Implants

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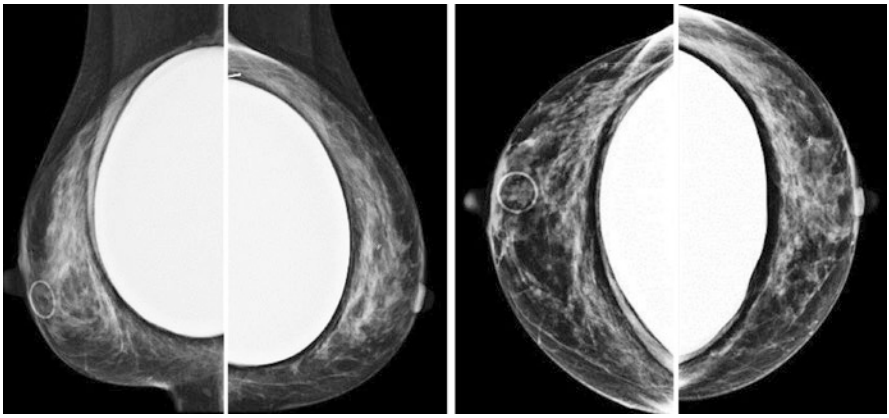
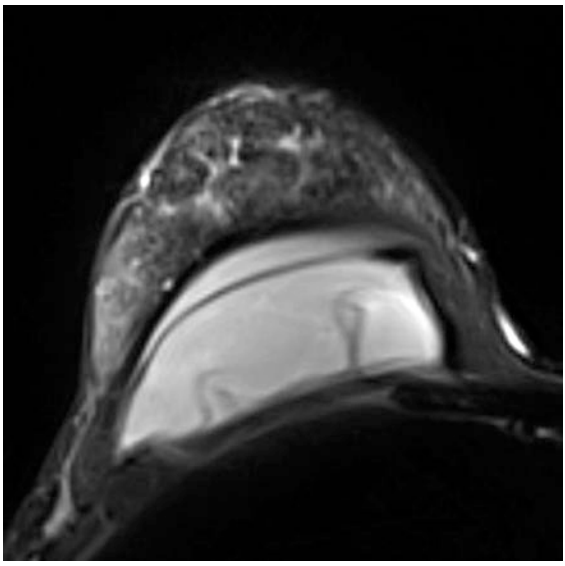
1a. A 40-year-old female with a remote history of bilateral breast implants presents with right breast pain and subjective perception of change in right breast shape. What type of breast implant does this patient most likely have and what is the placement?



(a) Silicone implant; subglandular.
(b) Saline implant; subglandular.
(c) Silicone implant; subpectoral.
(d) Silicone implant; subcutaneous.

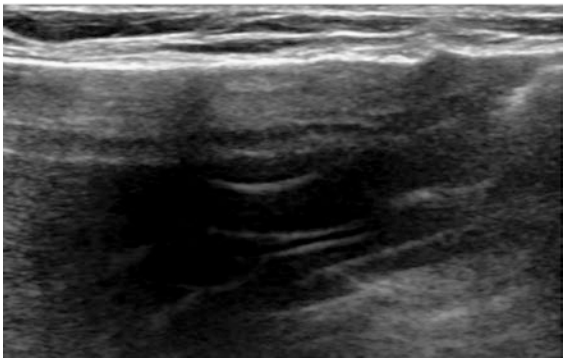
1b. What is the most appropriate next step given the patient's history?
(a) Nothing, no evidence of rupture.
(b) Repeat mammogram to obtain more views.
(c) Ultrasound, followed by a non-contrast MRI if ultrasound is inconclusive.
(d) Surgical removal of implant.

1c. The patient received an ultrasound with inconclusive results. The patient subsequently received an MRI without contrast. What is identified on the MRI? What named sign is observed?



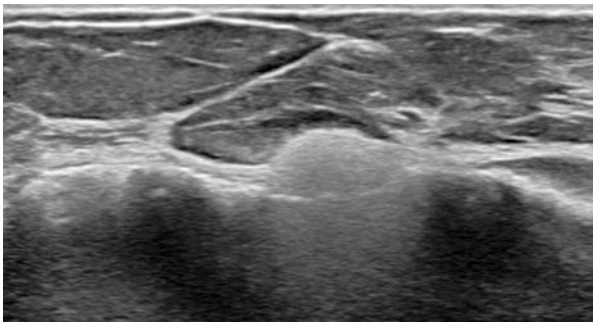
(a) Intracapsular rupture; subcapsular line sign.
(b) Intracapsular rupture; shell sign.
(c) Extracapsular rupture; keyhole sign.
(d) Extracapsular rupture; teardrop sign.

1d. If the patient's breast implant were imaged on ultrasound, what named sign would suggest the presence of intracapsular implant rupture?



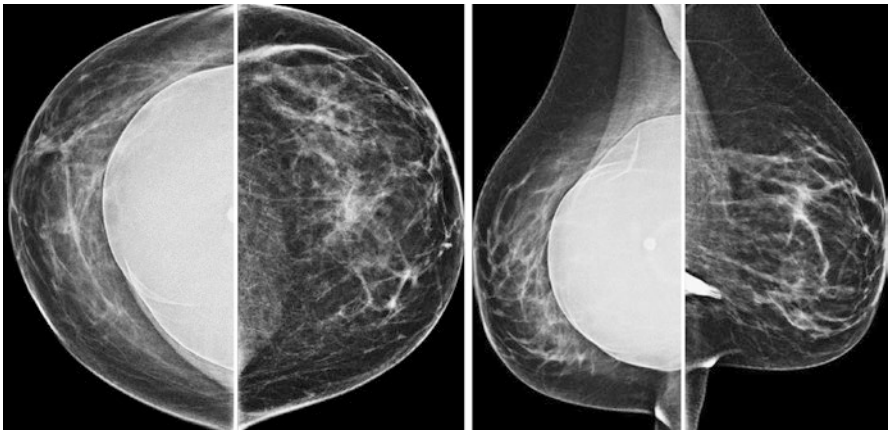
(a) Snowstorm sign.
(b) Stepladder sign.
(c) Shell sign.
(d) Shovel sign.

2. In a patient with silicone implants, what is demonstrated on this ultrasound?



(a) Donut sign.
(b) Snowstorm sign.
(c) Keyhole sign.
(d) Shadowing sign.

3. A 32-year-old female with a remote history of bilateral breast implants presents complaining of subjective perception of change in left breast shape. Based on the mammographic findings, what is the diagnosis?



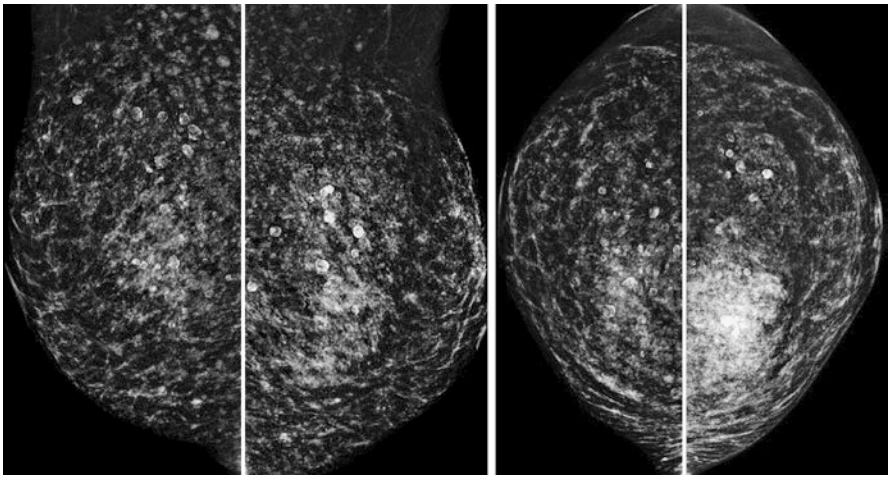
(a) Left subpectoral saline implant rupture.
(b) Left subglandular silicone implant rupture.
(c) Left subglandular saline implant rupture.
(d) Left subpectoral silicone implant rupture.

4a. A 53-year-old female with history of implants presents with left breast pain, firmness, and change in shape. CC and MLO views of the left breast are shown. What is the most likely diagnosis?

(a) Extracapsular implant rupture.
(b) Capsular contracture.
(c) Free silicone injection.
(d) Infection.

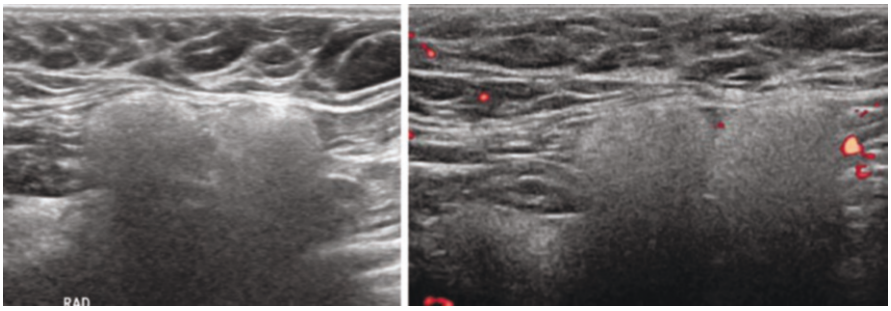
4b. What is the appropriate management for this condition?
(a) Nothing.
(b) Antibiotics.
(c) Capsulotomy/capsulectomy.
(d) Mastectomy.

5a. A 54-year-old female from South America presents for screening mammography. She reports no prior history of silicone implants augmentation. CC and MLO views of bilateral breasts are obtained. What would explain the appearance of this patient's breasts on mammography [1]?



(a) Fat necrosis.
(b) Extracapsular silicone implant rupture.
(c) Free silicone injection granulomas.
(d) Multiple breast metastases.

5b. Several months later the patient returns with a mass in her left armpit. Ultrasound images are shown. What is the most likely diagnosis?

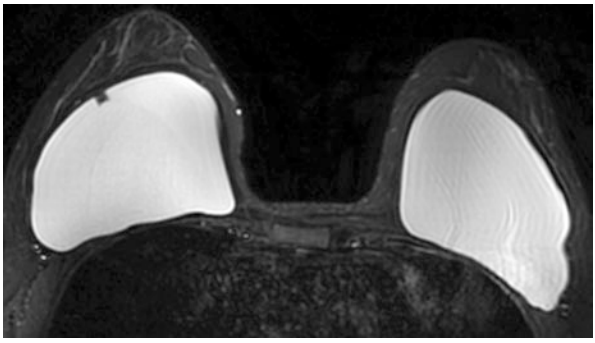


(a) Silicone-laden lymph nodes.
(b) Lymphoma.
(c) Lipoma.
(d) Reactive lymph nodes.

6. Ultrasound images of a breast with implant are provided. What type of implant is shown and what suggests the implant type?

(a) Silicone; step-off phenomenon.
(b) Saline; reverberation artifact.
(c) Silicone; reverberation artifact.
(d) Saline; step-off phenomenon.

7. MRI STIR image of breasts with implants are provided. What type of implant is shown?

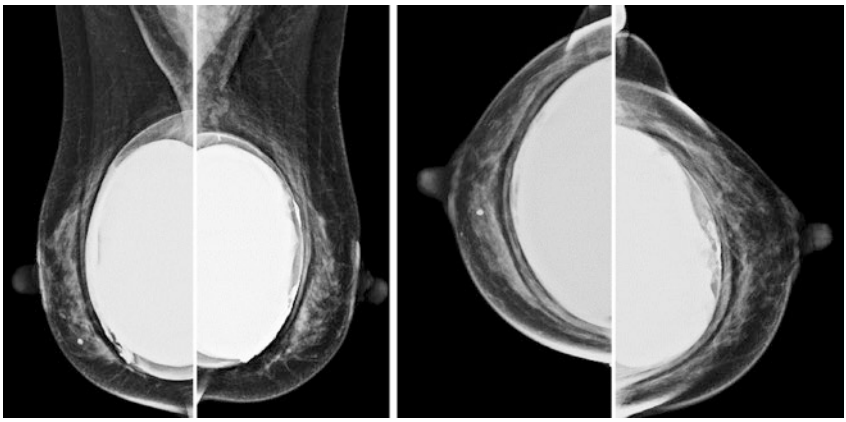


(a) Silicone.
(b) Saline.
(c) Double-lumen.
(d) Free injection.

8. A 40-year-old female with a history of bilateral breast implants presents complaining of left breast pain and subjective perception of change in left breast shape. Her mammogram was unremarkable. She subsequently received an MRI for her implant concerns. What is seen on MRI? What named sign is observed?

(a) Intracapsular rupture; linguine sign.
(b) Extracapsular rupture; shell sign.
(c) Intracapsular rupture; keyhole sign.
(d) Extracapsular rupture; loop sign.

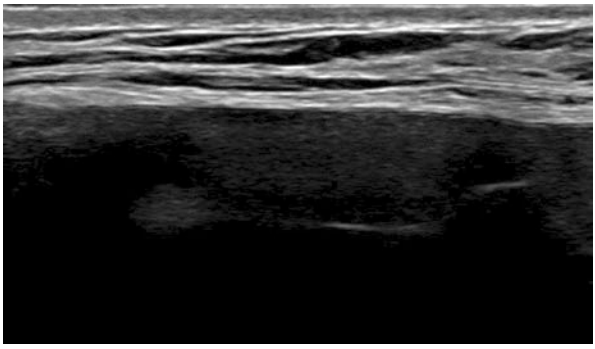
9. What type of implant is seen on this mammogram?



(a) Single-lumen saline.
(b) Single-lumen silicone.
(c) Standard double-lumen.
(d) Reverse double-lumen.

10. What technique can be employed to improve visualization of breast tissue when implants are present?
(a) DeBruhl technique.
(b) Eklund technique.
(c) Kagetsu and/or Manghisi technique.
(d) Bassett technique.

11. Ultrasound images are provided of a breast implant. What type of implant is shown?



(a) Silicone.
(b) Saline.
(c) Double-lumen.
(d) Unable to differentiate.

12a. A 55-year-old woman with a remote history of bilateral breast augmentation presents with asymmetric swelling and pain of her right breast. Mammogram was negative. What is the next best step?
(a) Nothing.
(b) Ultrasound.
(c) MRI.
(d) Surgical consultation.

12b. An ultrasound was performed. What is the differential diagnosis for this peri-implant fluid collection?

(a) Infection.
(b) Implant rupture.
(c) Late seroma.
(d) Breast implant-associated anaplastic large cell lymphoma.
(e) All of the above.

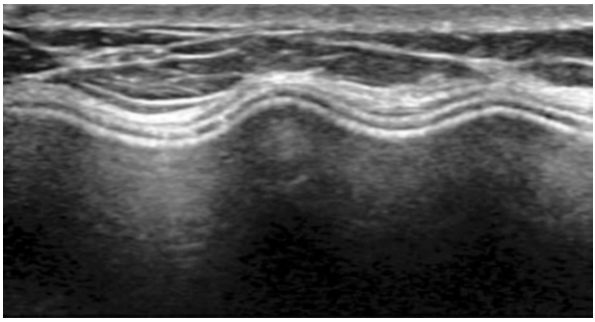
12c. An ultrasound was performed on the patient above, as shown. What is the best next step in the diagnosis and treatment?
(a) MRI.
(b) Fluid aspiration.
(c) Mammography.
(d) Surgery.
(e) PET scan.

12d. How common is breast implant-associated lymphoma?
(a) 0.3–100 in 100,000 women.
(b) 0.3–100 in 1000 women.
(c) 1 in 100 women.
(d) Unknown.

12e. What is a risk factor for breast implant-associated lymphoma?
(a) Smooth implant.
(b) Textured implant.
(c) Saline implant.
(d) Silicone implant.

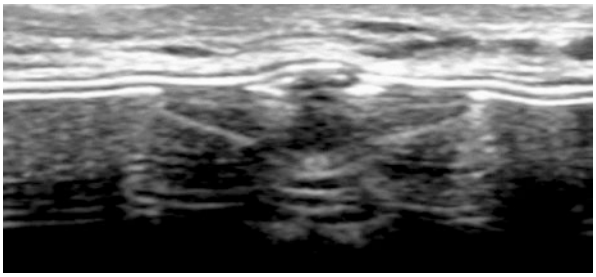
12f. What additional imaging can be considered for additional characterization?
(a) Mammography.
(b) MRI.
(c) Nuclear medicine.
(d) CT.

13. A 50-year-old female seen for diagnostic evaluation of the breast for personal breast cancer history. Ultrasound images are shown. What explains the three echogenic lines seen near the periphery of the implant seen on ultrasound?



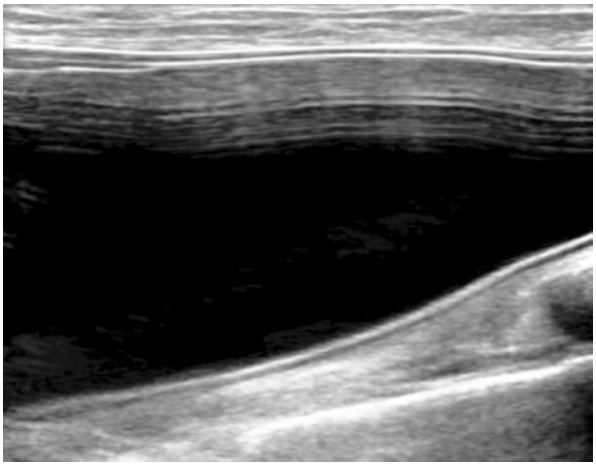
(a) Intracapsular rupture.
(b) Extracapsular rupture.
(c) Normal; trilaminar line.
(d) Normal; stepladder sign.

14. A 36-year-old female presents for diagnostic evaluation of a lump in the left breast. Ultrasound image is below. What is the most likely diagnosis?



(a) Saline valve.
(b) Nipple.
(c) Intracapsular rupture.
(d) Lymph node.

15. A 38-year-old female presents for screening. Ultrasound image is shown. What best describes the finding on ultrasound?

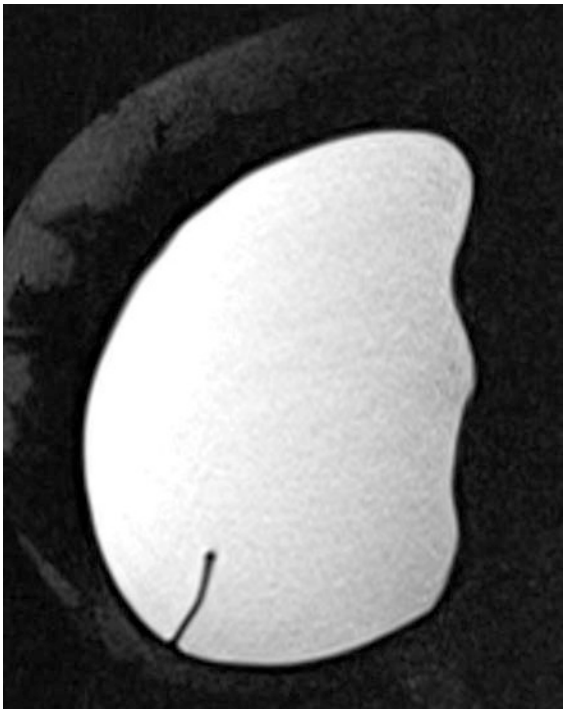


(a) Reverberation artifact; intact implant.
(b) Stepladder artifact; extracapsular implant rupture.
(c) Stepladder artifact; intracapsular implant rupture.
(d) Shell sign; intact implant.

16. A 70-year-old female is seen for callback from screening. Silicone-sensitive sequence image of the breast is provided. What is the diagnosis?

(a) Free silicone injections.
(b) Implant extracapsular rupture.
(c) Normal.
(d) Breast lymphoma.

17. A 50-year-old female with right breast lower inner palpable implant finding, evaluation for implant integrity. A silicone-sensitive sequence of the right breast is provided. What explains the finding?



(a) Radial fold.
(b) Intracapsular rupture.
(c) Extracapsular rupture.
(d) Valve.

Answers

1a. c. Silicone implant; subpectoral.

This patient has a silicone implant as evidenced by the dense contents of the implant on mammography. Single-lumen silicone implants are the most common implant type [2]. Saline implants are typically much less dense in appearance and there is a valve that can be seen in the central part of the implant. The patient's pectoralis major muscle is seen draped over the implant. "Subcutaneous" is not an appropriate term to describe the implant positioning.

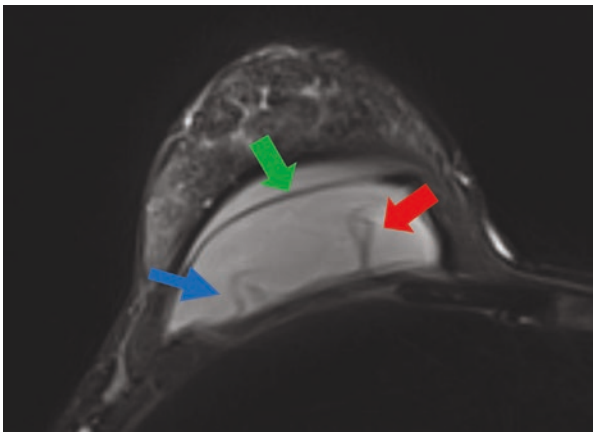
1b. c. Ultrasound, followed by a non-contrast MRI if ultrasound is inconclusive.

Given the patient's history, especially change in breast morphology, there is a concern of implant rupture. Although saline implant rupture can be identified on mammography and can be diagnosed clinically, silicone implant rupture—specifically intracapsular rupture—is often challenging to diagnose with mam-

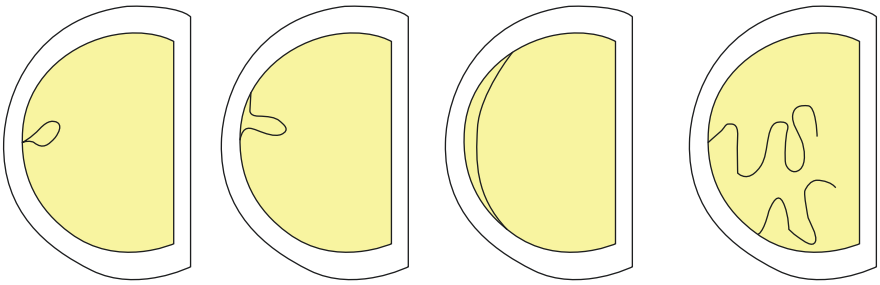
mography alone. Diagnosis of intracapsular rupture can be made by ultrasound. If the ultrasound is inconclusive, a non-contrast MRI can be performed to evaluate the silicone implants and implant integrity.

1c. a. Intracapsular rupture; subcapsular line sign.

No extracapsular silicone content is identified. The fibrous capsule appears intact and the silicone contents are contained entirely within the fibrous capsule. The implant demonstrates intracapsular rupture with the subcapsular line sign (green arrow), teardrop sign (red arrow), and keyhole sign (blue arrow). There is no "shell sign" pertaining to breast implant rupture.

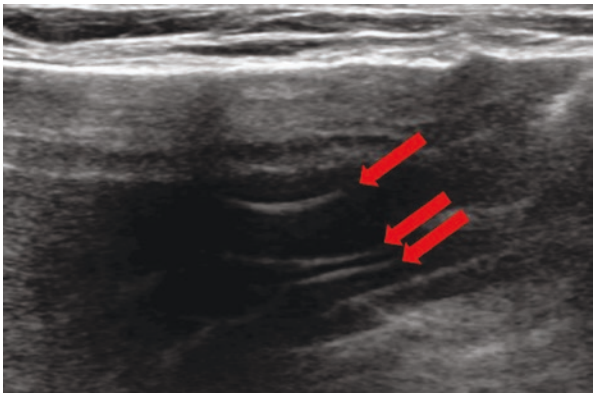


Linguine sign is demonstrated by multiple curvilinear hypointense lines within the silicone gel and describes the collapsed implant shell floating within the silicone. Subcapsular line sign is demonstrated by hypodense wavy lines running parallel and just beneath the fibrous capsule and describes the silicone outside of the implant shell, separating it from the fibrous capsule. Keyhole sign is suggestive of rupture and is depicted by focal invagination of the implant shell, where the two membranes do not touch. Teardrop sign is suggestive of rupture and is depicted by focal invagination of the implant shell containing silicone, where the two membranes touch [3].



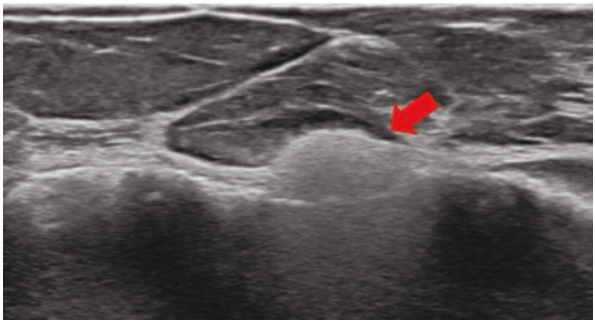
1d. b. Stepladder sign.

On ultrasound, intracapsular rupture may present with the stepladder sign, which is seen as multiple, parallel, discontinuous, hyperechoic lines within the implant lumen. A normal implant should be anechoic. Extracapsular rupture may present with the snowstorm sign. The other two signs do not exist as pertaining to breast implant rupture. Overall, ultrasound is only 59–85% sensitive and 55–79% specific for detecting implant rupture [4].



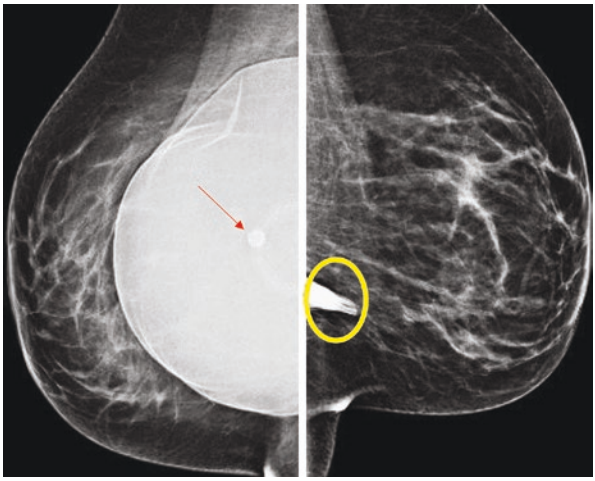
2. b. Snowstorm sign.

Extracapsular rupture presents with the snowstorm sign as demonstrated by a heterogenous echogenic appearance of free silicone droplets mixed with breast tissue. Keyhole sign is suggestive of intracapsular rupture on MRI. There is no donut sign or shadowing sign relating to implant rupture.



3. a. Left subpectoral saline implant rupture.

   The imaging appearance of the left breast on mammography is that of a subpectoral saline implant which has ruptured and collapsed (yellow circle). Saline implants are radiolucent with the presence of a saline implant valve (red arrow). Standard double-lumen implants feature a dense silicone central compartment with the less dense outer saline compartment encircling it. Reverse double-lumen implants feature a central saline compartment with a denser ring of silicone surrounding it.



4a. b. Capsular contracture.

   The left implant appears rounded and spherical rather than oval in shape, indicating capsular contraction. Another finding include contour irregularity. Capsular contraction is one of the most common complications after breast augmentation. It refers to a tightening of the fibrous capsule surrounding the breast implant, most commonly occurring within months after implantation but can occur at any time [5].

4b. c. Capsulotomy/capsulectomy.

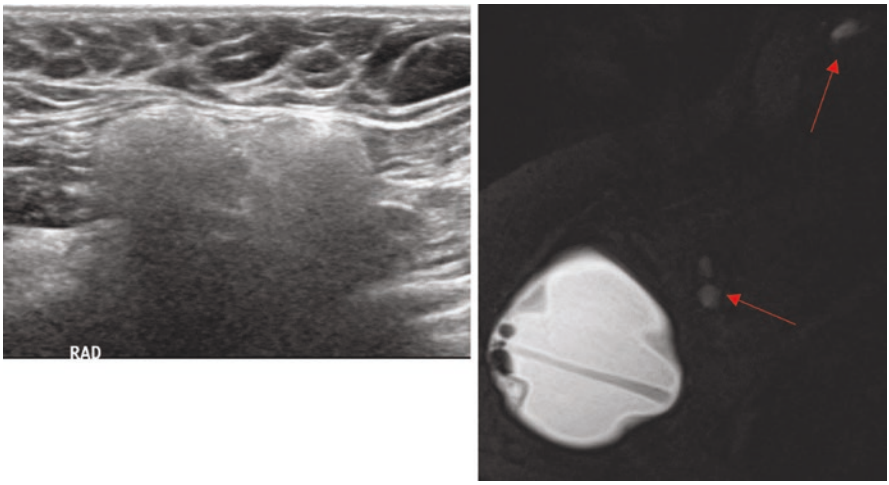
   The usual management for capsular contracture is capsulotomy/capsulectomy to relieve pressure on the implant and improve symptoms. This is not an infection, so antibiotics are not warranted. Mastectomy is too radical a solution for this complication. It would not be appropriate to do nothing given the patient's discomfort.

5a. c. Free silicone injection granulomas.

   This patient has undergone bilateral breast augmentation with free silicone injections. This practice is still performed in countries throughout Asia and South America, and rarely in the USA. The appearance on mammogram can be difficult to distinguish from extracapsular silicone implant rupture; however, there is no evidence to suggest this patient received silicone breast implants [1].

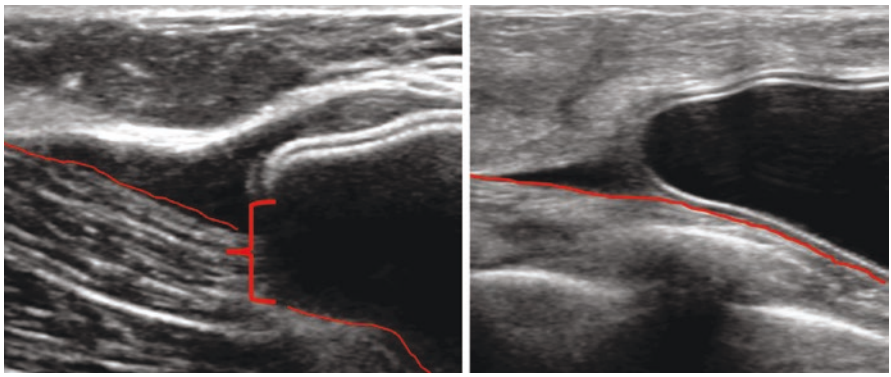
5b. a. Silicone-laden lymph nodes.

Ultrasound demonstrates two hyperechoic axillary lymph nodes with a well-defined anterior margin and poorly defined posterior margin resulting in a "snowstorm" appearance. These findings coupled with the patient's history of free silicone injections into the breasts are suggestive of silicone-laden lymph nodes. Silicone-laden lymph nodes can be identified on MRI as extracapsular hyperintense signal on silicone-sensitive sequences (red arrows).



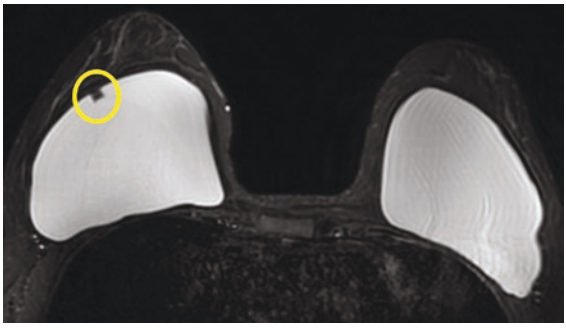
6. a. Silicone; step-off phenomenon.

This patient has silicone implants as evidenced by the step-off phenomenon [2]. Because sound travels more slowly through silicone than saline, soft tissues behind a silicone implant appear farther away and a discontinuity or step-off of the fascia (red bracket) posterior to the silicone implant is seen. The thicker the implant, the more exaggerated the effect [5]. Light compression during scanning can help minimize this effect. Saline implants on ultrasound do not demonstrate step-off effect.



7. b. Saline.

Based on the images, this patient most likely has saline implants. Distinguishing different implant types on MR can usually be done by examining STIR or T2-weighted images, where saline implants will appear very bright relative to fat and silicone implants will appear intermediate intensity (relative to fat). On T1-weighted images, saline implants are more hypointense compared to silicone implants. An additional finding suggesting saline implant is the presence of a fill valve (also known as injection port), usually seen in a subareolar location at the margin of the implant shell (circle).



8a. a. Intracapsular rupture; linguine sign.

The fibrous capsule is intact and the silicone contents are contained within it. However, the silicone shell is collapsed and exhibits the linguine sign as demonstrated by multiple curvilinear hypointense lines within the silicone gel.

9. c. Standard double-lumen.

This is the classic imaging appearance of a standard double-lumen implant, comprising approximately 11% of all implants [2], which has a silicone center and inflatable saline outer lumen. Less than 1% of implants are reverse double-lumen, most often used after reconstructive surgery. Additional, even rarer, varieties include triple-lumen and reverse-adjustable double lumen implants.

10. b. Eklund technique.

When implants are present, the Eklund technique is used to improve breast tissue visualization. It involves posterosuperior displacement of the implant (toward the chest wall) with simultaneous anterior traction of the breast tissue forward and around the implant. These implant-displaced images result in maximizing the tissue seen in the mammogram [6].

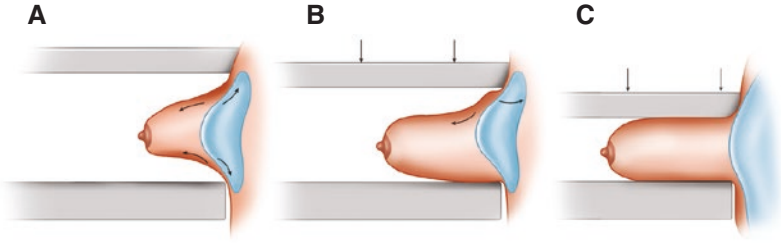


Illustration demonstrating sequential posterior displacement of the implant within the breast during compression for mammography to improve visualization of underlying breast tissue

11. d. Unable to differentiate.

On ultrasound, saline and silicone implants appear similar. They both appear anechoic with a linear echogenic rim capsule. Within the implant, low-level echoes may be seen normally. Additionally, reverberation artifacts can be seen anteriorly and should not be confused with lack of implant integrity.

12a. b. Ultrasound.

Breast ultrasound is the initial test of choice to evaluate swelling or pain related to a breast implant. Ultrasound can assess implant integrity, peri-implant effusion or mass. Mammography does not have the accuracy to detect peri-implant effusion or mass-forming breast implant-associated anaplastic large cell lymphoma. Breast MRI is an imaging test with high accuracy that can be performed after inconclusive ultrasound and can evaluate capsule integrity or contracture, implant rupture, tissue edema, effusion, and mass.

12b. e. All of the above.

A late seroma associated with a breast implant is defined as a periprosthetic fluid collection occurring more than 1 year after the breast augmentation or reconstruction procedure. This complication is rare and usually benign. The symptoms can be indistinguishable from those of Breast Implant-Associated Anaplastic Large Cell Lymphoma (BIA-ALCL). At a median age of 10 years after implant placement, the typical presenting features are sudden onset of breast swelling from peri-implant effusion and less likely a mass [7].

12c. b. Fluid aspiration.

The initial assessment of late onset enlargement of the breast in the setting of breast implants should include a clinical history querying recent trauma or infection. An initial screening with breast ultrasound should be performed to assess for implant integrity, the presence of effusion, the presence of a mass and axillary lymph nodes. If an effusion is present, fluid aspiration is indicated in an attempt to relieve the patient's symptoms and to exclude breast implant-associated anaplastic large cell lymphoma (BIA-ALCL). At least 50 ml of effusion fluid should be analyzed for cytologic analysis and immunophenotyping, culture, cell count, and protein. In contrast, 5–10 ml of fluid surrounding an implant in an asymptomatic patient is usually normal and generally does not require further investigation. Surgery (en-bloc capsulectomy) followed by chemotherapy and radiation are typically the next steps in management [7]. In this case, cytology revealed a breast implant-associated anaplastic large cell lymphoma.

12d. a. 0.3–100 in 100,000 women [7].

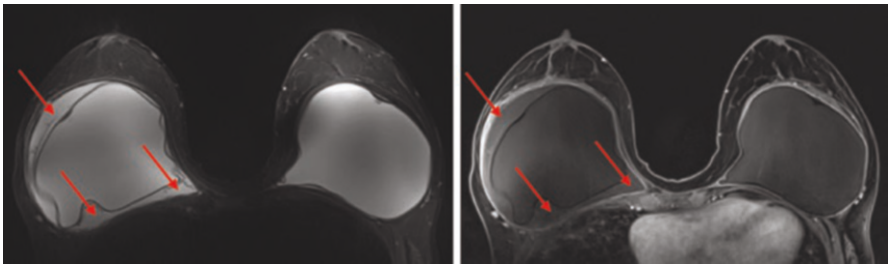
12e. b. Textured implant.

Textured implants are known to increase risk for this type of lymphoma, possibly related to peri-implant inflammation and biofilm formation with chronic

subclinical infection, ultimately leading to malignant transformation of T-cells. Smooth implants are not known to increase risk. There is no known association with implant filling [7].

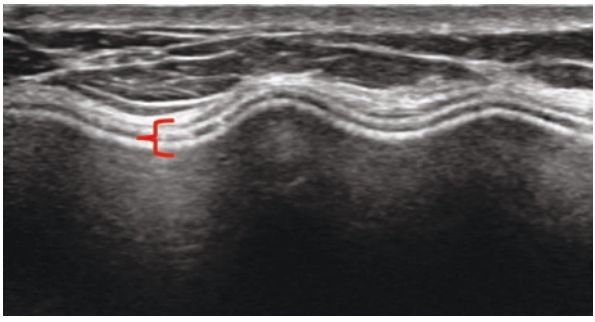
12f. b. MRI.

MRI may demonstrate effusions (arrows) and masses associated with the lymphoma. Additionally, capsular enhancement may be seen in a small number of cases. Neither mammography, nuclear medicine, or PET-CT scans are specific for implant-associated lymphoma [7].



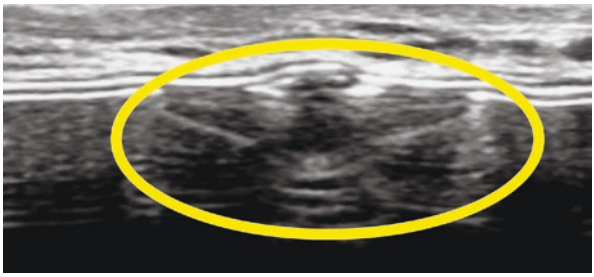
13. c. Normal; trilaminar line.

A fibrous capsule eventually forms around the implant shell and creates a trilaminar line on ultrasound. The outer echogenic line is the outer surface of the capsule, the middle echogenic line reflects two echogenic lines, which are the inner surface of the capsule and the outer surface of the elastomer shell, and the inner echogenic line corresponds to the inner surface of the elastomer shell. The isoechoic space between the outer and middle echogenic lines represents the fibrous capsule thickness, and the intervening anechoic space between the middle and inner echogenic lines reflects the elastomer shell thickness [5]. The stepladder sign is discussed in question 1.



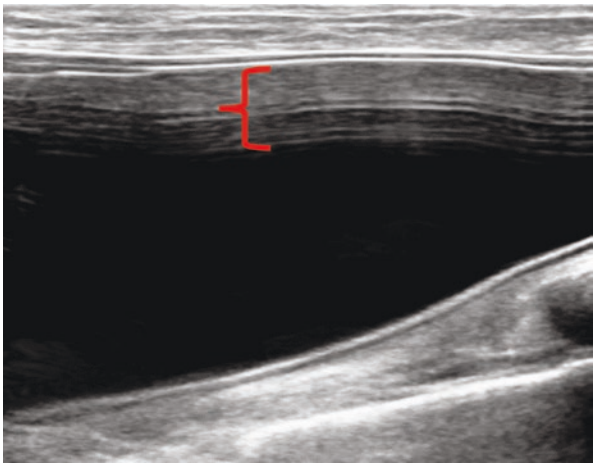
14. a. Saline valve.

This finding in the area of the patient's concern represents a saline valve. The nipple would not be found so deep within the subcutaneous tissues. Intracapsular rupture and lymph node have different ultrasound appearance.



15. a. Reverberation artifact; intact implant.

    Ultrasound image shows a band of multiple, closely spaced, echogenic lines (bracket) in the near field parallel to the capsule-shell complex, a finding consistent with reverberation artifact, which can be seen even with an intact implant, as was the case above. There are no imaging findings to suggest implant rupture. Reverberation artifact occurs when the ultrasound beam encounters two strong parallel reflectors, and bounces back and forth between them, resulting in the above artifact. This artifact can be reduced by changing the angle of insonation.



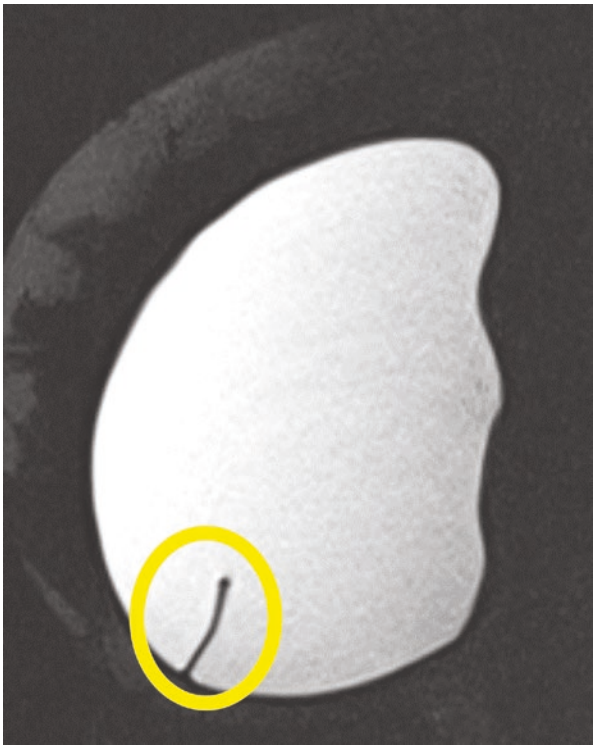
16. b. Implant extracapsular rupture.

    The irregular contour of the right breast implant and presence of silicone outside the implant capsule (red arrow) indicate extracapsular silicone rupture of the implant. Free silicone injections and breast lymphoma have an alternate

appearance. Linguine sign is also seen which is indicative of intracapsular rupture.

17. a. Radial fold.

The MR image above demonstrates a radial fold, a normal finding of intact breast implants. There is no evidence of intracapsular or extracapsular rupture. Valves appear different, and are seen with saline implants, not silicone.



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