Interventional Procedures

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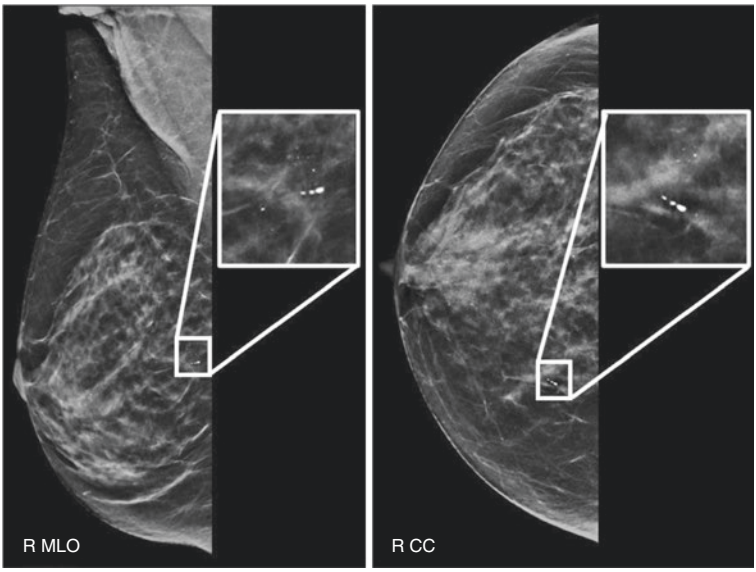
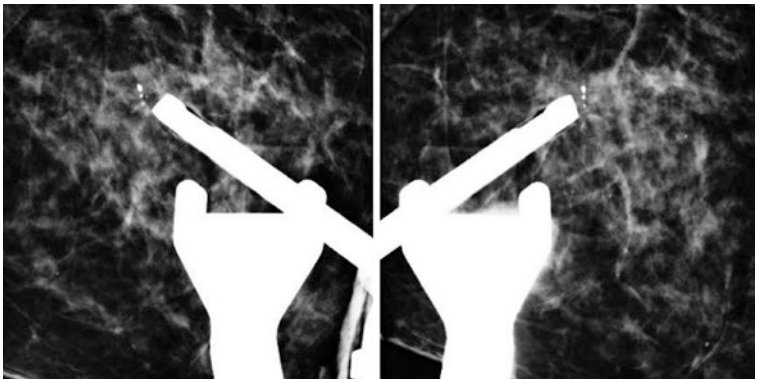
1a. A 55-year-old female presents for new calcifications in the right breast on screening mammogram. A diagnostic mammogram is shown. What is the next best step in management?



(a) Ultrasound-guided biopsy.
(b) Stereotactic biopsy.
(c) MRI-guided biopsy.
(d) Surgical excision.

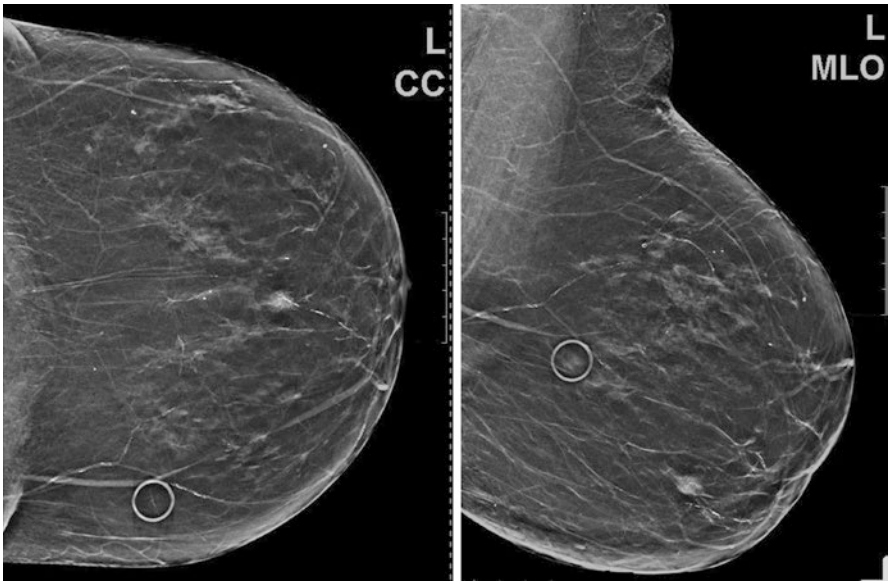
1b. What is the best approach for stereotactic biopsy?
(a) Medial.
(b) Lateral.
(c) Superior.
(d) Inferior.

1c. A stereotactic-guided biopsy was performed. This post-fire diagram of the stereotactic biopsy demonstrates the location of the needle in relation to the biopsy target. What type of error do these diagrams demonstrate?



(a) None, the needle is in good position.
(b) *X*-axis error.
(c) *Y*-axis error.
(d) *Z*-axis error.

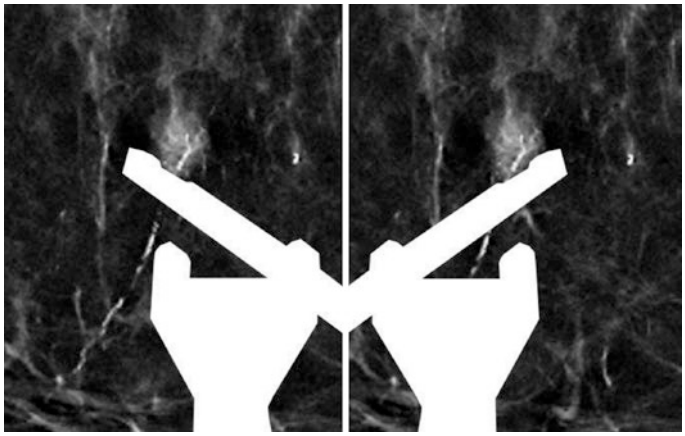
2a. An 80-year-old female presents with a palpable abnormality in the left breast. Diagnostic mammogram demonstrates an irregular mass in the left breast. No sonographic correlate is identified on diagnostic breast ultrasound. What is the next best step in management?



(a) Ultrasound-guided biopsy.
(b) Stereotactic biopsy.
(c) Breast MRI.
(d) Surgical excision.

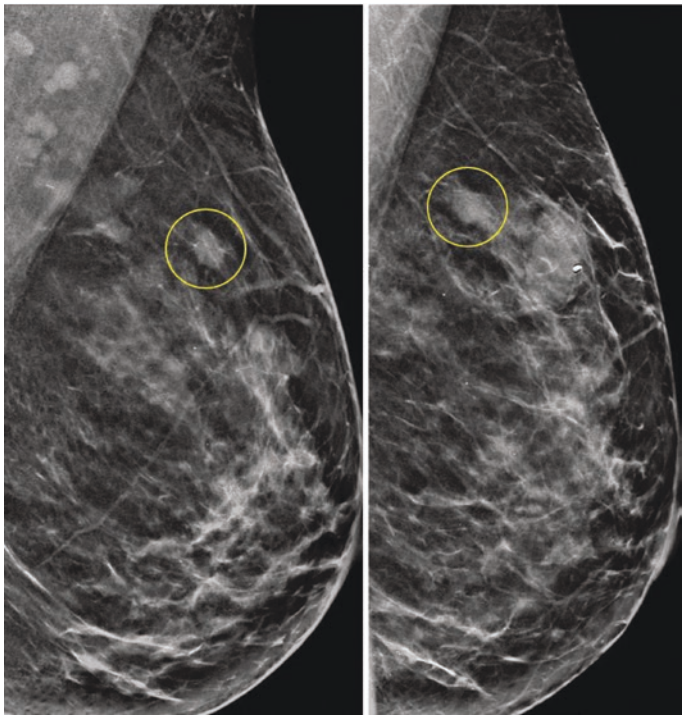
2b. What is the best approach for stereotactic biopsy?
(a) Medial.
(b) Lateral.
(c) Superior.
(d) Inferior.

2c. A stereotactic guided biopsy was performed. These post-fire images of the stereotactic biopsy demonstrate the location of the needle in relation to the biopsy target. What type of error do these images demonstrate?



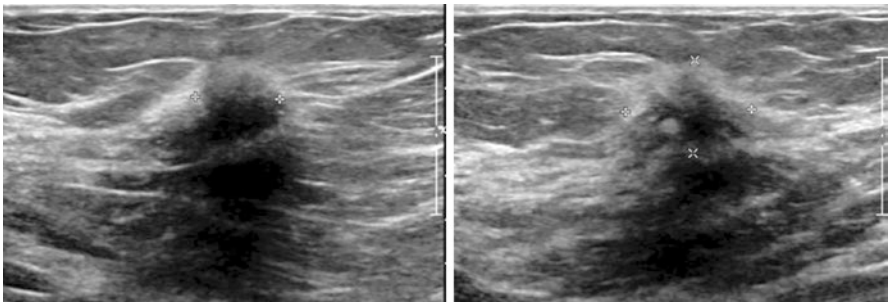
(a) *Y*-axis and *Z*-axis error.
(b) *X*-axis error.
(c) *Y*-axis error.
(d) *Z*-axis error.

3. A 53-year-old female has a new left breast mass seen on screening mammogram. Diagnostic mammogram (image on the left) demonstrates a suspicious mass (circled) in the superior breast, and a presumed sonographic correlate was visualized (BI-RADS 4). Ultrasound-guided core needle biopsy was performed and a biopsy microclip was placed. Post-procedure mammogram (image on the right) demonstrates post-biopsy changes and biopsy microclip. The originally seen suspicious mass is circled in both images. What is the next best step?



(a) Await pathology results as findings are related to clip migration.
(b) Repeat ultrasound-guided core needle biopsy.
(c) Perform stereotactic biopsy of the mammographic finding.
(d) Perform wire localization targeting the microclip.

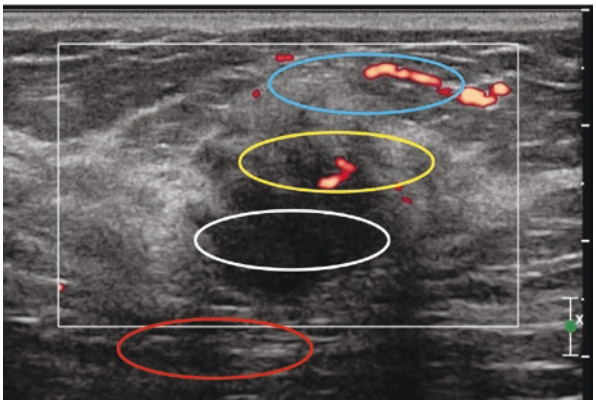
4a. A 48-year-old female underwent diagnostic mammogram and ultrasound for a palpable abnormality in the right breast at 9 o'clock. Diagnostic mammogram demonstrates a spiculated mass, and a correlate mass is seen on diagnostic breast ultrasound. What is the next best step in management?



(a) Fine-needle aspiration.
(b) Ultrasound-guided core needle biopsy.
(c) Stereotactic biopsy.
(d) Breast MRI.

4b. What is the best approach for ultrasound-guided biopsy?
(a) Medial.
(b) Lateral.
(c) Superior.
(d) Inferior.

4c. What area should be targete.d at the time of biopsy?



(a) Blue circle.
(b) Yellow circle.
(c) White circle.
(d) Red circle.

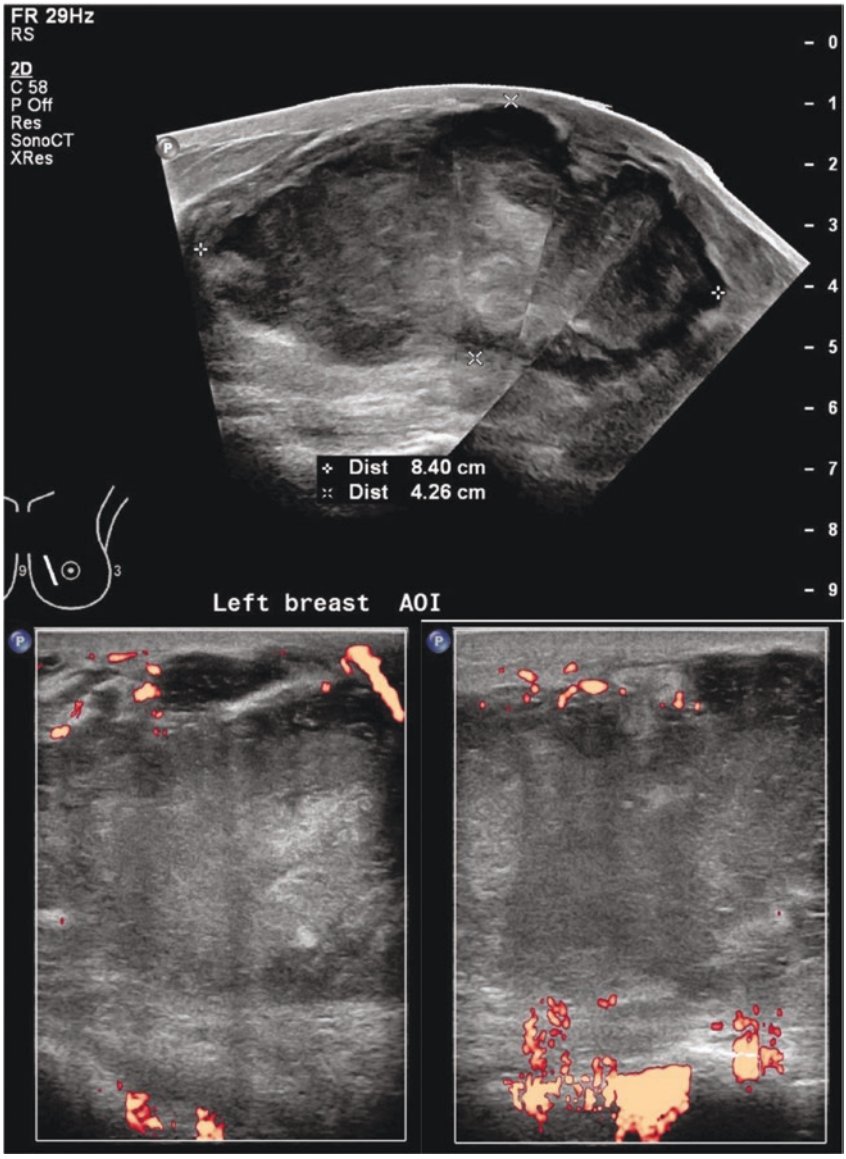
5a. A 28-year-old female presents with a palpable abnormality in the right breast. Diagnostic breast ultrasound demonstrates a complicated cyst. The cyst was aspirated to completion and clear fluid was obtained. What is the next best step?

(a) Discard fluid.
(b) Send fluid for culture.
(c) Place a microclip and send fluid for cytology.
(d) Perform ultrasound-guided core needle biopsy.

5b. If cyst aspiration had yielded bloody fluid, what would be the next best step?
(a) Nothing.
(b) Send fluid for culture.
(c) Place a biopsy microclip and send fluid for cytology.
(d) Perform ultrasound-guided core needle biopsy.

5c. If the finding did not fully resolve following aspiration, what would be the next best step?
(a) Nothing.
(b) Send fluid for culture.
(c) Place a microclip and send fluid for cytology.
(d) Perform ultrasound-guided core needle biopsy.

6a. A 32-year-old breastfeeding female with a strong family history of breast cancer presents with 3 days of pain, warmth, and redness of the left breast with an associated palpable abnormality. Diagnostic breast ultrasound was performed. What is the most likely diagnosis?

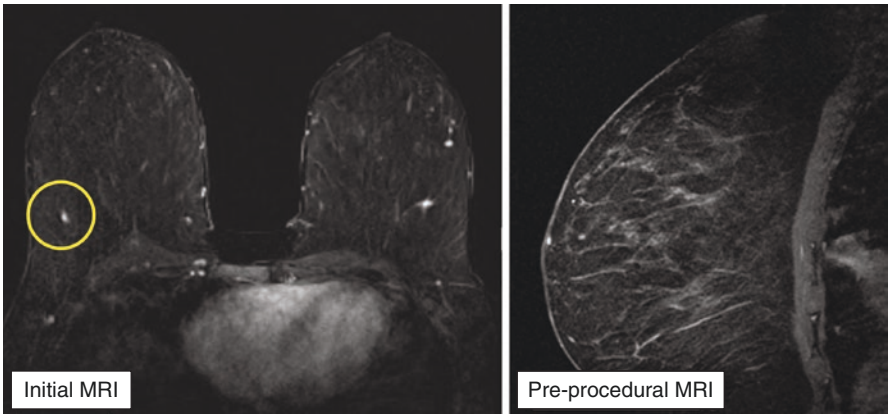


(a) Invasive ductal carcinoma.
(b) Breast abscess.
(c) Complicated cyst.
(d) Simple cyst.

6b. What is the next best step?
(a) Ultrasound-guided core-needle biopsy.
(b) Ultrasound-guided drainage.
(c) Six-month follow-up ultrasound.
(d) Clinical follow-up. No follow-up imaging is required.

6c. Following multiple aspirations and several courses of antibiotics, the patient continues to report a painfully palpable abnormality in the left breast. What is the next best step?
(a) Ultrasound-guided core-needle biopsy and surgical consultation.
(b) Ultrasound-guided drainage.
(c) Six-month follow-up ultrasound.
(d) Clinical follow-up. No follow-up imaging required.

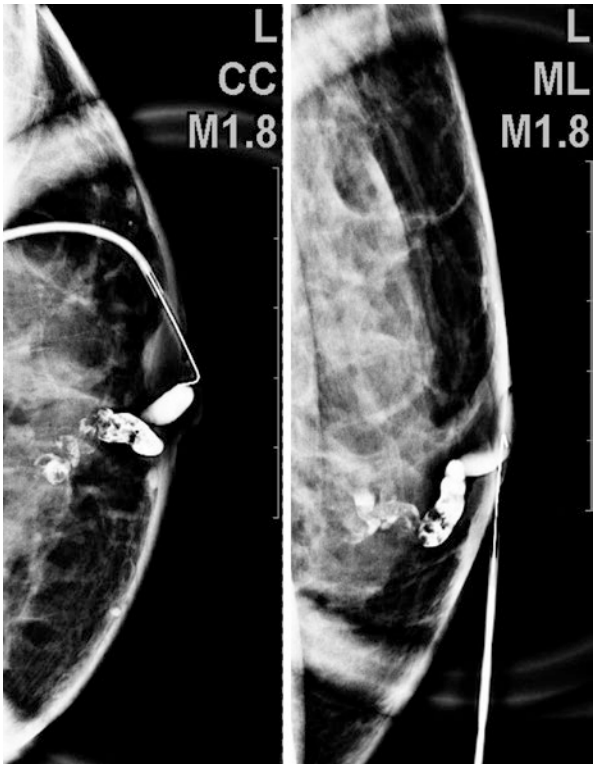
7a. A 53-year-old female with left breast cancer underwent breast MRI for surgical planning. A focus of enhancement was seen in the lateral right breast (circled). At the time of MRI-guided biopsy, the suspicious focus of enhancement is not seen on post-contrast images. What is the appropriate step to take following nonvisualization of an MRI finding during MRI biopsy?



(a) Verify grid positioning.
(b) Obtain delayed post-contrast images.
(c) Decrease compression.
(d) All of the above.

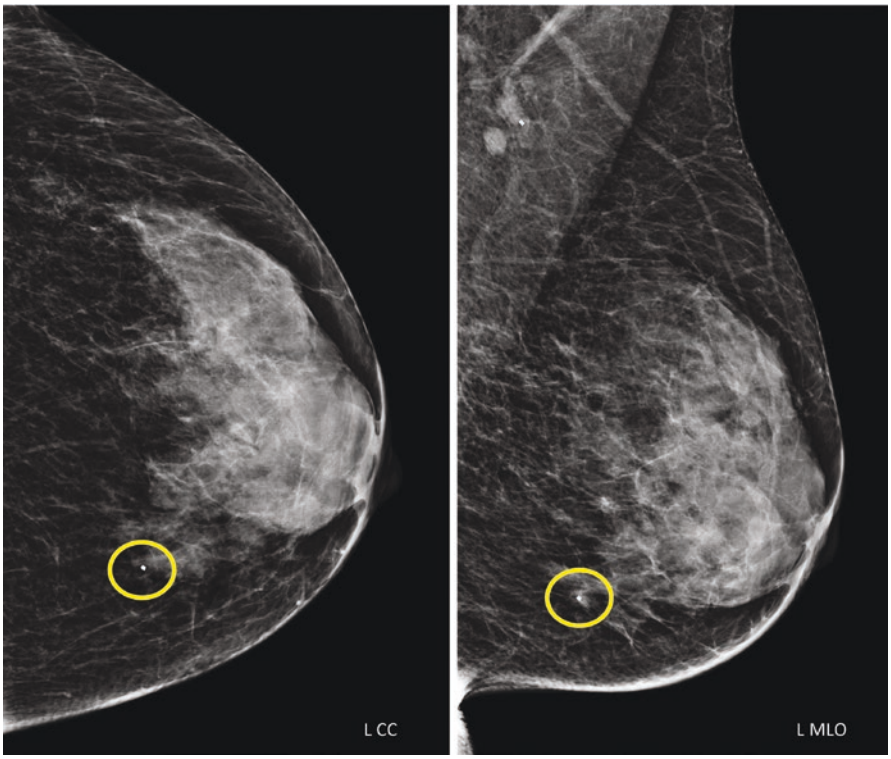
7b. The finding was not visualized after all appropriate steps were taken (as noted in the above question). What is the next best step?
(a) Return to screening breast MRI.
(b) Short term interval follow-up breast MRI.
(c) Decrease compression.
(d) All of the above.

8. A 49-year-old female with left bloody nipple discharge undergoes a ductography. Which of these best describes the finding seen on ductography?



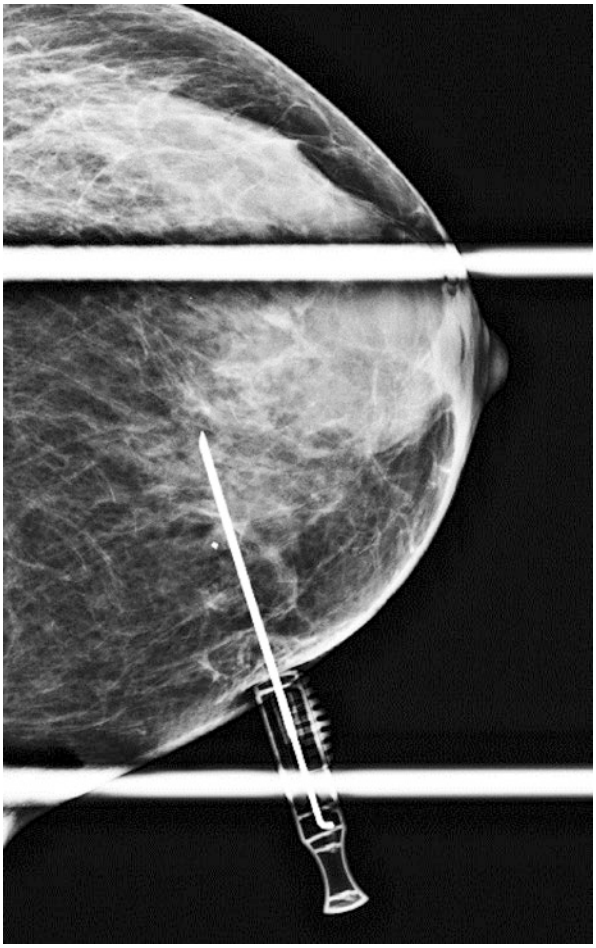
(a) Normal duct without filling defect.
(b) Duct ectasia without filling defect.
(c) Multiple intraductal filling defects.
(d) Extravasation of contrast.

9a. A 58-year-old female underwent stereotactic biopsy of suspicious calcifications in the lower inner quadrant of the left breast, with pathology consistent with invasive ductal carcinoma. A microclip was placed at the time of biopsy (circle). Post-procedure mammogram demonstrated accurate microclip placement without clip migration. Pre-surgery wire-free localization using a reflector device is planned under mammographic guidance. If the microclip is to be targeted at time of wire-free localization, which approach should be taken?



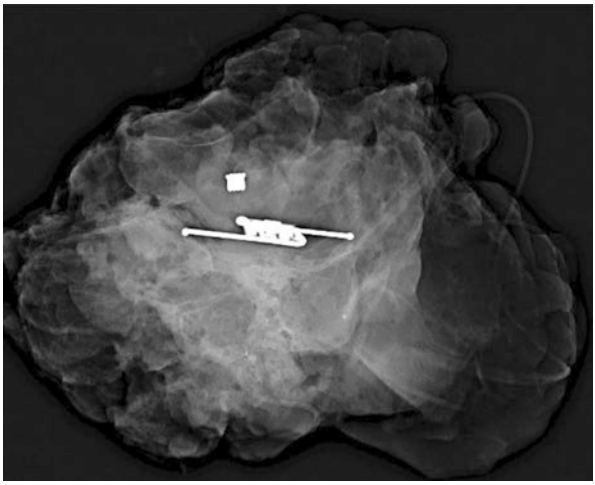
(a) Medial.
(b) Lateral.
(c) Superior.
(d) Oblique.

9b. A reflector device is placed from a medial approach. Prior to deployment, a craniocaudal mammogram is performed to confirm position. What is the next best step?



(a) Deploy the reflector.
(b) Pull back the deployment device and repeat craniocaudal view mammogram to confirm position.
(c) Advance the reflector deployment device and repeat craniocaudal view mammogram to confirm position.
(d) Remove the reflector deployment device and repeat placement via the inferior approach.

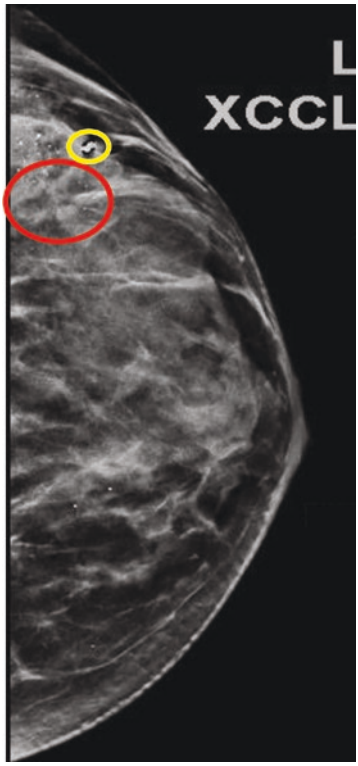
9c. Following surgical excision, a specimen radiograph is obtained. What should be communicated to the surgeon?



(a) Biopsy microclip is seen within the specimen.
(b) Reflector is seen within the specimen.
(c) Both a and b.
(d) None of the above.

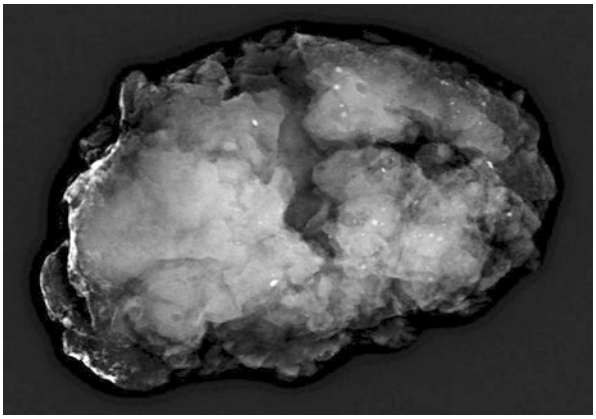
9d. What is an advantage of wire-free localization?
(a) Improved patient experience.
(b) Device can be placed prior to day of surgery.
(c) Potential for removal of smaller amount of nontargeted tissue.
(d) All of the above.

10a. A 33-year-old female underwent a stereotactic biopsy for an architectural distortion noted on diagnostic mammogram. There was 10-mm lateral migration of the biopsy clip (yellow circle) relative to the architectural distortion (red circle) noted on the post-biopsy mammogram. Pathology demonstrated radial scar. What finding should be targeted at time of pre-surgery wire localization?



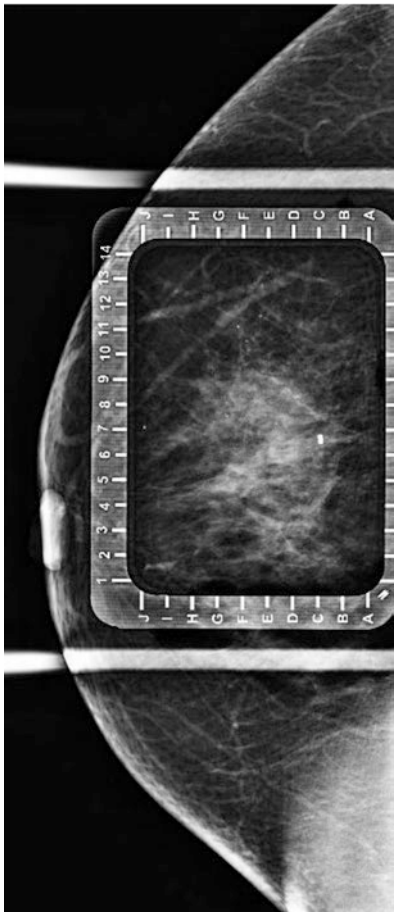
(a) Architectural distortion with associated calcifications.
(b) Biopsy microclip.
(c) Biopsy microclip and calcifications.
(d) None of the above.

10b. The architectural distortion and associated calcification were targeted at time of pre-surgery wire localization. A specimen radiograph is performed following surgical excision. What should be communicated to the operating room?



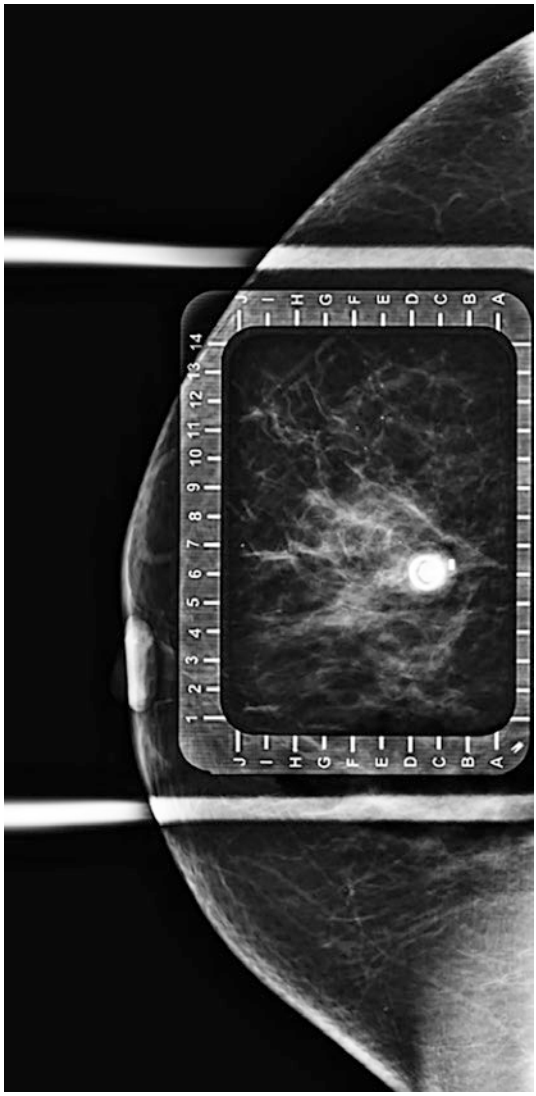
(a) The biopsy microclip is seen within the specimen.
(b) The biopsy microclip is not seen within the specimen and more tissue should be excised in order to remove the target.
(c) The biopsy microclip is not seen within the specimen, which is expected as the microclip was not the localization target.

11a. A 71-year-old female underwent stereotactic biopsy for an architectural distortion in the right breast. Post-procedure mammogram demonstrated accurate placement of the biopsy microclip. Pathology demonstrates atypical ductal hyperplasia, and surgical excision is recommended. Pre-surgery needle-wire localization is performed under mammographic guidance. Using the biopsy microclip as a target, needle-wire localization is performed from a medial approach. What are the closest coordinates to the target?



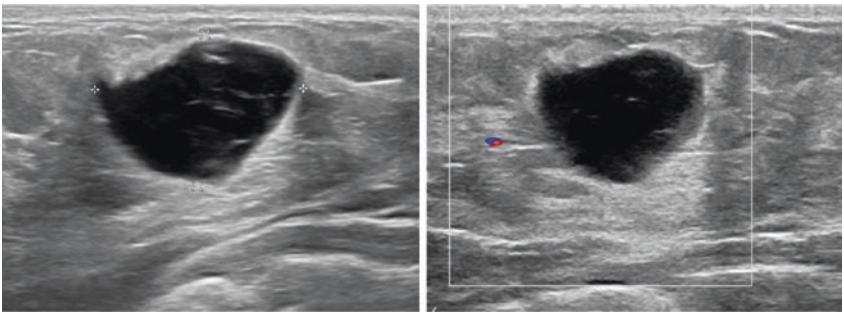
(a) A14.
(b) C6.
(c) F3.
(d) J10.

11b. Using the biopsy microclip as a target, needle-wire localization is performed from a medial approach. What is the next best step?



(a) Obtain a craniocaudal mammogram to confirm positioning.
(b) Deploy needle in the current position.
(c) Remove needle and re-position over the microclip.
(d) Remove needle and attempt from a superior approach.

12a. A 62-year-old female presents with a palpable abnormality in the left breast 1 week after stereotactic biopsy for suspicious calcifications. The lump is located in the area of her recent biopsy. The following finding is seen in the area of concern on diagnostic breast ultrasound. What is the most likely finding?



(a) Abscess.
(b) Fibroadenoma.
(c) Invasive ductal carcinoma.
(d) Hematoma.

12b. What steps can be taken if excessive bleeding is noted during image-guided biopsy?
(a) Administer additional lidocaine with epinephrine.
(b) Maintain manual compression against a hard surface in the plane of needle insertion for 10–20 minutes.
(c) Apply a pressure dressing to maintain continuous pressure.
(d) Obtain surgical consultation if excessive bleeding persists.
(e) All of the above.

Answers

1a. b. Stereotactic biopsy.

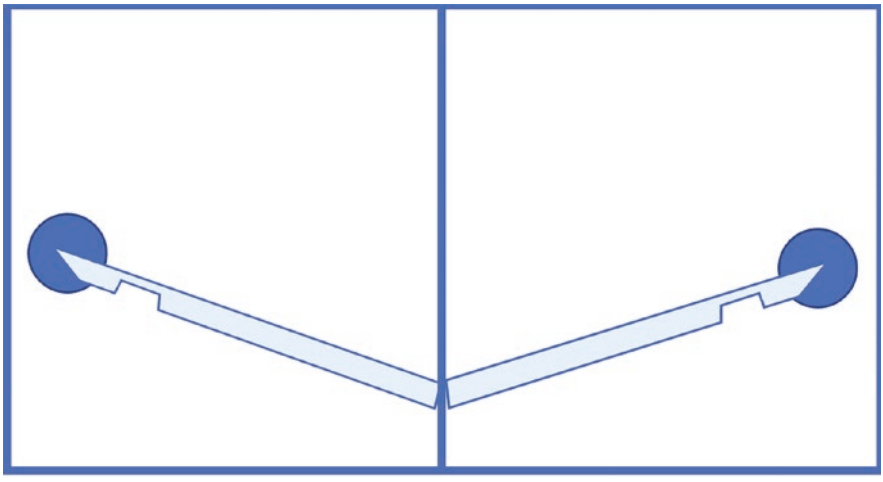
Magnification views show grouped coarse heterogeneous calcifications. According to BI-RADS fifth edition [1], grouped coarse heterogeneous calcifications are BI-RADS 4b. Category 4b lesions have a 10–50% likelihood of malignancy. As a result, biopsy should be recommended. For suspicious findings seen only on mammography, stereotactic biopsy should be performed to obtain tissue diagnosis.

1b. a. Medial.

Suspicious calcifications are seen in the right breast at 3 o'clock. The biopsy approach should be made based on the projection that provides the best visualization of the finding and the shortest distance from the skin entry site to the target [2, 3]. In this case, the shortest distance for biopsy would be via a medial approach.

1c. d. *Z*-axis error.

For stereotactic biopsies, a scout image demonstrating the target lesion is acquired. Then, two images are acquired at +15 ° and − 15 ° angles to form the stereo pair. Another stereo pair image is acquired after firing the biopsy needle mechanism to confirm needle placement. In this example, the needle and target are aligned on the *x*-axis and *y*-axis, however, the needle has not reached the target on the *z*-axis, consistent with a *z*-axis error [4, 5]. A *z*-axis error corresponds to an error in depth positioning. If the needle is too deep to the target, the needle needs to be pulled back and re-imaged to ensure the target is in the trough. If the needle is too shallow to the target, the needle needs to be pushed further in.



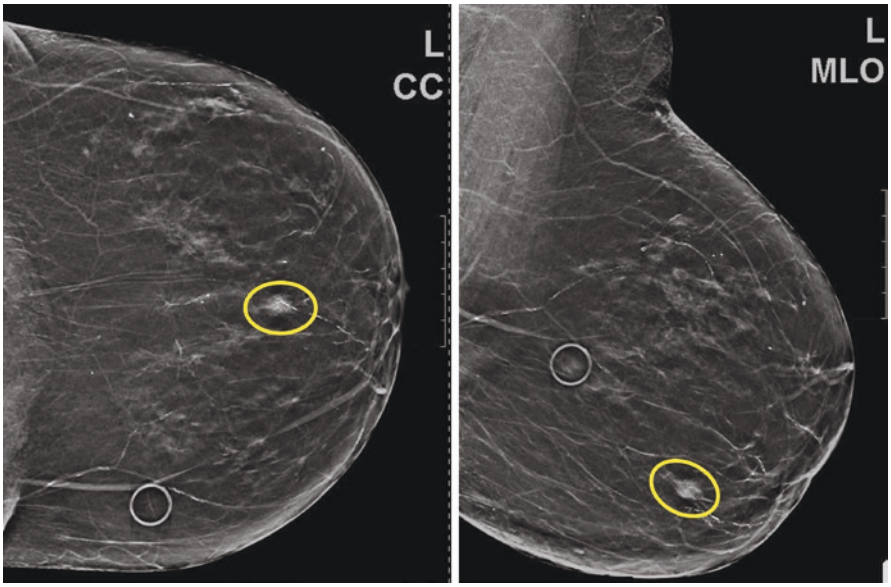
***Z*-axis error**

2a. b. Stereotactic biopsy.

Given the presence of an irregular mass seen on mammogram, biopsy should be recommended. If no sonographic correlate is identified, stereotactic biopsy should be performed to obtain tissue diagnosis.

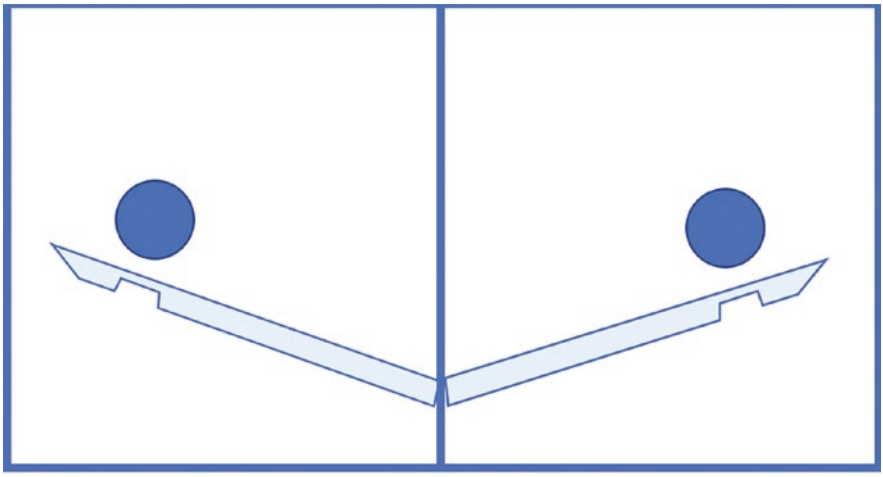
2b. d. Inferior.

An irregular mass is seen in the left breast at 6 o'clock. The shortest distance for biopsy would be via an inferior approach.



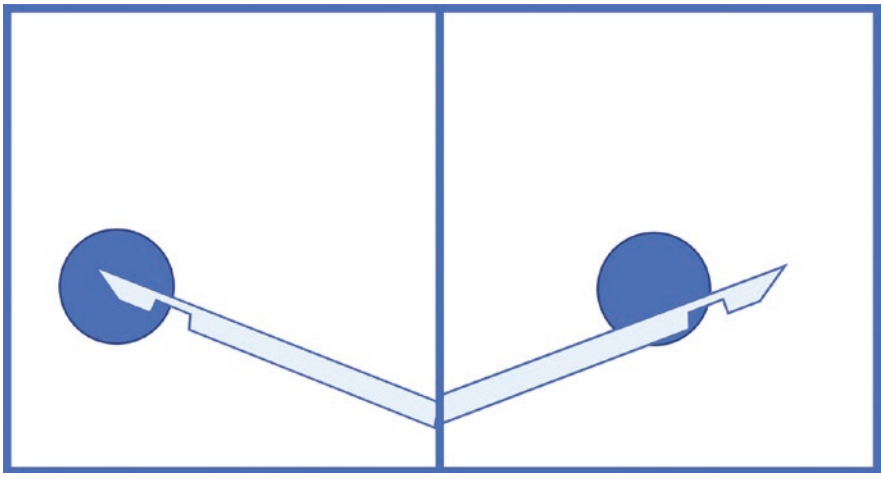
2c. c. *Y*-axis error.

In this example, the needle and target are aligned on the *x*-axis and *z*-axis, however, the needle is below the target on the *y*-axis, consistent with a *y*-axis error [4, 5]. A *y*-axis error corresponds to an error in vertical positioning, with the needle either below or above the target. Either re-targeting or sampling more above or below the needle can help correct the error.



***Y*-axis error**

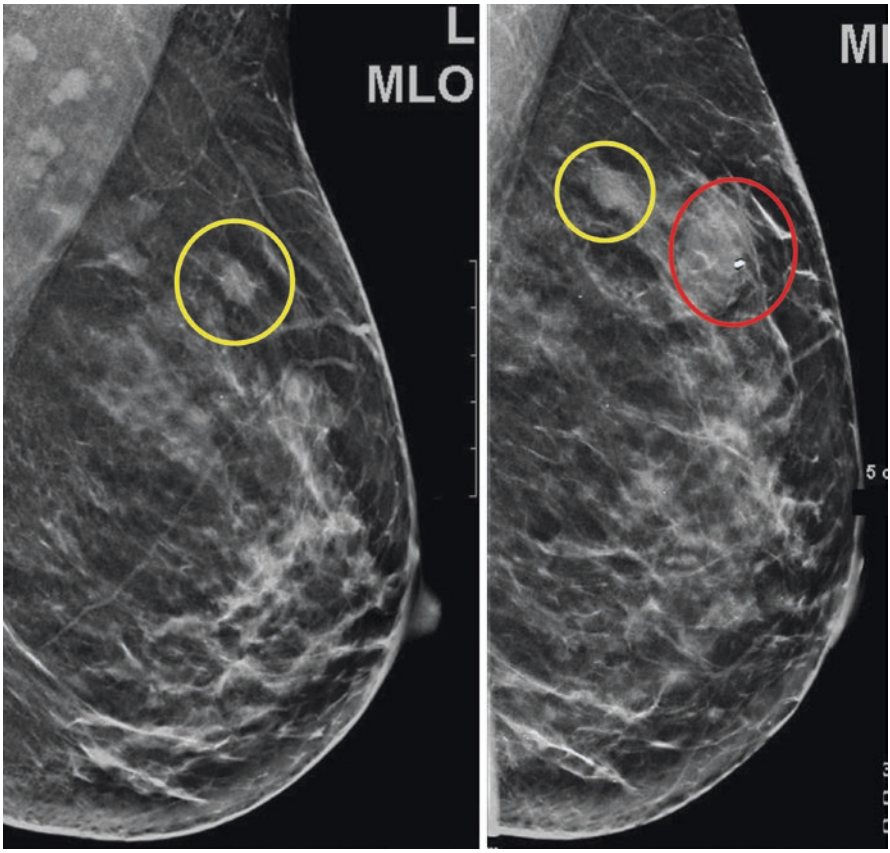
An *x*-axis error corresponds to an error in horizontal positioning, with the needle either too far to the right side or left side of the target.



***X*-axis error**

3. c. Perform stereotactic biopsy of the mammographic finding.

   Post-procedure mammogram following ultrasound-guided biopsy is needed to confirm biopsy microclip placement. It is also used to confirm that the biopsied sonographic finding correlates to the original mammographic area of interest. If the sonographic biopsy target does not correlate with the mammographic finding, a re-biopsy using stereotactic guidance should be performed. Note that in the annotated images, the microclip and hematoma (red circle) are located anterior to the biopsy target (yellow circle).



4a. b. Ultrasound-guided core needle biopsy.

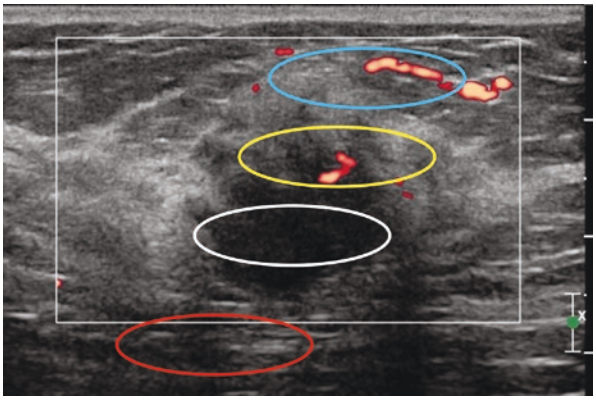
   When a sonographic correlate is seen for a mammographically detected abnormality, ultrasound-guided core needle biopsy should be performed for tissue diagnosis. Benefits of ultrasound-guided biopsy when compared to stereotactic biopsy include lack of radiation exposure, greater patient comfort and real-time visualization [6, 7]. Although fine-needle aspiration was previously utilized, better specimen quality is obtained with core needle biopsy [2].

4b. b. Lateral.

The suspicious mass is seen in the right breast at 9 o'clock. A lateral approach would provide the shortest distance to the lesion while avoiding the nipple and interference from the contralateral breast.

4c. c. White circle.

When performing an ultrasound-guided biopsy, care should be taken to avoid vascularity [8] surrounding a mass (blue circle) and within the mass (yellow circle). Targeting the central portion of the mass with the least vascularity (white circle) will ensure adequate sampling and decreased bleeding risk.



5a. a. Discard fluid.

If cyst aspiration yields non-bloody clear fluid and the cyst collapses following the procedure, the fluid may be discarded [2]. Routine follow-up is recommended.

5b. c. Place a biopsy microclip and send fluid for cytology.

If a cyst aspiration yields bloody fluid, the fluid should be sent for cytology in order to rule out occult malignancy [2]. A biopsy microclip should be placed as the lesion will likely resolve following aspiration.

5c. d. Perform ultrasound-guided core needle biopsy.

A failed cyst aspiration suggests that the finding is a solid mass [9]. Given the suspicious imaging features, ultrasound-guided core needle biopsy should be performed to obtain tissue diagnosis.

6a. b. Breast abscess.

In a lactating patient, a breast abscess can occur as a complication of mastitis. Patients can present clinically with focal pain, warmth, and redness of the affected breast with associated palpable abnormality, as well as systemic symptoms such as fever [10]. On ultrasound, an abscess can present as a hypoechoic collection with mobile internal debris. Abscesses lack internal color Doppler flow; however, the surrounding soft tissues may appear hyperemic.

6b. b. Ultrasound-guided drainage.

Patients with mastitis or breast abscesses should be prescribed a course of oral antibiotics. For treatment of breast abscesses, ultrasound-guided percutaneous drainage may be performed using an 18-gauge needle. The material obtained should be sent for cultures in order to determine the pathogen and antibiotic sensitivity. Antibiotics can be adjusted as needed [11].

6c. a. Ultrasound-guided core-needle biopsy and surgical consultation.

If symptoms of mastitis and/or breast abscess persist despite appropriate management, an ultrasound-guided core needle biopsy or skin punch biopsy should be performed to rule out malignancy, such as inflammatory breast cancer. Surgical consultation is also recommended for patients with breast abscesses that fail to resolve after multiple ultrasound-guided drainages [10, 11].

7a. d. All of the above.

Target nonvisualization at time of MRI-guided biopsy occurs in approximately 12% of cases [12]. Grid positioning should be verified in order to ensure that the target is not outside of the field of view. Obtaining delayed post-contrast sequences and decreasing compression of the breast will allow for better vascular perfusion [13]. If there is persistent nonvisualization of the target, hormonal changes in the breast may be the cause of the initial MRI finding.

7b. b. Short-term interval follow-up breast MRI.

If nonvisualization of the target occurs at time of MRI-guided biopsy, short-term follow-up MRI should be performed in order to rule out malignancy [2]. In this case, the focus of enhancement was not seen on the six-month follow-up MRI.

8. c. Multiple intraductal filling defects.

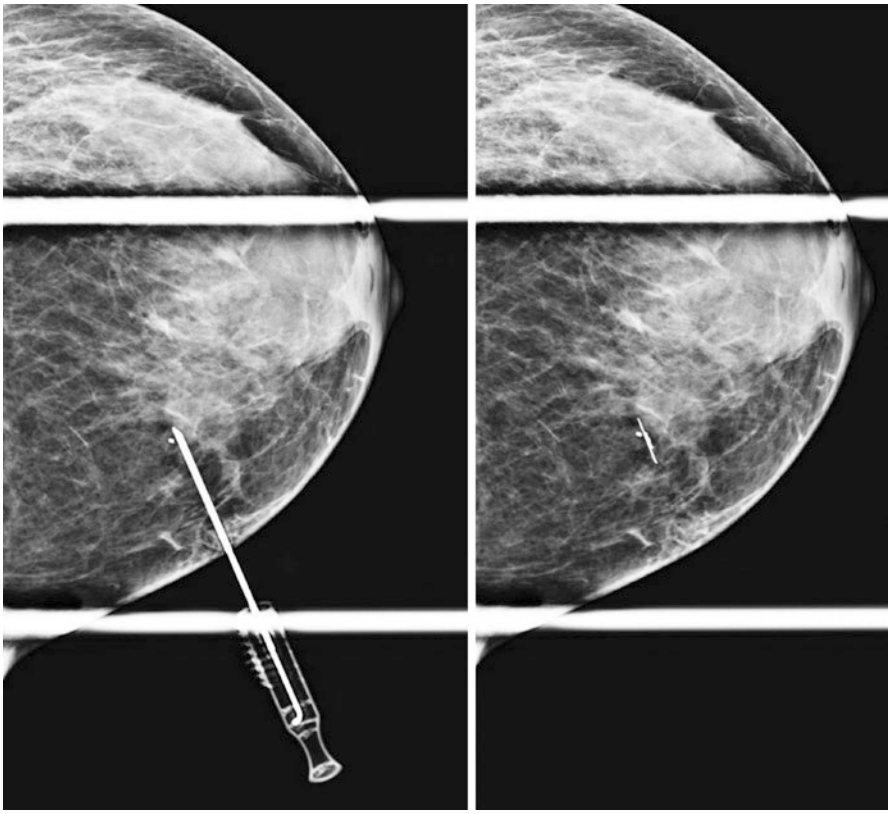
Ductography can be used for evaluation of unilateral spontaneous nipple discharge arising from a single pore. At the time of procedure, discharge is elicited using periareolar pressure. The discharging pore is then cannulated using a 30-gauge blunt-tipped catheter, and 0.2–0.3 mL of iodinated contrast is slowly administered through the catheter via extension tubing. The cannula can then be removed or secured in place using paper tape. Craniocaudal and 90-degree mediolateral magnification views of the subareolar breast are then obtained in order to visualize the contrast-opacified duct [14].

9a. a. Medial.

The biopsy microclip is in the lower inner quadrant of the left breast. Of the answer choices provided, the shortest distance for pre-surgery localization would be via a medial approach. Although an inferior approach would also provide a short distance to the target, performing the procedure from the inferior breast can be technically challenging for the radiologist.

9b. b. Pull back the deployment device and repeat craniocaudal view mammogram to confirm position.

For accurate wire-free localization, the tip of the needle device should be placed at the target prior to deployment. In this image, the tip of the reflector deployment device needs to be pulled back, so that the tip is at the target. A repeat craniocaudal mammogram should be performed to confirm positioning, as was in this case. The reflector was then deployed, with post-deployment craniocaudal mammogram demonstrating appropriate reflector placement.



9c. c. Both a and b.

Specimen radiographs are obtained following excision to confirm that the target was excised. If a wire localization was performed, the wire and localization target should be seen within the specimen radiograph. If wire-free localization was performed, the wire-free device (in this case a reflector) and target should be seen within the specimen radiograph. Findings should be reported to the operating room as soon as possible in order to confirm adequate surgical excision.

9d. d. All of the above.

Wire localizations are typically performed just prior to surgical excision. Wire-free localization, however, may be performed days to months before the day of surgery. Since there is no need for patients to have a wire protruding from the breast while waiting in the pre-operative area, the overall patient experience is improved and patient anxiety is reduced with wire-free localization. Additionally, the wire-free device allows for continuous intraoperative reorientation in relation to the target, which gives the potential for removal of a smaller amount of nontargeted breast tissue.

10a. a. Architectural distortion with associated calcifications.

Following stereotactic biopsy, clip migration may occur due to accordion effect or migration along the biopsy tract. In such cases, the initial biopsy target should be localized rather than the biopsy microclip.

10b. c. The biopsy microclip is not seen within the specimen, which is expected as the microclip was not the localization target.

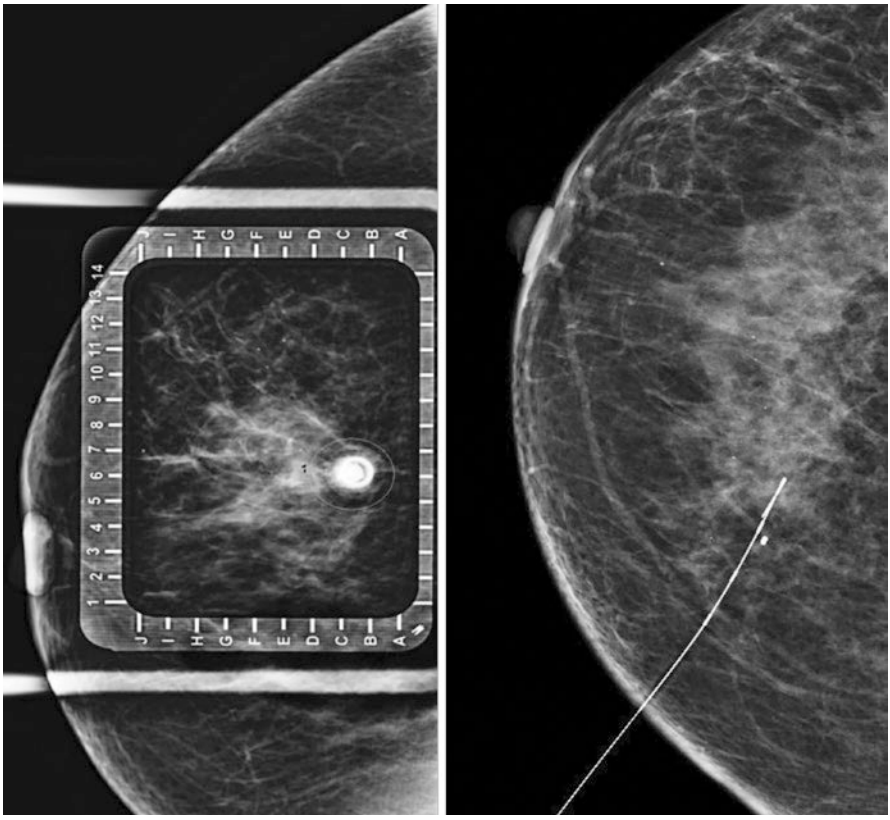
If the biopsy microclip was not targeted at time of pre-surgery localization, the microclip is not expected to be seen within the specimen radiograph.

11a. b. C6.

The grid overlying the area of localization target is used to determine accurate placement of the localization needle [15]. In this case, using the biopsy microclip as the target, the localization needle should be placed at approximately C6.

11b. c. Remove needle and re-position over the microclip.

On initial images following needle placement during mammographic localization, the needle should overlap the localization target, which in this case is the biopsy microclip. Once the needle is in appropriate position, an orthogonal view is obtained in order to determine needle position relative to the target. Once positioning is confirmed, the localization wire may be deployed [16].



12a. d. Hematoma.

A post-biopsy hematoma can present as a hypoechoic fluid collection or as a complex cystic and solid mass, depending on the amount of clotted versus free blood within the cavity [11]. Most hematomas resolve within 2–4 weeks.

12b. e. All of the above.

If excessive bleeding is encountered during image-guided biopsy, additional lidocaine with epinephrine may be administered in order to cause vasoconstriction. Additionally, manual compression should be applied and a pressure dressing may be utilized. If excessive bleeding cannot be controlled, a surgical consultation should be obtained [11].

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