# Breast prostheses: what the radiologist should know

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Learning objectives

In recent years have witnessed a significant rise of prosthetic breast surgery, in most cases for aesthetic, which has been accompanied by an increase in the prevalence of complications arising therefrom.

To properly identify them, the radiologist should be familiar with the characteristic findings of each complication.

Background

Before analyzing the imaging characteristics of the various complications of prosthetic breast surgery should briefly discuss the imaging techniques available for study and prosthetic models that are available today.

- **Mammography**: technique of little use in the study of prosthetic breast pathology. Given the high density of the prosthesis does not allow assessment intracapsular rupture.
- **Ultrasound**: first imaging test that is usually performed when suspected prosthetic pathology. You must have high resolution linear transducers, with a high frequency (center frequency between 7 and 12 MHz) to obtain high image quality in breast ultrasound.
- **MRI**: enables detection of capsular rupture in earlier stages than ultrasound. The protocol included axial T1, axial high-resolution T2 for volumetric reconstruction, axial STIR and axial only Silicone (SS) sequences Fig. 1 on page 5. The dynamic study after iv administration of gadolinium is optional. The volumetric T2 sequence is useful in the detection of the capsular tear (especially intracapsular), being the sequence that best identifies the different suggestive signs of breakage. The only silicone sequence enables the identification of free silicone and distinguish between intra and extracapsular breakage, and determine if an adenopathy with high signal intensity on T2 sequence is infiltrated or not with silicon.

The convenience of knowing the different types of breast implants for their content lies in the implications that may arise from some complications, such as broken, that will be very different depending on the type of prosthesis, and characteristic signs of some particular complications involved in a particular type of prosthesis can also be seen in other types of prosthesis without involving pathology. In our environment used models are **single lumen**, and of these, by far, the **silicone** ones, which has a silicone outer shell and, as filler, high cohesiveness silicone gel. **Saline** prostheses Fig. 2 on page 5 differ from silicon using a saline solution as a filler, that in case of breakage capsular is absorbed
by the body, so that, unlike the previous ones, does not imply toxicity for the body. They possess filling valves that control its volume. The **double and triple lumen** prosthesis Fig. 3 on page 6 are less used, containing two or more internal pockets with saline or silicone gel.

It is also useful to know the type of prosthesis according to their location, determined by the surgical technique, because it has certain implications for the assessment of breast parenchyma. You can differentiate between prosthesis of retroglanular location and prosthesis of retropectoral location. In the case of **retro or subglandular** location prostheses Fig. 4 on page 7, they are placed in front of the pectoral muscle and the mammary gland is behind, so the percentage of breast tissue in the mammography is less visible than in the location prosthesis **retropectoral**. The latter ones Fig. 5 on page 8 are placed behind the pectoral muscle in attempt to reduce the frequency of fibrous capsule formation and improve visualization of breast parenchyma.

So about complications from breast prosthetic surgery, they can be classified into early or late depending on the time elapsed since the completion of surgery.

**Early complications:**

- **Seroma**: sequel of intervention manifested as a fluid collection in the surgical area, next to the scar Fig. 6 on page 9.
- **Hematoma**: complication that occurs in early stages and seen in mammography as a well-defined image of high density, sometimes heterogeneous. To determine the developmental stage, are useful both ultrasound and MRI, with blood appearing characteristicly on T1 with high signal intensity in acute-subacute phase Fig. 7 on page 10.
- **Infection**: clinically manifested with heat, redness, etc (typical inflammatory signs), radiology is little usefull, showing only a significant enhancement after administration of contrast in MR perfusion studies Fig. 8 on page 10.
- **Abscess**: mixed-fluid collection accompanied by clinical inflammatory, sometimes as a result of infection of a seroma.

**Late complications:**

- **Capsular contracture or encapsulation**: due to a retraction of the fibrous capsule, its diagnosis is primarily clinical. In ultrasound can be seen a spherical morphology of the prosthesis and, occasionally, an abnormal thickening of the capsule. In MRI it can be appreciated by an alteration of normal ovoid morphology of the prosthesis with an increased diameter with respect to the transverse anteroposterior and/or a sphericity of the prosthesis Fig. 9 on page 11.
- **Herniation**: occurs when the fibrous capsule surrounding the prosthesis is torn, resulting in a solution of continuity with the membrane protrusion
ultrasonography it's displayed as a focal defect capsule Fig. 10 on page 12, while in MRI it's observed a deformity of the prosthesis with protrusion through the capsule. It should be borne in mind in the differential diagnosis of ruptured intracapsular, and it is useful silicone sequence Fig. 11 on page 13.

- **Transudate** or silicone "bleeding": it's the output of silicone through the membrane micropores, but contained by the fibrous capsule, being observed in RM as a small accumulation of silicone between the folds of the membrane and the fibrous capsule Fig. 12 on page 14. Many authors consider it as an early sign of breakage intracapsular, but the transudate of a small amount of silicone gel through the intact membrane is also considered normal, that will condition the formation of the fibrous capsule.

- **Intracapsular rupture**: silicone output through a crack or tear in the membrane but bordered by the fibrous capsule. At ultrasound an increase of intracapsular space, diffuse echoes of medium intensity between the membrane and the capsule Fig. 13 on page 14 and/or anomalous radial folds with liquid, echogenic or "snowstorm" content Fig. 14 on page 15 can be observed. You can also see the "sign of the ladder", thin echogenic lines parallel to each other simulating the steps of a staircase, and corresponding to the folds of the collapsed membrane Fig. 15 on page 16. In MR different signs by chronology can be seen. In early stages may be seen the "tear sign", which is a local invagination of the membrane containing a small drop of silicone inside Fig. 16 on page 17, and/or the "keyhole sign" which is a local invagination of the membrane but without contact between the two sides of the membrane, unlike what happens in the tear sign Fig. 17 on page 18. Therefore, there is a small amount of free silicon instead a small drop of silicone. In intermediate stages is possible to find the sign of subcapsular line, that is a low signal intensity line which runs parallel to and beneath the fibrous capsule and continues with the membrane Fig. 18 on page 19. In advanced stages of intracapsular rupture can be seen the "linguini sign", which consists of multiple curvilinear lines of low signal intensity within the silicone gel, that appears with high signal intensity and correspond to the folded membrane floating in the silicone Fig. 19 on page 20. In some cases, the membrane can be collapsed and floating within the silicone gel. Another sign that can be seen is the "sign in salad oil", but it is only indicative of intracapsular rupture in mixed double lumen prosthesis, translating the presence of water or saline droplets suspended in the silicone gel Fig. 20 on page 21. In the silicone prostheses this finding corresponds to steroid or antibiotic drops infiltrated perioperatively inside the prosthesis, and it's no indication of breakage Fig. 21 on page 21. Finally, commenting that breast implants can fold into its surface, producing a characteristic images in ultrasound and MRI that should not be confused with intracapsular rupture. They are displayed as small lines with radial arrangement originated in the membrane and not reaching the opposite face of the prosthesis Fig. 22 on page 23. This
finding should be confirmed in at least two planes and only in the case of containing silicone may represent a break intracapsular at very initial stage.

- **Extracapsular rupture**: extravasation of silicone outside the fibrous capsule, with secondary formation of granulomas (siliconomas) and infiltration of lymph nodes. In ultrasound nodules are observed with a characteristic appearance on "snow storm", with high echogenicity and intense posterior acoustic backing Fig. 23 on page 23 Fig. 24 on page 24 and Fig. 25 on page 24, but there may be seen as complex cysts or solid isoechoic nodules Fig. 26 on page 25. In MRI free silicone outside the fibrous capsule Fig. 27 on page 26, siliconomas Fig. 28 on page 27 and/or lymph node involvement Fig. 29 on page 27 and Fig. 30 on page 28 can be seen, not being able to differentiate sometimes between the latter two.

- **Periprosthetic collections**: liquid located between the prosthesis and the fibrous capsule. Using specific sequences to display silicone, it will be able to differentiate from the intracapsular rupture, which doesn't behave as the silicone in such sequences Fig. 31 on page 28.

Images for this section:

![Fig. 1: MRI sequences.](image-url)
**Fig. 2:** Saline prostheses. MRI axial T2, STIR and SS sequences.
Fig. 3: Double lumen prosthesis. MRI axial T2, T1, STIR and SS sequences.
Fig. 4: Retro or subglandular prosthetics. T2 sagittal sequence.
Fig. 5: Retroglandular prosthesis. T2 sagittal sequence.
**Fig. 6:** Seroma. Axial STIR and SS sequences.

**Fig. 7:** Hematoma postpuncture in no prosthetic breast. Axial T1 sequentially.
Fig. 8: Periprosthetic infection + seroma. Axial T2, STIR and perfusion sequences.
Fig. 9: Encapsulation. Axial T2 and STIR sequences.
Fig. 10: Herniation. Linear probe.
Fig. 11: Herniation. Axial T2 and SS sequences.

Fig. 12: Gel transudate. Axial T2 sequence.
Fig. 13: Increased intracapsular space + isoechoic nodule. Linear probe.
**Fig. 14:** Anomalous radial fold with echogenic material in "snow storm". Linear probe.
**Fig. 15:** Sign of the ladder. Linear probe.
Fig. 16: Sign of the tear. Axial T2, STIR, T1 and SS sequences.
Fig. 17: Sign keyhole. T2 sagittal sequence.
**Fig. 18:** Subcapsular line. Axial T2 and SS sequences.
**Fig. 19:** Sign linguini. Axial T2 sequence.

**Fig. 20:** Sign in salad oil in double-lumen prosthesis (intracapsular rupture). Axial and coronal T2 sequences.
**Fig. 21:** Sign in salad oil in silicone prosthesis. Axial T2, STIR and SS sequences.

**Fig. 22:** Radial fold. Axial T2 sequence.
Fig. 23: Periprosthetic collection with echogenicity in "snowstorm". Convex probe.

Fig. 24: Siliconomas with echogenicity in "snow storm". Convex probe.
Fig. 25: Lymphadenopathy infiltrated with echogenicity in "snow storm". Convex probe.
Fig. 26: Isoechoic nodule. Linear probe.

Fig. 27: Silicone free. Axial T2, STIR and SS sequences.
Fig. 28: Siliconoma. Axial STIR and SS sequences.
**Fig. 29:** Infiltrated axillary lymphadenopathy. Axial STIR and SS sequences.

**Fig. 30:** Infiltrated axillary lymphadenopathy. Axial T2, STIR and SS sequences.
Fig. 31: Periprosthetic Collection. Axial T2 and SS sequences.
Imaging findings OR Procedure details

Mamography.

Ultrasound: high resolution linear transducer with high frequency (center frequency between 7 and 12 MHz)

MRI: 1.5 or 3 T. Sequences: axial T1, high-resolution axial T2 for volumetric reconstruction and axial only Silicone STIR (SS); the dynamic study after iv administration of gadolinium is optional.

Conclusion

With frequency prosthetic breast surgery may associate complications, so the knowledge of the various imaging techniques available to the radiologist and the most characteristic findings in each of them is essential for proper evaluation.

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