Breast cancer screening with mammography has come a long way from its beginnings. Before the Mammography Quality Standards Act (MQSA), a voluntary accreditation program developed by the American College of Radiology started the process of ensuring quality mammograms throughout the United States. In 1992, Congress enacted the MQSA, which established national standards for accreditation, certification, and inspection of mammography facilities and personnel in the United States and allowed patients the opportunity to receive high-quality, consistent, and reliable breast imaging at mammography facilities. MQSA includes minimum educational qualifications for radiographers who perform mammography, the interpreting radiologists, and the medical physicists who inspect the mammography equipment. There is also a component to monitor and track violations, including regular checks of the continuing education of mammographers, radiologists, and physicists. These standards ultimately have helped to optimize radiation doses and improve early detection rates, allowing earlier treatment and better outcomes for breast cancer patients.

Even with all the imaging options available today, breast screening with mammography remains the gold standard. It is the most efficient and effective method for screening thousands of women daily. The biggest change to mammography screening came with the advent of digital imaging. In analog breast imaging, standardized equipment and processing were just as important as patient positioning for obtaining high-quality images. A perfectly positioned mammogram could be ruined by poor processing or poorly maintained equipment. Digital processing of mammograms, although still...
not an exact science, is less subject to fluctuations and variation in image contrast. In digital imaging, image acquisition is separate from image display, and a well-maintained digital processing system automatically corrects for minor exposure errors. This means that with digital mammography systems the emphasis has shifted, and quality imaging has moved squarely into the hands of the mammographer. With the emphasis on the competency of the mammographer in today’s imaging world, the importance of breast compression and accurate positioning cannot be overemphasized.\(^\text{2,3}\)

Routine breast screening usually includes a 4-projection series: the craniocaudal (CC) and the mediolateral oblique (MLO) projections of both breasts. These routine projections are relatively easy for an experienced mammographer to perform on the typical patient and the examination can be completed in 10 to 15 minutes. The projections are complementary, and when some portion of the breast tissue is not visible on one projection, it does not necessarily mean an extra projection is required (see Figure 1). However, to maximize the amount of breast tissue under the compression field and ensure a quality image is produced, the mammographer must employ not just positioning skills but also a knowledge of breast anatomy and physiology.

Complexity arises because patients are different ages, sizes, and have varying body habitus. Mammographers must know how to image patients who do not fit the typical profile. In addition to competent positioning skills and anatomical knowledge, the mammographer needs a thorough knowledge of the various projections and the skills to modify any projection to meet the individual patient’s needs.\(^\text{4,6}\)

The key is to understand how to determine good positioning while recognizing that no single technique will work on all patients in all situations.

Special groups of patients include those with very small breasts, men, large-breasted patients and patients with wide breasts, patients with pectus excavatum or pectus carinatum, patients with a barrel chest or kyphosis, and patients in a wheelchair or on a stretcher. Occasionally, postmastectomy imaging and implant imaging are required. All mammographers also should have a workable routine in place when performing magnifications or spot compression views. This requires knowledge of positioning terminology and an understanding of triangulation.\(^\text{6}\)

### Standard Projections

The CC projection best demonstrates the anterior, central, medial, and posteromedial portions of the breast, but it poorly demonstrates the lateral and posterior lateral breast tissue. There are a number of key points to note for any CC projection\(^\text{4,5,7,8}\):

- The imaging plate (IP) or detector should be positioned at the level of the raised inframammary crease. This means that the posterior breast tissue must be lifted before positioning the detector or IP.
- The mammographer should drape the medial contralateral breast on the corner of the IP or detector to avoid pulling away medial tissue of the ipsilateral breast.
- The patient’s head should be turned away from the side being examined.
- The patient should stand with feet slightly apart and with weight equally distributed for stability.
- The arm closest to the breast being examined is positioned by the patient’s side with the humerus externally rotated to keep the shoulder from the compression field and to avoid rotating the patient medially.

---

**Figure 1.** The blue arrow indicates the area that will be missed on the craniocaudal (CC) projection.
The contralateral arm can be raised. The patient can hold the machine for support. This technique maximizes the amount of medial tissue on the detector or IP.

Exposure is made on suspended respiration. The patient should not take a deep breath before the exposure as this action can pull breast tissue from under the compression plate.

In evaluating the CC projection, the following are important points:
- The nipple should be in profile and centered on the radiograph. However, do not eliminate breast tissue to center the nipple if the nipple is not naturally centered.
- The medial and lateral borders of the breast must be included in the collimated field.
- The pectoralis major muscle is seen on approximately 30% to 40% of all CC projections. However, if the pectoral muscle is seen all the time, medial breast tissue might not be included on images.
- Dense areas of the breast must be well penetrated.
- On the CC projection, the posterior nipple line (PNL) measurement should be within 1 cm of the PNL measurement for the MLO projection. The PNL measurement is the distance from the nipple to the edge of the image (see Figure 2).

All images should have the appropriate markers and labeling as required by MQSA.

Because it is an oblique projection, the MLO best demonstrates the extreme posterior and upper Outer quadrant, however, there is distortion of the anterior, central, and medial breast tissue. This means that the CC projection is critical to demonstrating medial breast tissue. Dedicated mammography units are very versatile, allowing tube rotations of 360°. With the MLO, the tube rotation can range from 30° to 70°, with shorter, stockier patients requiring less angulation and tall patients requiring more. Typically, men require the steepest angulation. The main purpose of varying the tube rotation is to position the IP or detector parallel to the pectoralis muscle to maximize the area under the compression paddle.4,5,7,8

The following are key points when imaging the MLO projection:
- The degree of tube angulation varies between 30° and 70°, depending on patient body habitus.
- The IP or detector must be placed in the axilla with the arm draped over the top of the IP. If the IP is too high, the arm is raised too high and the pectoral muscle is not imaged entirely. Similarly, positioning the IP too low also results in poor imaging of the pectoral muscle.
- The anterior breast must be supported before

![Figure 2. CC projections (A-B) and mediolateral oblique projections (C-D) showing the posterior nipple line. Images courtesy of Olive Peart.](image-url)
Breast Compression

Breast compression is essential, and it is one of the most basic principles used to produce a high-quality image. Compression is designed to maximize the amount of tissue visualized on the radiographs. The main reason for breast compression in mammography is to produce a uniform breast thickness. The noncompressed breast is thicker at the chest wall and thinner toward the nipple. Radiation passing through it is non-uniform and of varying intensities. There are also other benefits of compression. Compression reduces radiation dose to the patient. With a compressed breast, the radiation passes through a thinner tissue thickness, and less radiation is needed to penetrate the part. This allows the use of lower technical factors, thereby reducing the radiation dose to the patient.4,5,7,9

In addition, the lower factors result in less scatter production, allowing improved image contrast. Compression also reduces the possibility of motion unsharpness. Compression keeps the breast immobilized during the exposure and makes it less likely to shift during respiration. Finally, compression separates superimposed areas of breast tissue and brings abnormalities closer to the detector or IP. Lesions closer to the IP have a smaller object-to-image receptor distance and therefore are subject to less distortion. The image is sharper and there are fewer overlying structures, allowing better visualization. In general, adequate compression is achieved when the breast is compressed until taut.4,5,7,9

Typically, after the automatic compression stops, manual compression must be applied to immobilize and compress the breast adequately. This is crucial, particularly when imaging the MLO projection. The MQSA guideline restricts the maximum automatic compression applied to 45 lb, with a minimum of 25 lb. However, manual compression is at the discretion of the radiographer, with some units having a limit of up to 65 lb. Although too little compression will compromise image quality, compression should not be applied to cause the patient severe pain. Patients have different sensitivity, and the same force of compression should not be applied on all patients at all times.4,5,7,8

Communication is a necessary factor in helping patients tolerate the compression. Before applying compression to the breast, the mammographer should explain the importance of compression and address all questions in a reassuring and thoughtful manner. The mammographer needs to convince the patient that compression is absolutely essential in mammography. Some patients appreciate being shown images of the breast with and without compression, which can be used to demonstrate how easy it is to miss a lesion or how ill-defined and blurry a lesion can appear without compression. Mammographers also can explain some of the causes of a painful mammogram. One cause is breast cysts. Patients who have a history of sensitive breasts or breast cysts should be advised to schedule their mammogram 7 to 10 days after their menstrual period ends when the breast is least cystic and therefore less sensitive. Patients with extremely sensitive breasts could be advised by their physicians to take over-the-counter pain medication 30 minutes prior to the mammogram, or the mammogram can be rescheduled. A topical pain gel also is available. The gel can be applied directly to the breast and has been shown to help relieve pain for patients with extremely sensitive breasts.4,5,7,10
Finally, patients are reassured if they are given some measure of control. They should be reassured that compression lasts only a few seconds and with state-of-the-art mammography units the compression automatically releases immediately after the exposure. With a thorough explanation of the importance of compression, most patients are able to tolerate the compression necessary to ensure a good mammogram.  

**Applying Compression**

During compression, the natural mobility of the breast must be considered. The breast is more loosely attached at its inferior and lateral aspects and more rigidly attached to the chest wall at its superior and medial aspects. In maximizing the amount of tissue under compression, the most mobile margins of the breast always are positioned on the fixed structure (ie, detector or IP) then the compression is applied from the fixed margins. When applying compression, the mammographer should keep his or her hand between the breast and the compression plate until the plate touches the back of the hand. Only then should the mammographer remove his or her hand, pulling the breast out and applying the final degrees of compression slowly with the manual controls. The mammographer should never apply the final degrees of compression with the automatic controls.

**Routine Labeling**

MQSA requires all mammograms to include a patient identification label. In analog imaging, this label is exposed or flashed onto one border of the image using a light mechanism system before the film is processed. This creates a permanent reproduction that cannot be erased easily. In digital imaging, prerecorded information automatically is added to the image after each exposure.

The patient identification label should include:

- Facility name.
- Facility location, including the city, state, and ZIP code.
- Patient’s first and last names.
- An additional patient identification number, such as the medical record number.
- Date of the examination.

In addition to the patient identification label, the mammogram should have the right or left projection label placed near the axilla and the initials of the mammographer performing the examination. The identification may include only the initials of the mammographer if the facility maintains a log of the mammographers and their identifying initials. The projection label should be the standardized projection identifier code developed by the American College of Radiology. Facilities with more than one mammography unit must identify each unit on the image. Analog units must have a number system for the cassette/screen to identify defective cassettes or cassettes with persistent artifacts. Optional information that can be included on mammograms includes the technical factors (kV, mAs, compression force, and breast thickness) and the degree of obliquity of the projection.

**Supplementary Projections**

Mammography often requires the use of supplementary projections or positions. Each supplementary projection or position serves a unique purpose and often is needed to complement the routine projections. Supplementary projections provide additional information by imaging areas of the breast not well visualized on routine projections or demonstrating a suspicious area seen on only one of the routine projections. Supplementary projections allow better visualization of suspicious microcalcifications or the borders of a lesion.

In imaging some patients who present unusual positioning challenges, supplementary projections serve another function. Often, the patient’s medical history or body habitus is such that the standard projections are difficult or impossible to obtain. Supplementary projections might be the only projections capable of imaging the breast. The mammographer therefore needs a thorough knowledge of the supplementary projections when imaging certain patients.

The supplementary projections recognized by the MQSA, the American College of Radiology, and the American Registry of Radiologic Technologists are listed in the Box. Other recognized modified positions include the rolled medial or rolled lateral, rolled inferior or rolled superior, magnification, and spot compression.

**Mediolateral or 90° Lateral**

The mediolateral (ML) is a true lateral projection and provides an exact representation of the breast structures relative to the nipple (see Figure 3). The central...
ray passes from medial to lateral with the tube rotated 90°, which best visualizes details of laterally located lesions. This projection can be used to verify a finding, localize a lesion in another dimension, or prove breast calcifications benign. The “teacup”-shaped milk of calcium is a benign calcification that can be identified on the 90° lateral. The ML projection also is useful in showing an open inframammary fold; however, it is poor at visualizing the posterior and lateral aspects of the breast and cannot replace the MLO. If a lesion is seen only on the MLO, the ML is useful as a localization tool.

Comparing the MLO and ML projections can help to determine a lesion’s position:

- Medial lesions move up on the ML from their position on the MLO.
- Lateral lesions move down on the ML from their position on the MLO.
- Central lesions do not change significantly from the ML to the MLO.

**Lateromedial**

In the lateromedial (LM) projection, the tube is rotated 90°, with the central ray traveling lateral to medial. The chest wall edge of the detector or IP is positioned to rest on the sternum (see Figure 4). This projection also gives a true representation of the structures of the breast relative to the nipple and is ideal to improve visualization of a lesion located in the medial aspect of the breast or high on the chest wall. The LM can be used when performing localizations of inferior or lateral lesions and can be more comfortable for some patients. The LM can be used instead of the lateromedial oblique (LMO) to image tissue missed on the MLO. The LM is also a useful projection for imaging patients whose sternum or areas around the sternum are compromised and cannot tolerate the compression pulling tissue across the sternum.

**Lateromedial Oblique**

The LMO is an inferolateral to superomedial projection and is a true reverse of the MLO (see Figure 5). This projection is necessary when the standard MLO projection is difficult to obtain because of the patient’s body habitus or past surgery. The LMO projection also can be used to improve visualization of a medial lesion, for patients with prominent pacemakers to

---

**Box**

**Recognized Supplementary Mammographic Projections**

- AT – axillary tail
- CV – cleavage or valley view
- FB – “from below” or caudocranial
- LM – lateromedial
- LMO – lateromedial oblique
- ML – 90° mediolateral
- SIO – superior-inferior oblique
- TAN – tangential projection
- XCCL – exaggerated craniocaudal

---

**Figure 3.** A. Positioning for the mediolateral projection. B. Mediolateral mammogram, courtesy of Olive Peart.
prior to the exposure. The projection can be taken with the tube rotated in any direction (see Figure 6).6,9,13

**Exaggerated Craniocaudal**

This projection is used to locate lesions in the posterior lateral aspect of the breast not seen on the CC projection (see Figure 7). The patient is turned laterally from the CC position. Generally, the image demonstrates the nipple off center and more medial. This projection often does not include the medial breast and, to avoid distortion of the breast tissue, both shoulders should remain on the same level.6,9,13

---

**Tangential**

The tangential projection is ideal for locating skin calcifications or lesions near the skin surface. The x-ray beam should be directed tangential to the area of interest. This will project the area in question free of superimposition. If an abnormality is detected or if it is palpable, a lead spot marker can be placed over the area of interest.
From Below
The “from below,” or caudocranial, projection can be used to image men or women with very small breasts (see Figure 8). It also can be used when imaging patients with kyphosis. This projection clearly visualizes lesions in the superior or upper quadrants of the breast. The projection places the least mobile margin of the breast against the detector or IP, which sometimes results in less tissue under the compression area. Before compression, the inframammary fold should be elevated. The compression begins at the level of the elevated fold.6,9,13

Cleavage or Valley View
The cleavage projection shows the deep posterior medial aspect of the breast (see Figure 9). This area, close to the chest wall, is not demonstrated on the standard CC. Often, to image the cleavage properly, both breasts are placed on the IP or detector, thus maximizing the area under compression.6,9,13

Axillary Tail
The axillary tail projection visualizes the tail of Spence, the most lateral aspect of the breast (see Figure 10). The axillary tail is actually an oblique projection of the axillary area or tail of the breast, and the degree of obliquity often depends on the radiologist’s preference. The breast tissue immediately below the head of the humerus should be included in the compression. Including the humeral head under compression should be avoided because this does not allow adequate compression of the breast tissue.6,9,13

Superior-Inferior Oblique
The superior-inferior oblique projection best demonstrates the upper-inner quadrant and the lower-outer quadrant of the breast free of superimposition. The beam is directed from the superior lateral aspect to the inferior medial aspect of the breast. This projection especially is useful when imaging patients with encapsulated implants, and it also can be used to demonstrate the inframammary fold or crease (see Figure 11).6,9,13

Rolled Positions
The rolled positions are useful to eliminate overlapping structures and superimposed tissue, especially when
imaging dense breasts (see Figure 12). In imaging the rolled lateral or rolled medial projection, some radiologists prefer to angulate the tube 5° instead of rolling the breast to aid in reproducing the image at a later date.  

Both the rolled lateral and rolled medial projections start with the breast positioned for the CC projection.

- Rolled lateral – from the CC position, the portion of the breast farthest from the IP is rolled laterally and the lower portion medially.
- Rolled medial – from the CC position, the portion of the breast farthest from the IP is rolled medially and the lower portion laterally.

The rolled superior and rolled inferior start with the breast positioned for the ML projection.

- Rolled superior – from the lateral position, the portion of the breast farthest from the IP is rolled superiorly and the lower portion inferiorly.
- Rolled inferior – from the lateral position, the portion of the breast farthest from the IP is rolled inferiorly and the lower portion superiorly.

Magnification

Magnified projections are used to improve visualization of fine detail, especially when analyzing calcifications (see Figure 13). Magnification can be accomplished with or without spot compression and in any orientation. Magnification can reveal the number, distribution, and morphology of microcalcifications. It also can be used to evaluate the margins of lesions, to image specimens and surgical sites, or to evaluate a mass density. Magnification cannot be used to assess lesion size because the final image will be magnified.

Magnification factors of 1.5, 1.8, and even up to 2 are used in some units. Magnification must be done only using the smallest focal spot and with the correct magnification device. The smaller focal spot is necessary to improve the resolution and sharpness, which would otherwise decrease with a large object-to-image receptor distance. However, the large distance between the image receptor and the object acts as an air gap to reduce the amount of scattered radiation reaching the image receptor. Grids are therefore not needed and not used with magnification mammography. Grid use would unnecessarily increase radiation dose to the patient, exposure time, tube loading, and motion artifacts due to long exposure time.

The American College of Radiology guidelines set the glandular dose for magnification at 100 mrad (1 mGy). However, with magnification, the skin dose to the patient is higher than with standard imaging and can reach levels of 1200 mrad (12 mGy) because the breast is closer to the radiation source.

Spot Compression

Spot compression is used to localize suspected abnormalities by applying more compression to a localized area of interest using a smaller compression plate (see Figure 14). Spot compression is useful for
evaluating a suspicious area and eliminating pseudo-masses by spreading out the breast tissue in the area of interest and allowing more even compression. Spot compression can be performed in any projection, with or without magnification.\(^6,9,13\)

**Imaging Patients Who Present a Positioning Challenge**

The first step in imaging any patient is to determine whether a routine imaging protocol can be followed. Sometimes a routine imaging series can be obtained with minor modification of patient positioning and without compromising image quality. However, sometimes imaging using the basic CC and MLO projections is not possible. Occasionally, after taking the initial series of images, the mammographer must determine which area of the breast has not been demonstrated before deciding which supplementary projection will best image that area. In other cases, one or more of the supplementary projections might be the only way to image the breast.\(^6,9,13\)

Each mammographer must develop a unique sequence of steps in positioning the patient. However, some basic guidelines should be followed regardless of the patient, projection, or position. The key to imaging is to use the mobility of the breast plus creativity to image as much breast tissue as possible. However, it is recognized that the standard projections maximize the amount of breast tissue under compression and provide the ideal imaging option for the early detection of breast cancer. This means that whenever the standard projections are not used, the patient’s mammogram has not been optimized. Because of the possibility that breast tissue will be missed, this fact must be documented.\(^6,9,13\)

Before repeat or additional imaging, the mammographer should perform a careful evaluation of the patient’s anatomy, the standard mammograms, or the supplementary projections. This will enable the necessary corrections, and the most suitable projection for completing the study can be selected. A careful analysis is required because any extra projection must demonstrate missed breast tissue to justify the added radiation dose to the patient.\(^6,9,13\)

Regardless of the position or projection, communication is essential, and the mammographer will find it easier to manipulate and position the breast if the patient is relaxed and cooperative vs distressed and rigid. Always
respect the patient’s privacy. Some patients are modest even in a private examination room one-on-one with a female mammographer.

Controlling patient motion also is important and motion is best limited if all breast images are taken on suspended respiration; however, avoid telling the patient to take a deep breath before arresting respiration. A deep inspiration effort is likely to lift the shoulder or move the breast out of position. The mammographer should always reheat breathing instructions with the patient before the start of positioning. 5,12

**Imaging Small Breasts**

It usually is easier to image small breasts in the MLO projection. For extremely thin breasts, the patient can slouch during the MLO positioning, allowing the breast tissue to fall forward. 4,6,13

Sometimes the breast is very thin and the mammographer’s fingers are compressed, yet the breast tissue slips out of compression. In such circumstances, a potential solution is to use a rubber spatula to hold the breast in place before compression takes over. The spatula also can be used to pull the breast tissue away from the chest wall during initial compression or to hold the anterior breast in place before compression when imaging for the MLO. The spatula is much thinner than the mammographer’s hand and holds the breast in place while avoiding squeezed fingers.

Another option for imaging small breasts is to use a breast pad. The use of a breast pad increases the friction between the breast and the detector. This helps to prevent the breast from slipping out of or off the detector as the compression descends. If the pad only is used occasionally, no change in quality control tests is needed. However, if breast pads are used for all routine work, the mammographer should consult and follow the manufacturer’s specific quality control requirements. 6,13

For the CC projection, care should be taken to ensure proper penetration of glandular structures by having the breast tissue cover at least the first automatic exposure control detector when using an analog imaging system. Manual technique must be used if the breast does not cover at least the first automatic exposure control detector. Digital imaging systems are more sensitive because the detectors cover the entire field. However, even with digital systems, there still should be sufficient breast tissue covering the detector to ensure an adequate automatic exposure. 6,8,13

A possible problem when imaging the small breast is the inability to get and keep sufficient breast tissue under the compression paddle. To address this problem, turn the patient slightly away from the side being examined, bringing the elbow of the ipsilateral side forward. This action allows more breast tissue to fall on the IP or detector. However, when using this method, the radiographer always should focus on pulling medial breast tissue under the compression and ensuring that the patient’s shoulders remain on the same level to avoid distorting the breast tissue.

Another option is a 5° lateral tube angulation, which can be substituted for turning the patient medially. However, this results in a CC projection that is imaged at 5° and not at 0°, which is not the preference of some radiologists. Regardless of the option used, if medial breast tissue is missed, the radiographer can use the cleavage view (CV) projection to image the medial breast. Another possibility is to first image the patient in a standard CC projection to include the entire medial breast, then use an exaggerated craniocaudal (XCCL) projection to obtain more lateral tissue. 6,8,13,15

**Male Breast Imaging**

Men with gynecomastia usually have enough breast tissue to image reasonably well. In the absence of gynecomastia, male breast imaging is very similar to imaging the very small female breast. As with imaging a woman’s small breast, the mammographer might use a spatula to hold the breast in place while avoiding squeezed fingers.

Another option for imaging small breasts is to use a breast pad. The use of a breast pad increases the friction between the breast and the detector. This helps to prevent the breast from slipping out of or off the detector as the compression descends. If the pad only is used occasionally, no change in quality control tests is needed. However, if breast pads are used for all routine work, the mammographer should consult and follow the manufacturer’s specific quality control requirements. 6,13

For the CC projection, care should be taken to ensure proper penetration of glandular structures by having the breast tissue cover at least the first automatic exposure control detector when using an analog imaging system. Manual technique must be used if the breast does not cover at least the first automatic exposure control detector. Digital imaging systems are more sensitive because the detectors cover the entire field. However, even with digital systems, there still should be sufficient breast tissue covering the detector to ensure an adequate automatic exposure. 6,8,13

In the MLO projection, too much pectoral muscle can prevent compression of the anterior breast tissue. It might not be necessary to include all the pectoral muscle...
Depending on which area of the breast was missed during imaging, the CV or the XCCL can be used as additional projections to image the entire breast for CC imaging. One technique is to place a lead spot marker in the center of the breast as a reference point. Each image can include the lead spot marker to ensure that all tissue is covered. Even if a lead spot marker is used, all sections should be numbered or carefully identified to avoid confusion or missed sections.6,9,13

The MLO projection can be used to image either the anterior or the far posterior of the breast. If the MLO is used to image the posterior breast tissue, the ML projection can image the anterior breast. Alternatively, if the MLO is used to image the anterior breast, the axillary tail can be used to image the far posterior breast tissue as needed. The focus of the MLO or axillary tail when imaging the posterior breast is to maximize the amount of pectoral muscle visualized and to eliminate the axillary fold (see Figure 16). The breast is imaged without the normal lifting of the anterior breast. Allowing the anterior tissue to fall, in effect deliberately creating a drooping anterior breast, eliminates the tissue fold in the axillary region. When imaging a large breast, it is impossible to eliminate this fold if the anterior breast tissue is lifted. The second image, the ML, allows visualization of the anterior breast with maximum compression.6,9,13

For wider breasts, the CC projection requires multiple images to include the medial and lateral breast tissue, whereas for a long, narrow breast both the medial and lateral breast tissue can be covered on a single exposure while missing the anterior or posterior breast. Some women might have a combination of wide and long. Some women’s breasts image typically on the MLO projection, yet because the breast tissue wraps around the axilla, multiple images are required for the CC projection.6,9,13

Regardless of the imaging sections, there should always be about 1 inch of tissue overlap between sections.

Sectional Imaging of the Extremely Large Breast

Sectional imaging of the breast sometimes is referred to as mosaic imaging or tiling. If the breast is too large to image all of the tissue in one projection using one exposure, the first job for the mammographer is to decide how to section the breast for imaging with the smallest number of exposures. A breast that is wider than it is long involves a different set of projections than a breast that is long and narrow (see Figure 15).6,9,13

For wider breasts, the CC projection requires multiple images to include the medial and lateral breast tissue, whereas for a long, narrow breast both the medial and lateral breast tissue can be covered on a single exposure while missing the anterior or posterior breast. Some women might have a combination of wide and long. Some women’s breasts image typically on the MLO projection, yet because the breast tissue wraps around the axilla, multiple images are required for the CC projection.6,9,13

Regardless of the imaging sections, there should always be about 1 inch of tissue overlap between sections.

Men can be uncomfortable in breast imaging facilities because the examination is seen as a woman’s study. This especially is true when the facility only has dedicated changing or waiting rooms for women. Care should be taken to give men the same privacy and reassurance that women receive.

Figure 15. Positioning for sectional imaging of the breast using the CC projection (A-B) and MLO projection (C-D).
strap pressure and will need careful handling to avoid irritating the area. Others might be experiencing neck, back, or shoulder pain and find it difficult to maintain the necessary positions. The mammographer needs to perform the examination quickly, giving clear instructions to minimize the possibility of motion, while maintaining a calm and reassuring demeanor. Care should be taken when imaging patients with skin irritation because rough pulling or lifting for CC positioning can cause the skin to tear.6,9,13

**Imaging Patients With Obese Upper Arms**

When imaging patients with extra fat tissue on the upper arm, the mammographer must prevent including the fatty tissue on the image or having the fatty tissue superimpose the breast tissue. This problem generally occurs when imaging the MLO projection and not the CC. The fatty tissue must be repositioned to fall behind the detector. This is achieved as soon as the correct tube angulation is determined and before compression begins. The mammographer can lift the ipsilateral arm and position the fatty tissue using the pressure of the upper arm on the detector to keep the extra tissue in place. Another solution is to tape the extra tissue out of the imaging area.6,13

Patients with this condition sometimes have other medical issues related to obesity, including difficulty moving, pain, and joint stiffness. The mammographer must be polite and tactful and should allow the patient to move at his or her own pace.

**Patients With a Nonhorizontal Inframammary Crease**

Occasionally, when the mammographer lifts the inframammary fold (IMF), he or she finds that it is not horizontal. If imaging continues, the detector or IP will not be level with the entire length of the fold (see Figure 17). Either the medial or the lateral aspect of the posterior breast will be too high or too low. Thus, the area of the posterior breast that is not in contact with the IP will not be imaged. If the detector or IP is too high, the posterior and inferior breast will not be compressed. If the detector is too low, the posterior and superior breast will not be compressed.6,13 The solution is to either angle the tube or the patient to ensure that the entire posterior breast is in contact with the IP. MLO imaging generally is not affected.

**Patients With a Protruding Abdomen**

A patient with a protruding abdomen can present a challenge for both the CC and MLO projections. In the CC projection, the abdomen prevents close contact between the detector and the posterior breast. In MLO positioning, the abdomen is superimposed on the inframammary fold, the inferior breast, or both.4,6,13

**Incorrect Elevation of IMF**

![Incorrect Elevation of IMF](image)

Figure 17. The position of the imaging plate can affect imaging of the posterior, superior, and inferior breast. Image courtesy of Olive Peart.
For the CC projection, the patient should stand slightly away from the detector before compression begins. The patient then leans forward as the mammographer lifts the breast, bringing it onto the detector or IP.\textsuperscript{4,6,13} For a MLO projection, a reduced tube angulation gives the radiographer more control of the anterior breast. The MLO can be divided into 2 exposures, with an MLO or axillary tail and the ML. The MLO or axillary tail demonstrates the posterior breast. The second image, the ML projection, allows visualization of the anterior breast with maximum compression and an open inframammary fold.\textsuperscript{4,6,13}

Another option is to acquire a standard MLO and use the superior-inferior oblique projection to image an open fold after completing the routine MLO projection. With the x-ray beam traveling from superolateral to inferomedial, the superior-inferior oblique projection clearly demonstrates the fold without the abdominal tissue overlap.\textsuperscript{4,6,13}

**Patients With a Thick Axilla or Uneven Breast Thickness**

Patients with thick axillae can include both men and women. In men, the problem generally occurs with the MLO projection. There is sometimes too much pectoral muscle, which prevents compression of the anterior breast.\textsuperscript{4,6,13} In women, the problem can occur when imaging both the CC and MLO projections. The breast tissue closest to the chest wall is compressed, but the anterior breast is not. Even the most vigorous compression cannot compress the anterior breast.\textsuperscript{4,6,13}

Before any modification, the detector or IP should be carefully positioned parallel to the pectoral muscle when imaging the MLO. A check also should be made of the IP’s height. The upper edge should rest in the patient’s axilla. If the detector is positioned correctly, one solution for MLO is to image using the MLO for the axillary tail for the posterior breast and an ML for the anterior portion of the breast. This requires 2 separate exposures. In imaging the CC, the standard CC is used for the first exposure. For the second exposure, the patient should stand slightly away from the detector before compression begins. Compression should then focus only on the anterior breast. The posterior breast should not be in the compression field.\textsuperscript{4,13}

Some mammography units have a built-in flex compression paddle that eliminates this problem (see Figure 18). The flex paddle automatically flexes and applies uniform compression to both the thicker posterior and the thinner anterior breast. These paddles also can be purchased separately.\textsuperscript{4,6,13}

**The Kyphotic Patient**

Kyphosis is an anterior curving of the thoracic spine leading to a “hunchback” posture. Although the condition can occur at any age, it most often occurs in adults who have degenerative diseases of the spine or fractures caused by osteoporosis. Patients with severe kyphosis can experience dyspnea or back pain. Patients with moderate-to-severe kyphosis have an exaggerated thoracic curvature, rounded shoulders, or both. This creates a sunken chest that pulls the breast tissue inward.\textsuperscript{16,17}

Imaging in both the CC and MLO projections can be difficult. However, depending on the degree of kyphosis, the major imaging modification involves the CC projection. With the standard CC projection, the image includes the patient’s nose or face if the patient cannot bend her head back. One option is to perform the “from below” projection instead of the CC. This projection works well if the patient does not have a protruding abdomen. An alternative could be to split

![Figure 18. A flex compression paddle.](image-url)
the CC imaging, using 2 exposures per breast. The first exposure images the lateral portion of the breast, or the XCCL can be used. The patient turns her head medially. The second exposure images the medial portion of the breast, or the CV is used. The patient turns her head laterally. Complete CC imaging of both breasts consists of 4 exposures. To reduce the number of exposures from 4 to 3, a CV projection can be used to demonstrate the medial tissue of both breasts, followed by the XCCL of each breast.\textsuperscript{4,5,17}

The reverse of the MLO, the LMO, can be used when MLO imaging is not possible. In the kyphotic patient, it becomes difficult to include the medial breast tissue in the compression field when compressing from medial to lateral. Placing the detector at the sternum eliminates this problem. Another option is to use the LM projection. When the LM is used, generally tissue is missed in the most posterior aspect of the breast, and this should be indicated in the patient’s records. When the LMO is used, no documentation is necessary because this projection is the true reverse of the MLO.\textsuperscript{4-6}

Kyphotic patients also can be imaged while seated, which often reduces the kyphotic curvature and allows the use of standard imaging techniques. Care should be taken in selecting a chair for the patient. The chair should not have arms or arm rests because they make tube angulation for the MLO projection difficult if not impossible. Although a chair without wheels might be safer for patients, maneuvering the chair for positioning can be difficult for the mammographer. Using a chair with wheels allows easier maneuvering; however, the chair should have locking wheels for safety.\textsuperscript{4-6}

**Patients With a Frozen Shoulder**

*Frozen shoulder* describes the loss of motion at the shoulder joint because of inflammation or injury. Other causes of frozen shoulder include diabetes, shoulder surgery, and thyroid problems. A patient with a frozen shoulder can present with decreased motion, pain, or stiffness.\textsuperscript{18}

Generally, the patient can complete a standard CC projection but might be unable to lift or raise the arm when positioning for the MLO projection.\textsuperscript{18} When imaging a patient who can lift her arm at least 90° or can bring the arm backward, one option is to reverse the MLO (ie, perform the LMO or LM projection). With the IP against the sternum, the edge of the compression plate keeps the raised arm out of the way. If movement at the shoulder joint is not painful, another option is to use the detector or IP to lift the arm for MLO imaging. However, when the patient’s arm cannot be lifted or moved backward, both the MLO and the LMO projections are limited because they will not include the posterior breast tissue. This must be documented.\textsuperscript{4-6}

**Patients With Pectus Excavatum or Pectus Carinatum**

Pectus excavatum is caused by an abnormal formation of the rib cage and gives the chest its caved-in or sunken appearance.\textsuperscript{19} In this condition, the sternum sometimes caves in to the point where the ribs are protruding.

Patients with pectus carinatum (sometimes referred to as *pigeon chest*) have a very prominent sternum. The bone protrudes, and a narrow depression forms along either side of the sternum, giving the appearance of a pigeon’s beak. Pectus carinatum can occur as a solitary abnormality or in association with other genetic disorders or syndromes.\textsuperscript{20}

On most patients with these conditions, it is almost impossible to include the medial breast on the standard CC projection. Two CC projections might be necessary, one for the medial breast tissue and the other for lateral tissue. An alternative that reduces the number of exposures from 4 to 3 is to image the medial breast tissue using the CV projection and complete the study with an XCCL projection of each breast.\textsuperscript{19,20}

MLO imaging is difficult in patients with pectus carinatum because the compression plate hitting the protruding sternum can be painful. The best projection option is the LMO or the LM. With the detector or IP positioned against the sternum, compression from the lateral side of the breast is accomplished easily.\textsuperscript{4-6}

**Barrel Chest**

The term *barrel chest* describes a rounded, bulging chest that resembles the shape of a barrel. The chest protrudes outward from the body, causing the breast tissue to extend laterally under the arms. Barrel chest is not a disease, but it can indicate an underlying condition such as early osteoarthritis. Arthritis stiffens the joints at the vertebral aspect of the ribs, where the ribs attach to the spine. The ribs then become fixed in their most expanded position, causing the barrel-like appearance of the chest.\textsuperscript{21}

In patients with this condition, it usually is not possible to image the entire breast using one CC projection.
Two exposures are necessary. The first should focus on the medial breast tissue; then the XCCL projection can be used to image any missed lateral breast tissue. Reducing the number of exposures by using the CV is not possible because of the wide spacing between the right and left breasts. The standard MLO projection is performed, and any posterior medial breast tissue missed on the MLO can be imaged using the axillary tail projection.

**Delicate Skin in the Inframammary Fold**

Tissue under the breast, in the inframammary fold region, can be compromised if it remains moist for prolonged periods. This can be due to obesity or other medical conditions. Delicate skin can be subject to tears if not handled carefully. A routine mammography examination can be rescheduled if the mammographer suspects that the breast skin is too fragile and will tear on handling. This is particularly important for patients undergoing radiation treatment or chemotherapy and other treatments that compromise the immune system. For patients without underlying medical conditions, several over-the-counter or prescription drugs are available that help to promote healing of minor skin irritations that result in fragile skin. Although the mammographer cannot recommend that the patient take any drug, patients can be advised to consult with their physician.

Mammography screening always should be performed using standard precautions and the proper infection control techniques as outlined by the Centers for Disease Control and Prevention and the Hospital Infection Control Practices Advisory Committee. These standard precautions incorporate fluid and body precautions and body substance isolation. Standard precautions should be used whenever there is contact with blood, body fluids, secretions, excretions, mucous membranes, and nonintact skin and should be applied to all patients. Infection control techniques include washing hands and cleaning all areas of the unit before and after contact with the patient. This means that the compression plate, face place, IP, and handle bar should be cleaned, and the mammographer should wash his or her hands before and after imaging a patient. Unit cleaning supplies that conform to manufacturer-specific guidelines should be readily available in the mammography room, especially if a sink is not available.

**Imaging Implants**

Breast implants are surgically placed in the breast tissue to increase fullness or improve symmetry when the breasts are moderately disproportionate in size and shape. The procedure is known as augmentation mammoplasty, and it has been performed since the 1950s. Two types of breast implants are common in the United States: saline and silicone. Saline implants are silicone shells filled with a sterile saline solution. Silicone implants are silicone shells filled with a silicone gel. Because of medical concerns, silicone implants were halted in the United States between 1992 and 2006; however, implants made of silicone now are considered safe and can be placed in front of the pectoral muscle (subglandular or retromammary implants) or behind the pectoral muscle (subpectoral or retropectoral implants).

The standard series of projections for a patient with an implant is the routine CC and MLO projections with minimal compression plus the implant-displaced projections. Most implants can be displaced using a technique that was introduced in 1988 by GW Eklund, MD. Common names for the technique are the Eklund technique or implant-displaced (ID) projections. The result of standard and ID imaging is an 8-projection series of images.

The 4-image standard projections, taken using minimal compression for immobilization purposes only, show the implant in position. These projections demonstrate the posterior breast tissue surrounding the margins of the implant and often require manual techniques. Compression is used solely for immobilization because vigorous compression of the implant can be painful and could cause ruptures. ID projections are taken with the implant displaced or pushed posteriorly. These projections are taken in the CC, MLO, and sometimes the ML projections (see Figure 19).

In the ID projections, manual technique is necessary only if the breast tissue does not cover at least the first automatic exposure control detector on analog units. The mobility of the breast and the possible compression depend on the type of implant and the degree of scarring and adhesion of the implant to the chest wall. The size of the breast and the amount of natural breast tissue also can have an effect. Most modern
Implants are placed behind the pectoral muscle, allowing flexibility in positioning.⁴⁶ Using the ID technique, breast tissue that is compressed against the implant in a standard series is pulled forward and imaged free of the implant. The natural breast tissue must be pulled forward while simultaneously pushing the implant back toward the chest wall. Compression then is applied only to the breast tissue. The ID technique works with all implants regardless of placement, as long as the implant is not encapsulated.³⁶

Implant encapsulation or capsular contracture more commonly is seen with subglandular or retromammary implants. This condition might result in a hard and distorted breast that is difficult to position. ID projections are not possible with capsular contracture. Mammographic imaging often is limited, and other modalities such as ultrasonography or magnetic resonance imaging are acceptable alternatives.⁴⁶

When positioning for ID projections on a nonencapsulated implant, the mammographer must locate the extent of the implant by feeling for the edges to determine how large or small the implant is. Next, the patient should stand in the position for a routine CC or MLO projection. The patient steps back, slightly away from the detector or IP. The mammographer then locates the anterior edge of the implant and places the IP just posterior to the edge. The thumb and fingers can be used to grasp the anterior breast, pushing the implant back and pulling the breast tissue forward. The edge of the detector or IP helps to keep the implant pushed back. The mammographer begins compression while still pulling the breast tissue forward. As the compression plate descends, it helps to pull the breast tissue forward and outward while allowing the implant to displace posteriorly. The breast, free of implant, is compressed normally. The extent of posterior displacement of the implant

Figure 19. A-D. Imaging with a breast implant in place. E-H. Projections with the implant displaced posteriorly. Images courtesy of Olive Peart.
depends on whether the implant was placed subglandularly or subpectorally, with maximum displacement occurring with subpectoral placements.\textsuperscript{4,6}

**Postlumpectomy Imaging**

A recurrent tumor in a treated breast is not uncommon, and mammography follow-up of women after breast conservation surgery is necessary to detect local recurrence at the earliest possible stage. Mammographic signs of recurrence include the development of new microcalcifications or a new mass. Enlargement of the scar and suspicious axillary nodes also are signs of recurrent tumor. Rarer signs are increased skin thickening or breast density. Failure to irradiate the original tumor can result in local recurrence within 6 years—and sometimes as early as 18 months—after treatment.\textsuperscript{4,6,23}

In general, the postsurgical site can be imaged in the CC and ML or MLO projections. Scar markers are useful to identify the site of the surgical scar, although too many scar markers can be a distraction. Magnification projections might be required for further evaluation of suspicious lesions or to evaluate calcifications. The breast might be tender, and compression should be applied carefully and not beyond what the patient can tolerate.\textsuperscript{4-6,23}

**Postmastectomy Imaging**

A postmastectomy imaging examination is controversial because not all radiologists agree with imaging of the mastectomy site. However, most literature supports the possibility of another cancer developing at the mastectomy site.\textsuperscript{6} Projections usually include the CC, a spot projection of the area of concern, an axillary tail projection, or the MLO projection.\textsuperscript{4-6}

Research suggests that if the mastectomy site is not imaged regularly, the patient should have an oncologist perform an annual visual inspection and examination of the site, especially during the first 5 years after the mastectomy.\textsuperscript{4-6}

**Mammography of the Irradiated Breast**

Radiation can cause skin thickening, trabecular thickening, increased density of the parenchymal pattern, and a diffuse increase in breast density. Most of the changes are a result of edema, coarsening of the fibrous or stromal elements of the breast, or both, plus increased thickness and density of the ductal and glandular elements. However, regardless of any initial change, further changes diminish or resolve over time, and their pattern should not increase. The exception is calcifications, which can develop up to 5 years after radiation.\textsuperscript{4,6}

Generally, the breast should not be imaged immediately after radiation treatment. The recommendation is to wait 6 to 12 months after completion of radiation treatment. If there are minimal adverse effects and the breast did not become red, firm, or tender after treatment, mammograms of diagnostic quality can be obtained 3 to 6 months after radiation treatment.\textsuperscript{4-6}

When imaging the postirradiated breast at a normal interval, routine projections are possible, but care should be taken in handling the breast. The irradiated breast is often very tender and the skin easily broken. The purpose of the imaging can be to record new mammographic patterns in the breast. If the original tumor contained microcalcifications, magnification imaging or additional workup can be used to assess fully the status of any calcifications at the site.\textsuperscript{4-6}

**Imaging Patients on Stretchers**

Patients who present for imaging on a stretcher can have limited mobility and in some cases cannot assist in their care. However, if the patient can sit up, the imaging and positioning for the standard CC and MLO projections can be used. General precautions include locking the stretcher before positioning and compression and ensuring that the patient is supported as needed. If the patient cannot sit up, mammography imaging must take place with the patient recumbent on the stretcher.\textsuperscript{4-6}

The breasts can be imaged for the CC projection with the patient lying laterally on the stretcher and the x-ray tube rotated 90°. The beam can be directed inferior to superior or superior to inferior, whichever is most comfortable for the patient. The CC projection also can be obtained with the patient supine on the stretcher, and the x-ray tube rotated 90°. Again, the beam can be directed either inferior to superior or superior to inferior.\textsuperscript{4-6}

In imaging for the MLO projection, the tube is positioned at 0° (vertical) and the patient is turned semiprone onto the side of interest. The detector or IP is positioned under the patient’s breast. If the down side is of interest, the patient can be asked to hold the opposite
breast or tape can be used to prevent the superimposition of both breasts in the image. The alternative is to image the upside using an LM projection.1,6

**Imaging Patients Who Use a Wheelchair**

Patients who use a wheelchair often are very independent. The mammographer should respect the patient’s independence and not assume the patient is unable or unwilling to help.1,6

Imaging of patients in wheelchairs can be best accomplished when the chair has removable arms. The arms of a wheelchair do not allow tube angulation for the MLO projection. If the chair does not have removable arms, the patient must be raised (ie, the seat built up) or transferred to another chair. However, patient imaging in the chair can be accomplished using the LM or ML projections. Because the arm of the chair provides a measure of support for some patients, the patient should be monitored to prevent falls once the arm is removed.1,6

Positioning for the CC projection is accomplished with the patient seated upright in the chair. If the patient is slouched in the chair, a pillow or folded towels can be placed behind the patient’s back. The added support straightens the spine and reduces kyphosis caused by slouching. An alternative is to use the “from below” projection; however, this is not possible on patients with protruding abdomens.1,6

**Specific Imaging Challenges**

**Nipple Not in Profile**

The main purpose of getting the nipple in profile is to differentiate the nipple from a lesion (see Figure 20). If imaging routinely is performed using a nipple marker, nipple projections often are unnecessary. In addition, in most women, with proper positioning, the nipple automatically will fall in profile on at least one projection, either the CC or the MLO.1,6

If the nipple is not in profile after accurately positioning the CC or MLO projections, the first option should not be to reposition the breast solely to place the nipple in profile; this places much of the posterior breast tissue outside of the compression plate. A mammographer always should image the entire breast first, even if the nipple will not fall naturally in profile. The nipple should be imaged separately only if necessary, taking nipple projections with the nipple in profile.1,6

**Skin Folds or Wrinkling of the Breast**

Wrinkles in the skin or skin folds often produce architectural distortions or minus-density distortions that can obscure surrounding tissue. To avoid excessive radiation to the patient, the mammogram should not be repeated if the skin fold or wrinkle does not interfere with the interpretation. This often depends on the location of the fold or wrinkle. Skin folds in the axillary area sometimes are unavoidable when imaging large breasts, especially because the anterior breast must be lifted and pulled out for maximum compression. It is also sometimes difficult to avoid skin fold or wrinkles when imaging patients with prior surgery or elderly patients with very thin breast tissue (see Figure 21).1,6

In normal imaging, to avoid skin folds the breast should be lifted and pulled out before placing it on the detector or IP. The mammographer then can use one or more fingers to smooth out the breast as compression begins.1,6

However, the mammographer should never smooth or push the breast tissue posteriorly and away from the nipple to eliminate a fold or wrinkle because this also eliminates posterior tissue from the mammogram. In such cases, additional projections are required to supplement the original set.1,6

**Skin Lesions and Scars**

Skin lesions include keratosis, moles, skin tags, and epidermoid cysts. The breast is a 3-D structure, and in
Positioning Challenges in Mammography

2-D imaging causes all skin lesions to appear within the breast tissue itself. Using a marking system helps prevent misdiagnosis.4–6

There are different forms of keratosis, some premalignant and others benign. A common form, the seborrheic keratosis, is composed of benign immature epithelial cells. Often they appear as a rough, sandpaper-textured growth on the surface of the skin. Generally, the nevus or mole is a congenital discoloration of a circumscribed area of the skin due to pigmentation. It also can be a circumscribed vascular tumor of skin caused by hyperplasia of the blood vessels. A nevus can be premalignant or benign. Patients should be encouraged to inspect for moles or keratosis regularly and should consult with a health care professional about any moles or other skin lesions that change color, show signs of growth, or change in appearance.4–6

A skin tag (acrochordon) is a small flap of tissue that hangs off the skin by a connecting stalk or peduncle. It is benign and may be smooth or irregular in appearance. When the breast is compressed, the skin tag folds over and can mimic the appearance of a mole or lesion on the radiograph. The epidermoid cyst is a closed sac filled with keratin, sebum, and skin debris. It is benign and typically forms just below the skin surface. The epidermoid cyst can appear as a high-density irregularly shaped lesion and can mimic a malignancy (see Figures 22 and 23).4–6

Scars are often the result of surgical intervention. Some radiologists prefer that the mammographer mark all skin lesions and scars with radiopaque markers. Other radiologists believe that radiopaque markers are a distraction and can interfere with interpretation. They prefer detailed diagrams of the breast, indicating the position of skin lesions or scars. Whatever the preference, multiple skin lesions or scar markers on a single projection could be distracting (see Figure 24). Often, the patient history sheet has a schematic diagram of the breast that can be used for documentation. Another consideration is that many surgeries are performed with the goal of achieving good cosmetic results. Hence, a superior lesion might be accessed from the inferior aspect of the breast, and a scar marker indicating the surgical site will not show the location of the original lesion.4–6

**Triangulation Techniques**

Every mammographer should understand how to localize and determine the approximate position of lesions in the breast. This requires knowledge of positioning terminology and an awareness of triangulation. The triangulation of a lesion is necessary to locate the area of interest correctly and avoid repeat images using a spot compression or spot magnification projection.4–6

In breast imaging, 3 methods of localization are used: the quadrant, the clock face, and the region. In the quadrant method, the breast is divided into 4 sections: upper outer, upper inner, lower outer, and lower inner. Using the clock face method, the breast becomes the face of a clock. The uppermost part of the breast is 12 o’clock and the lowermost part is 6 o’clock. Note that the 5 o’clock position is the lower-inner quadrant on the right breast, but the 5 o’clock position is the lower-outer quadrant on the left breast. The breast also can be divided into regions, with the posterior region (closest to the chest wall), the middle region, and the anterior region (furthest from the chest wall). The area just behind the nipple sometimes is termed the **subareolar region** (see Figure 25).4–6

If any 2 mammographic projections demonstrate a lesion, the radiographer can determine the lesion’s approximate location in either the CC or MLO projection by triangulating the exact location of the lesion. It generally is easier to use fingers and then transfer the finger measurements to the breast4–6:
1. Measure the length of the line directly posterior of the nipple to the level of the lesion.
2. From the end of the first line, measure the line superior or inferior (if measuring on an MLO projection), or medial-to-lateral (if measuring on a CC projection) to the lesion.
3. The next line measures the distance from the lesion to the skin surface (see Figure 26).

In locating the area of interest on the breast, the mammographer would then use one hand to mimic breast compression while using the other hand to transfer the determined measurements. Mimicking breast compression allows a better approximation of the lesion’s location.

**Conclusion**

Imaging some patients requires more time and an especially thoughtful, planned approach. In addition to positioning competency and a knowledge of the various projections, the mammographer also needs adept communication skills. Patient communication should begin before the start of the procedure and continue throughout. The purpose is to relax the patient, provide education as needed, identify sensitive breasts that might need special handling, and reveal and address any misconceptions or fears. Communication should be as casual as possible and should be face-to-face. The patient should never leave the facility unsure of when or how results will be communicated.⁴,⁵,⁷,⁸,¹⁰

Words must be accompanied by the appropriate tone, pace, and volume of speech. Body language, which can be as simple as facial expression, is equally important. Communication also implies a 2-way exchange of information. After initiating the conversation, the
mammographer always should wait for a response. Any explanation should be acknowledged, and the mammographer should confirm that the patient understands. The key principle when communicating is to recognize that patients have practical needs, such as the need to have a mammogram. However, there also could be personal needs such as a need for education, compassion, reassurance, or simply professionalism. It is the mammographer’s responsibility to determine and address all of his or her patients’ needs.\textsuperscript{4,5,7,10}

Respect for the emotional, physiological, and personal needs of the patient are all critical to successful imaging, as is meeting the patient’s practical needs. The aim should be to maintain or enhance the patient’s self-esteem while listening and responding with empathy.

\textbf{References}\n


Positioning Challenges in Mammography

1. The Mammography Quality Standard Act (MQSA) established national standards for mammography facilities and personnel in all of the following areas except:
   a. accreditation.
   b. certification.
   c. building.
   d. inspection.

2. In digital mammography imaging, the emphasis for quality imaging has shifted to:
   a. regular checks for exposure errors.
   b. examining the credentials of technologists.
   c. continuing education and regular updates.
   d. breast compression and accurate positioning.

3. The craniocaudal (CC) projection best demonstrates the ______ portions of the breast.
   a. posterolateral, central, lateral, and medial
   b. anterior, central, medial, and posteromedial
   c. anterior, medial, posterior, and lateral
   d. medial, lateral, central, and posteromedial

4. The pectoralis major muscle is seen on approximately ______ % to ______ % of all CC projections.
   a. 10; 20
   b. 25; 35
   c. 30; 40
   d. 45; 55

5. The mediolateral oblique (MLO) projection best demonstrates the ______ quadrant of the breast.
   a. anterior, central, and lower-inner
   b. anterior, posterior, and upper-outer
   c. posterior and upper-inner
   d. extreme posterior and upper-outer

*Your answer sheet for this Directed Reading must be received in the ASRT office on or before this date.
6. In evaluating the standard MLO projection, the pectoral muscle should:
a. have a wide border superiorly with a convex anterior border.
b. extend to above the level of the posterior nipple line.
c. have a concave superior border and a wide anterior border.
d. extend at least 2 inches below the posterior nipple line.

7. The main reason for breast compression in mammography is to:
a. reduce radiation dose to the breast.
b. produce a uniform breast thickness.
c. reduce any possibility of motion.
d. separate superimposed structures in the breast.

8. According to MQSA guidelines, the maximum manual compression that can be applied to the breast is:
a. 25 lb.
b. 45 lb.
c. at the discretion of the mammographer.
d. mandated by the facility.

9. During breast compression, the final degree of compression should be applied using:
a. manual controls.
b. automatic controls.
c. the mobility of the breast as guide.
d. the rigidity of the breast as a guide.

10. Which of the following is not required labeling on all mammograms?
a. facility location
   b. date of the examination
   c. mammographer’s initials
   d. name of facility’s owner

11. In imaging special patient populations, supplementary projections:
a. are only used to provide additional information.
b. might be the only projections capable of imaging the breast.
c. are used to work up an area.
d. allow better visualization of suspicious microcalcifications.

12. In the lateromedial projection:
a. the central ray travels from medial to lateral.
b. the tube is rotated to 0°.
c. medial lesions are well visualized.
d. lateral lesions are well visualized.

13. The tangential projection:
a. can be taken with the tube rotated in any direction.
b. directs the central ray lateral to medial.
c. superimposes the area of interest onto the skin.
d. is used to identify lesions close to the chest wall.

14. The superior-inferior oblique projection:
a. can be used to demonstrate the inframammary fold.
b. best demonstrates the lower-inner quadrant of the breast.
c. is not useful for patients with encapsulated implants.
d. images the most lateral aspect of the breast.

15. Which of the following statements about magnification mammography is false?
a. The dose to the patient’s skin increases with magnification.
b. Magnification uses the smallest focal spot.
c. Magnification can be performed with or without spot compression.
d. Grids are needed in magnification to improve image resolution.
16. Which of the following statements about imaging very thin or small breasts is **true**?
   a. Imaging often is easier in the CC projection.
   b. A breast pad increases the friction between the breast and detector.
   c. The spatula replaces the compression paddle in compressing the breast.
   d. Manual technique must never be used.

17. One **difference** between imaging men’s breasts and imaging small female breasts is that male breast imaging:
   a. often presents an increased amount of pectoral muscle.
   b. requires more compression, especially on the anterior breast.
   c. requires a spatula to aid in positioning and compression.
   d. always presents less breast tissue than a small female breast.

18. Problems associated with large breasts can include all of the following except:
   a. skin rashes.
   b. shoulder or back pain.
   c. skin irritation.
   d. skin thickening.

19. A useful option when imaging a patient with a protruding abdomen can include reducing the tube angulation when imaging the MLO.
   a. true
   b. false

20. Which of the following statements is **true** when imaging the kyphotic patient?
   a. It is often easier to image in the CC vs the MLO projection.
   b. CC imaging can be split into 2 exposures, for the anterior and posterior breast.
   c. The “from below” projection can be used instead of the CC.
   d. Documentation of missed tissue is needed if the lateromedial oblique projection is performed instead of the MLO.

21. When positioning patients with breast augmentation, compression is used solely for immobilization because vigorous compression of the implant can be painful and could cause ruptures.
   a. true
   b. false

22. _______ might result in a hard and distorted breast that is difficult to position.
   a. Inflammatory breast cancer
   b. Pectus carinatum
   c. Ductal carcinoma in situ
   d. Capsular contracture

23. When imaging the postirradiated breast, the recommended timing is _______ months after completion of radiation treatment.
   a. 2 to 4
   b. 4 to 6
   c. 6 to 12
   d. 12 to 24

continued on next page
24. After accurately positioning for a CC or MLO projection, if the nipple is not in profile:
   a. do not reposition solely to place the nipple in profile.
   b. always take a second exposure with the nipple in profile.
   c. additional imaging will not be required.
   d. reposition to place the nipple in profile.

25. In triangulation, the 5 o’clock position is the ______ quadrant on the left breast.
   a. lower-inner
   b. lower-outer
   c. upper-inner
   d. upper-outer