Learning objectives

To describe the postsurgical imaging findings in patients with surgery for both benign and malignant breast pathologies and breast reduction, augmentation or reconstruction. To describe the recurrences and the scar evolution in time. To discuss the extent to which mammography and ultrasonography are used based on a series of 167 patients.
Background

Mammography and ultrasonography represent the standard of reference in the follow-up of patients after breast surgery. The accurate assessment of the breast can prove to be complex, given that the postsurgical changes can mimic or hide signs of malignancy.

It is not only lumpectomy and mastectomy that alter the tissue architecture of the breast, but a wider variety of procedures, such as core needle biopsy, excisional breast biopsy, wide excision or segmental mastectomy, subcutaneous or modified radical mastectomy with reconstruction, or reduction/augmentation mammoplasty.

While surveillance protocols vary, mammographies are performed at 12 month intervals in patients with benign conditions or more frequently in patients with breast conservation therapy (6 months). Mammography is performed after surgery in order to confirm the removal of the lesion, to identify post-procedural fluid collections, to detect residual and recurrent cancer and to screen for metachronous cancers in the ipsi-/contralateral breast. Sequelae after conservative therapy (surgery, radiotherapy) must be described in order to avoid future unnecessary invasive explorations.

Ultrasonography is often used as a complementary imaging method for the evaluation of architectural distortions, asymmetric densities, dense breasts and to differentiate between cystic and solid lesions. Furthermore, ultrasound is preferred for the assessment of the breast immediately after surgery (1).
Imaging findings OR Procedure details

Between January 2009 and January 2011, 167 patients were investigated in our department, of which 71 underwent breast conservative treatment (BCT) and radiation therapy, 68 surgery for benign pathologies, 14 with multiple postoperative scars, 8 reduction mammoplasty, 5 mastopexy and 1 breast augmentation with autologous fat.

Postsurgical mammographic and sonographic findings are acute or chronic, related to the time sequence from the procedure and they are associated with the type of surgical intervention.

1. Acute mammographic changes refer to the immediate postoperative period extending for the first several weeks and months and include increased density in the area, hematoma, seroma, edema, skin thickening and architectural distortion [Fig. 1] (2).

A hematoma may form immediately after the procedure - an amorphous ill-defined density or a relatively circumscribed mass is seen on mammography. Ultrasound reveals a hyperechoic area that will progressively organise into a nodular hypo/anechoic area with posterior reinforcement that may contain some internal echoes or debris, depending on the degree of organization [Fig. 2]. Seroma [Fig. 3] and hematoma gradually resolve over weeks, usually 3 to 6 weeks; in most cases there is no long-term mammographic finding after a needle biopsy [Fig. 4], irregular increased density and/or distortion (scar formation) may be noticed after excisional biopsy and, seldom, extensive scarring can occur, resulting in keloid formation. The more invasive the procedure, the more disrupted the breast architecture is.

Any breast interventional procedure can lead to infection and abscess formation. Cysts can become secondarily infected when aspirated. The mammographic and ultrasonographic features of the infected hematoma/seroma slightly differ from that of an uninfected one. Clinical changes and Doppler evaluation are to be trusted.

The skin within and around the incision is edematous immediately after surgery. While the peri-incisional edema usually resolves quickly, the edema within the incisional scar resolves more slowly and, in some cases, skin thickening can persist indefinitely [Fig. 5].

2. Chronic changes are architectural distortion, fibrosis, calcifications and oil cysts (both due to fat necrosis), recurrent cancer (2).
At 6 to 12 months, the maximum changes of increased breast density and skin thickening are seen. These diffuse findings are secondary to the edema from irradiation of the breast. These edematous changes will stabilize and then diminish, usually at 2 years or later [Fig. 6] (3, 4). Mammography reveals skin and stromal thickening (as in typical inflammatory breast), US - hiperechoic skin thickening of at least 2mm, without visualisation of two parallel echogenic lines, abnormal visualisation of subcutaneous lymphatic vessels building into a network and causing global augmentation of breast echogenicity. The latent normal changes after radiation are the development of calcifications of fat necrosis, developing usually after 1 year.

Postoperative scarring [Fig. 7, Fig. 8, Fig. 9, Fig. 10] (causing architectural distortion) depends on the volume of tissue removed, the breast density and the type of surgery (whether or not remodelling was intended). Diagnosis is confirmed by the great variation of forms in two orthogonal mammographic views, the development of the scar being flat. This variation is also found in ultrasonography: linear hipoechoic image with irregular outlines (corresponding to the mammographic spicular aspect) in one plane and a round image in the orthogonal one (5).

Fat necrosis is frequent succeeding hematoma, radiotherapy and reconstruction surgery. The mammographic sign is an oil cyst [Fig. 11], typically described as a spherically or elliptically shaped fatty density that is often surrounded by eggshell calcifications [Fig. 12]. Like the mammographic appearances, the sonographic appearances vary with the stage of development (fat-fluid levels within cysts are more frequently seen and more easily demonstrated on sonography than they are mammographically). In areas where lipid cyst formation does not occur, mastitis, foreign-body granuloma formation and fibrosis occur. The end-stage appearance of fat necrosis is dense fibrosis, that is identical and indistinguishable from the fibrosis of postoperative scarring that occurs in the absence of fat necrosis. The severe architectural distortion and spiculation is mammographically and sonographically difficult to distinguish from recurrent spiculated carcinoma.

The findings of recurrent carcinoma [Fig. 13] include the development of new microcalcifications, increased skin thickening after stabilization, increased density (particularly at the tumor bed) after stabilization, and the development of a new mass. Because of the difficulty in differentiating benign from malignant microcalcifications with certainty, biopsy is indicated unless the calcifications are those of fat necrosis. New spiculated masses and irregular ductal-type malignant microcalcifications are highly suspicious for recurrence. A rare complication of breast irradiation is the development of radiation-induced sarcoma (RIS).

Breast reconstruction may be performed after a mastectomy by means of reconstruction with autogenous tissue transfer and/or implants [Fig. 14]. Several types of myocutaneous
flaps have been used for breast reconstruction, including those from the transversus rectus abdominis muscle and the latissimus dorsi muscle. One complication of this procedure, which is related to maintaining an adequate blood supply, is fat necrosis of the flap [Fig. 15]. The patient presents with a firm mass and the differential diagnosis includes recurrent carcinoma or fat necrosis. Mammography may be used in this circumstance and may demonstrate changes of fat necrosis ranging from an irregular increased density to radiolucent oil cysts to ring-like calcifications characteristic of a benign process. Recurrent carcinoma in the flap may be clinically suspected because of development of a palpable mass. Mammography demonstrates a mass that is most often located peripherally, at the junction of the flap with the native tissue (1, 6).
**Fig. 1:** Ultrasonography shortly after surgery for fibroadenoma - increased density in the area, skin thickening and architectural distortion.

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Fig. 2: Seroma (fluid collection with internal echoes).

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Fig. 3: Seroma, one year after surgery.

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**Fig. 4:** Metallic marker placed to localize the biopsy site.

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Fig. 5: Fat necrosis and persistent skin thickening two years after surgery.

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**Fig. 6:** Mammography after breast conservative therapy and radiotherapy, 2009 (top) - skin thickening, fibrosis in the upper lateral quadrant, average density (BIRAD 2); and 2011 (bottom) - normal skin thickness, reduced density and radial scarring (note the variation in the shape in the two orthogonal mammographic views).

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Fig. 7: Skin thickening, scarring and nipple retraction.

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Fig. 8: Skin thickening, scarring, architectural distortion and calcification.

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Fig. 9: Postsurgical scarring and calcifications.

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Fig. 10: Postsurgical scarring and calcifications.

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**Fig. 11:** Oil cyst (steatonecrosis).

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Fig. 12: Extensive steatonecrosis.

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Fig. 13: Malignant development in breast previously treated for benign pathology (two years after surgery for intraductal papilloma, patient reported bloody nipple discharge; the cytologic exam is inconclusive but ultrasonography raised suspicions for recurrence; ulterior surgery revealed papilliferous carcinoma).

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Fig. 14: Saline breast implant with crystalised NaCl deposits.

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**Fig. 15:** Three years after breast augmentation with autologous fat - ring-like calcifications (fat necrosis).

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Conclusion

Breast changes after breast conservative therapy and surgery for benign pathology are specific and should be thoroughly understood in order to reduce the number of false positive diagnoses of malignant lesions or recurrent cancer. With a close observation of benign pathology through ultrasound and/or mammograms unneeded surgical interventions can be avoided.

Using mammography and ultrasonography in conjunction can lead to a correct diagnosis. However, there are some cases when the final diagnosis can be settled only by resorting to MRI or biopsy.

Mammography and ultrasonography are effective and specific in postoperative observation of both benign and malignant breast disease. A better awareness of postsurgical mammographic findings will lead to a correct interpretation and fewer unnecessary tissue samplings.
References