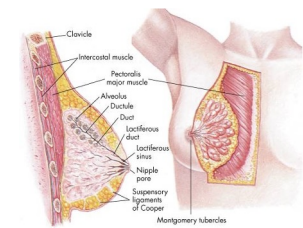
### Goals for **General Radiology** Positioning

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

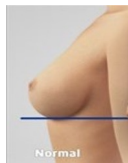
### Goals for **Mammography** Positioning

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.

### Anatomy of the Breast



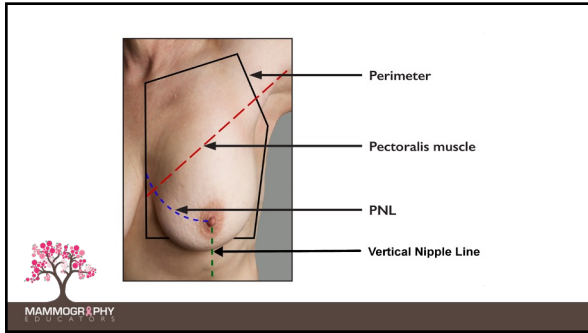
Normal or natural position of the breast is when the nipple is perpendicular to the chest wall.



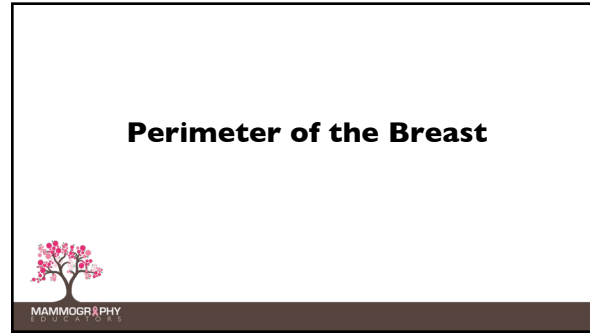
When positioning for mammography we need to bring the breast back to its 'normal' position.



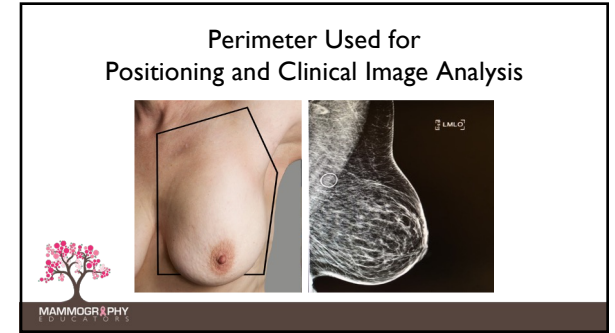
In order to accomplish this and include the maximum amount of breast tissue, we must consider the anatomical landmarks that will be used for positioning and clinical image analysis.



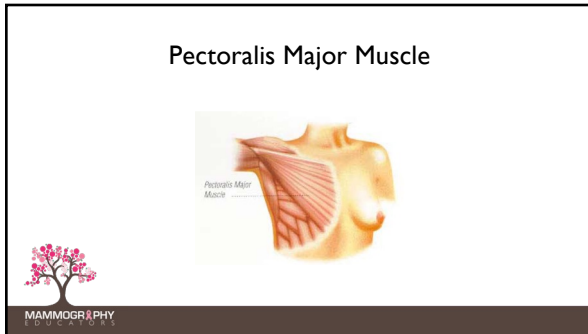
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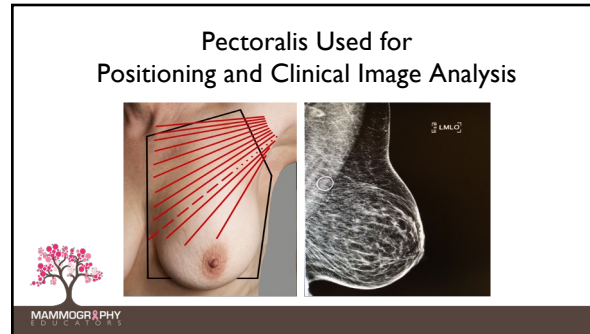
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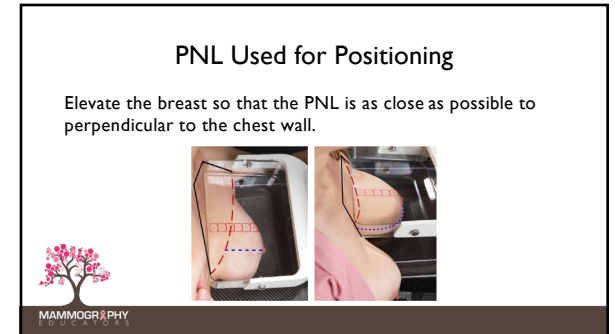
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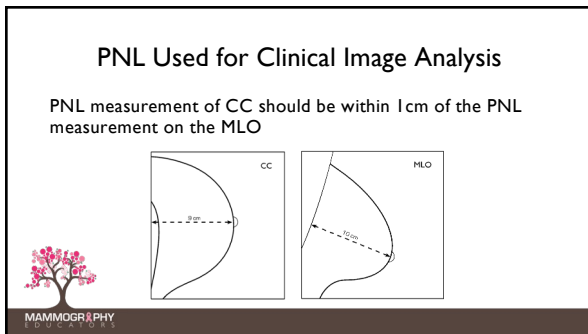
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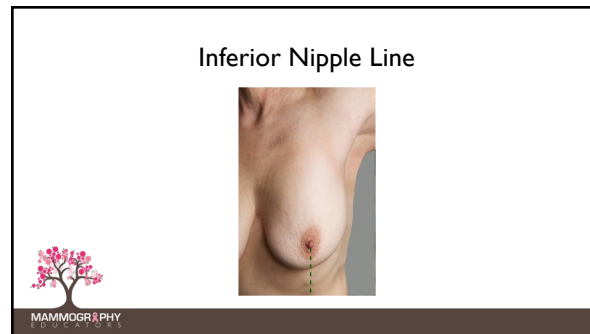
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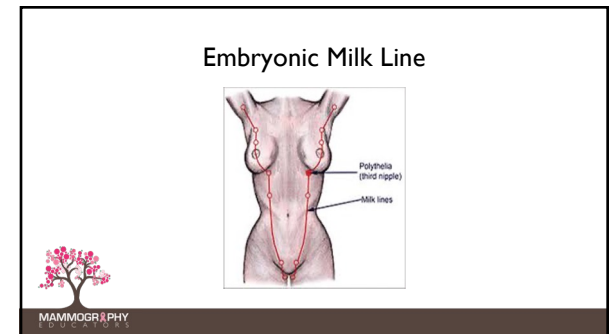
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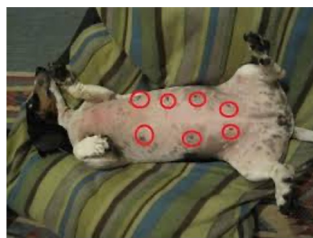
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## Polythelia or Ancillary Nipple



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## The MLO

- Inclusion of all breast tissue within perimeter
- Pectoral muscle fully visualized
- Tissue well separated
- Tissue visualized back to 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 film evaluation

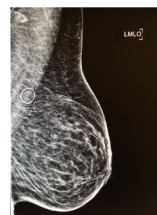


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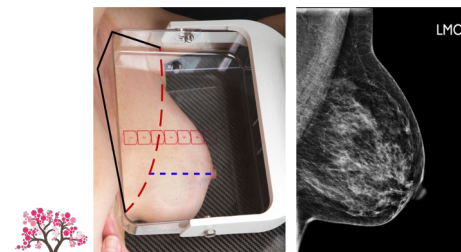
## The MLO

- Visualized down to the PNL
- Wide margin at the axilla
- Convex/straight
- Radiolucent



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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:

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

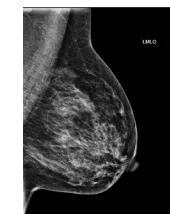


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## LENGTH OF MUSCLE

Should be visualized down to the level of the PNL



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**PATIENT: Length of 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 progress of the compression paddle.



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**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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**Recommended Angulation for MLO**

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



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I am going to say something that is shocking!



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**Keep Angles Consistent**

- 40 for shorter, heavier patients with large breasts
- 45 for average patients
- 50 for tall, thinner patients with smaller breasts



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**Keep Angles Consistent**

- Use variations at 5-degree increments
- No more 47, 42, 48, 53, etc.



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**Keep Angles Consistent**

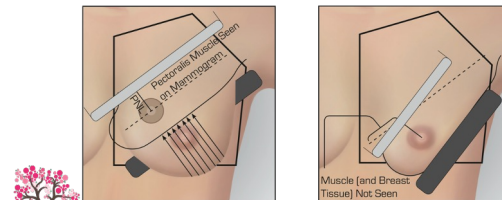
- I am **not** saying NEVER use 35 or 55, but try to keep it consistent, so comparison is easier from year to year
- An MLO angled at 56 degrees one year will look markedly different than an MLO angled at 42 degrees the next year



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Proper degree of angulation

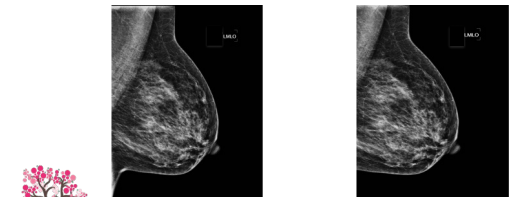
Angle too steep



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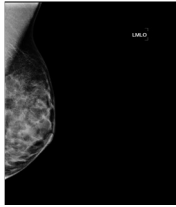
Proper degree of angulation

Angle too steep



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Is it the angle or the patient?

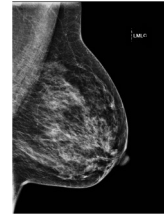


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**WIDTH OF MUSCLE**

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



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

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



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**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 shoulder as far forward as possible, with the shoulder down, relaxed and pulled forward.



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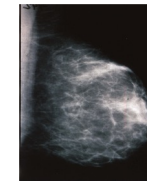
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Is it the placement of the IR in the axilla or the patient?



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**SHAPE AND OPACITY OF THE MUSCLE**

The muscle should be convex or straight.



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**EQUIPMENT: The shape and opacity of the muscle is related to the height of the IR**

The top of the IR should be positioned at height of the sternoclavicular joint, or halfway between the top of the shoulder and the axillary crease.



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

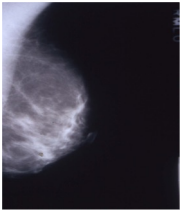

- Patient's shoulder, arm and hand muscle
- Be relaxed



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### Is it the height of the IR or the patient?

118

### Problems with the MLO

- No visualization of the IMF
- Folds in the IMF
- Breast drooping




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### Visualization of the IMF

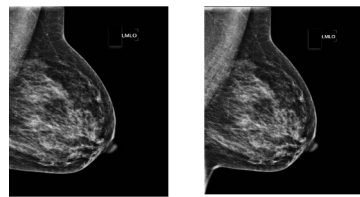

**Equipment challenges:**  
Change of the angle will not compensate for the increased length and the width of IR for FFDM and DBT (compared to the bucky)

*Change should be made in the patient position.*



120


### No IMF      IMF

121

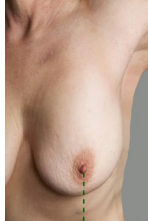

**The position of the patient related to the bottom, front corner of the IR is critical:**

- Patient must be facing forward with both feet
- The lower front corner of the IR should be directly below the patient's nipple (on VNL) or halfway between her ASIS and umbilicus
- This requires the patient taking a "side step" towards you



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### Inferior Nipple Line


123

### Improper      Proper

Edge of IR in front of IMF      Edge of IR behind IMF

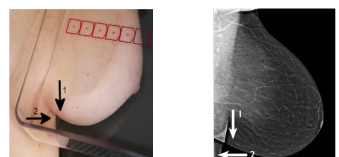


Top edge of IR indicated by vertical dotted line.




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### Folds in the IMF



1. Horizontal fold is in the medial breast
2. Vertical fold is in the lateral breast



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### Breast Sagging




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## Position of the Breast

- Breast held in “up and out” position to bring the breast back to its “normal” position (nipple perpendicular to the chest wall)
- Maintained by adequate compression



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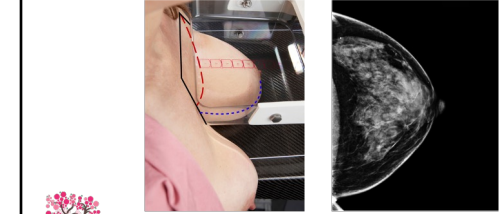
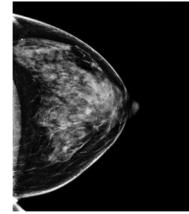
## The CC

- Include maximum amount of breast tissue in the axial/transverse plane
- Visualization of medial breast tissue (cleavage) if possible
- Visualization of pectoralis muscle on approximately 30% of all CCs



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## Is it the Equipment or the Patient?

### The Equipment:

- IR too high or too low
- Compression paddle size

### The Patient:

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



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



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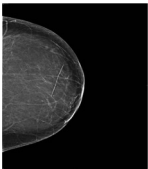
Elevate the breast so the PNL is perpendicular to the chest wall and pull the breast on with both hands.



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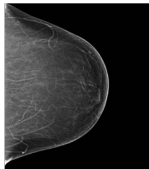
132

1 handed “plop”



12.5 CM

2 handed pull



14.8 CM



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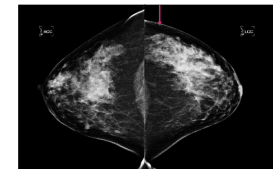
Lateral, mobile border of the breast pulled forward.



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Failure to pull on lateral posterior breast tissue



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## Nipple in Profile Nipple Centered



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## Nipple Centered

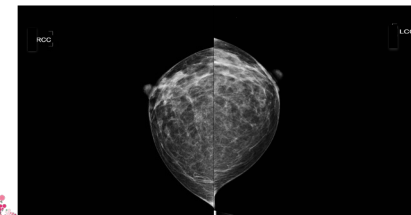
- Nipple should be centered on the CC view, if possible, and without sacrificing breast tissue.
- Nipple may not be centered due to prominent medial or lateral fullness of the breast, which should be noted on the history sheet.



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## Patient with Prominent Medial Fullness



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## Nipple Centered

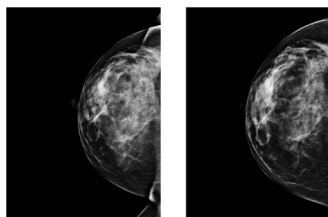
- Breast tissue should never be sacrificed in order to center the nipple or show the nipple in profile
- An additional view should be added and labeled appropriately
- Notation should be made on history sheet



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## Compression



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## Compression Solutions

- Criteria:** Breast should be compressed until taut or less than painful. Glandular tissue should be well separated.
- Technologist must compress the breast until "taut" or less than painful
  - Technologist must work with the patient to achieve adequate compression



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## Focus On

- Consistency
- Reproducibility
- Efficiency
- Proficiency
- Ergonomic principles



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## Mammography Saves Lives!

But it is up to you.....

Even the best radiologist, in the best breast center cannot diagnose a cancer that is not included on the image.



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## References

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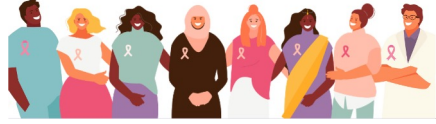
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